Evolution and Human Behavior xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

Evolution and Human Behavior

journal homepage: www.ehbonline.org

Original Article

Vocal characteristics of presidential candidates can predict the outcome of actual elections☆

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ARTICLE INFO

Article history:
Initial receipt 6 July 2015
Final revision received 25 October 2016
Available online xxxx

Keywords:
Voting
Voice
Pitch
Pitch variability
Presidential election

ABSTRACT

During political elections, voters rely on various cues that signal good social leadership, such as indicators of physical strength and masculinity. In adult men, masculine traits are related to testosterone levels, and one of those traits is low-pitched voice. Hence, lower pitch in a presidential candidate may be related to the election's outcome. This prediction is supported by experimental evidence showing that people prefer to vote for a candidate with a low-pitched voice. The aim of this study was to investigate the relationship between presidential candidates' vocal characteristics and actual election outcomes in 51 presidential elections held across the world. After analysis of the voices of opposing candidates, results showed that winners had lower-pitched voices with less pitch variability. Moreover, regression analysis revealed an interaction effect of voice pitch and voice pitch variability on the election outcome. Candidates with lower-pitched voices had greater likelihood of winning the election if they had higher pitch variability. This study extends previous findings, shows the importance of assessing vocal characteristics other than voice pitch, and offers external validity for the experimental evidence that candidates' vocal characteristics are related to the election outcome.

1. Introduction

It is assumed that human political behavior emerged in evolutionary history as an adaptation to problems of coordinating individuals living in a group, achieving group goals, and distributing resources within the group (Fowler & Schreiber, 2008; Petersen, 2015). It is possible that choosing a group leader could have solved these problems (van Vugt, 2006). Petersen (2015) argues that, when choosing a quality leader, human ancestors relied on various cues that signaled social leadership skills and abilities to solve group problems successfully. In an ancestral environment, important leadership activities might have included coordinating group hunting and warfare. Indicators of physical strength and masculinity, like someone's height, weight, and/or general health, were cues that might have signaled success in these activities (van Vugt, Johnson, Kaiser, & O'Gorman, 2008). Given that modern mass politics is an evolutionary novelty, modern political voters could also rely on cues that might have signaled good leadership qualities under ancestral conditions (Petersen, 2015). Specifically, voters' perceptions of leadership qualities might be under the influence of physical appearance.

Results of previous studies are in line with this assumption. Researchers have used visual stimuli of political candidates and looked for the differences in perceived dominance, competence, leadership, etc. Certain facial features were found to be associated with the perception of a woman as a preferable political leader (e.g. almond-shaped eyes or short hair) (Rosenberg, Kahn, & Tran, 1991). Little, Burriss, Jones, and Roberts (2007) reported that facial shape in politicians could predict who would win elections. Body weight was also found to be related to the perception of a given candidate (Elmore, Vonnahame, Thompson, Filion, & Lundgren, 2015). In addition, inferences of competence based only on a brief view of a candidate's photograph were related to election outcome (Todorov, Mandisodza, Goren, & Hall, 2005). Furthermore, people who knew little about politics, but were often exposed to images of candidates via television, were more likely to vote for more appealing candidates (Lenz & Lawson, 2011).

Besides relying on the physical appearance of a given candidate when making inferences about his/her competences, voters might rely on other characteristics as well. For example, Gregory and Gallagher (2002) predicted voting patterns in U.S. presidential elections from 1960 to 2000 based on the candidates' voices. It seems that the acoustic characteristics of politicians' voices might influence voters' perceptions of candidates' leadership qualities. Given that voters prefer candidates

☆ These research and manuscript preparation were not financially supported by any funding source.

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http://dx.doi.org/10.1016/j.evolhumbehav.2016.10.012
1090-5138/

with characteristics that signal physical strength and masculinity (van Vugt et al., 2008), fundamental frequency of phonation (F_0), which is perceived as pitch, might be related to the election outcome.

F_0 is based on the rate of vocal-fold vibration, which depends on the size, thickness and length of the vocal folds (Abitbol, Abitbol, & Abitbol, 1999). Longer, bigger and thicker vocal folds vibrate at lower frequencies, which are perceived as deeper voice (Abitbol et al., 1999). With the increase of testosterone levels during puberty, men's vocal folds become larger and thicker, and their F_0 becomes lower (Hollien & Shipp, 1972). It is noteworthy that a negative correlation between F_0 and testosterone levels was found in adult men as well (Dabbs & Mallinger, 1999; Puts, Apicella, & Cárdenas, 2011). Since testosterone levels are an indicator of dominance and social influence (Mazur & Booth, 1998), lower F_0 could be related to perceived dominance and higher social status. This implies that lower-pitched voices in men might be related to evolutionary success, which could be achieved through attracting potential mates and displaying dominance in intrasexual competition. Regarding the influence of the voice on attracting mates, previous studies have shown that men with lower-pitched voices were perceived as more attractive (Feinberg, DeBruine, Jones, & Little, 2008; Feinberg, Jones, Little, Burt, & Perrett, 2005) and that they were associated with favorable personality traits more often than men with higher-pitched voices (Tigue, Borak, O'Connor, Schandl, & Feinberg, 2012). Women also showed greater preference for men with lower-pitched voices in the fertile phase of the menstrual cycle (Feinberg et al., 2006; Pisanski et al., 2014; Puts, 2005), when they display general masculinity preference (Gildersleeve, Haselton, & Fales, 2014a, 2014b; but see also Wood, Kressel, Joshi, & Louie, 2014 and Gangestad et al., 2016 for further discussion). Conversely, lower preference for lower-pitched voice was related to higher progesterone levels, which occur after ovulation (Puts, 2006). Moreover, F_0 was negatively associated with men's reproductive success (Apicella, Feinberg, & Marlowe, 2007).

Regarding the role of the voice in intrasexual competition, Puts, Gaulin, and Verdolini (2006) found that lower-pitched voices were related to higher ratings of physical and social dominance, which might be important in intimidating a rival. Men with lower-pitched voices are perceived as older and larger (Collins, 2000), and more physically and socially dominant (Borkowska & Pawlowski, 2011; Sell et al., 2010). Puts et al. (2006) found that men spoke in a lower voice when addressing a man they found subordinate, and vice versa. This advantage of dominant voice might be found in hierarchically organized social structures. Mayew, Parsons, and Venkatachalam (2013) found that Chief Executive Officers with lower-pitched voices managed larger companies and had longer tenures. To sum up, a growing body of literature suggests that F_0 might serve as a source of biologically important information, both in the mating context to attract potential mates, and in the context of intrasexual competition to signal social dominance. In both contexts, lower F_0 predicts greater success.

In contexts relevant to voting, Tigue et al. (2012) reported that subjects, when choosing between two male candidates based on their voices, preferred to vote for a man with a lower F_0. Similarly, other studies have found that men and women preferred voices manipulated to a lower F_0 when they were asked to choose a leader (Anderson & Klofstad, 2012; Klofstad, Anderson, & Peters, 2012). It was shown that men with lower-pitched voices were perceived as stronger and more competent. These traits could be related to the perception of leadership capacity. Indeed, Klofstad, Anderson, and Nowicki (2015) recently reported that voters preferred low-pitched candidates' voices because they were perceived as stronger and more competent. Previous studies have mostly used manipulated voices, instead of real voice samples of political candidates, and assessed subjects' ratings of attractiveness, dominance or voting preferences (e.g. Anderson & Klofstad, 2012; Apicella et al., 2007; Feinberg et al., 2008; Klofstad et al., 2012; Puts et al., 2006; Tigue et al., 2012). To our knowledge, only a few studies so far have investigated the association between real presidential candidates' voices and actual voting outcomes. In a recently published study (Klofstad, 2015), the recorded voices of candidates for the 2012 U.S. House of Representatives were analyzed. The results showed that the F_0 of winning candidates was lower than the F_0 of losing candidates.

Furthermore, most studies so far have focused on F_0 as the main acoustic characteristic that could influence masculinity perception and voting behavior. As pointed out by Klofstad (2015), investigating the influence of candidates' F_0 on election outcomes is a reasonable starting point, given that it might serve as a dominance cue. However, other vocal characteristics might influence the perception of politicians as well (Klofstad, 2015). It was suggested that researchers should test whether the influence of voice pitch could be modulated by other vocal characteristics. For example, variability of voice pitch (F_{0SD}) might also be an indicator of dominant behavior and good leadership qualities. This acoustic characteristic refers to the fluctuation of F_0 over an utterance. Voices with lower values of F_{0SD} are perceived as more monotone, while higher values can have a sing-song character and might be perceived as more friendly (Hodges-Simeon, Gaulin, & Puts, 2010). For example, higher F_{0SD} values can be observed in speech directed towards infants (Trainor, Austin, & Desjardins, 2000; Trainor & Desjardins, 2002). Hence, Hodges-Simeon et al. (2010) argue that higher F_{0SD} is associated with affiliation, and lower F_{0SD} with intimidation. Furthermore, Daly and Warren (2001) reported lower F_{0SD} in male voices than in female, which suggests that lower F_{0SD} could imply greater masculinity. Puts et al. (2011) found negative correlation between F_{0SD} and self-reported physical aggression, and marginally significant negative correlation between F_{0SD} and arm strength. When investigating independent contributions of F_0 and F_{0SD} to physical-dominance ratings, Hodges-Simeon et al. (2010) found that only F_{0SD} was a significant predictor. These authors noted that F_0 might be an important correlate of men's attractiveness and might play a great role in mate selection. However, when it comes to intrasexual male competition, F_{0SD} might play a more important role because it could signal self-confidence or threatening behavior (Hodges-Simeon et al., 2010). Hodges-Simeon, Gaulin, and Puts (2011) also propose a proximate mechanism underlying the relationship between F_{0SD} and dominance perception. Higher F_{0SD} might be associated with negative emotional arousal, such as fear (Banse & Scherer, 1996; Pihan, Tabert, Assuras, & Borod, 2008) or tension (Park et al., 2011), and it could signal nervousness. Voices that signal lack of negative emotional arousal (lower F_{0SD}) may imply greater dominance in social interactions (Hodges-Simeon et al., 2011), while greater dominance might imply greater leadership qualities. In view of the above-mentioned findings, F_{0SD} might also play an important role in a political voting context, since it might signal preferable traits for a group leader.

Since there are, to our knowledge, only a few studies investigating voices of politicians and their shares of the vote in actual elections (which have all been based on U.S. elections), the aim of this study is to extend previous findings, regarding the relationship between candidates' voices and election outcomes, by analyzing the voices of political candidates in real presidential elections held across the world. To test whether additional acoustic characteristics might modulate the relationship between F_0 and election outcome, we measured F_{0SD} as well. The main hypothesis was that candidates with lower F_0 and F_{0SD} had greater probability of winning the election.

2. Method

2.1. Recordings of the presidential candidates

To test the hypothesis, we collected voice samples of presidential candidates. The procedure was as follows. First, by using the database at www.electionguide.org, we searched for presidential elections held across the world in the period of eleven years from January 2006 to March 2016. We only included direct elections where presidents were elected by popular vote, and not by any other type of election (e.g. in Greece, where the president was elected by Parliament). Due to the

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different acoustic characteristics of male and female voices (Abitbol et al., 1999) and poor representation of female presidential candidates, we included elections featuring only male candidates.

Two presidential candidates from each election were included in the sample. If an election included a final round with two candidates, both candidates were included. If an election was decided in the first round, the two candidates with the largest shares of the vote were included.

When the list of presidential pairs was made, the YouTube service was used to find voice recordings of presidential candidates. (One recording was downloaded from Vimeo.) Only recordings without background sounds or music were included. If it was not possible to find a quality recording for one of the two candidates in each pair, the election was excluded from the sample. After the selection procedure, we identified 51 pairs of presidential candidates from 50 countries with voice recordings suitable for the analysis. (See Supplementary Material, available on the journal's website at www.ehbonline.org for the list of elections and URLs.) Of the 50 countries included, 12 were in Europe, 21 in Africa, 8 in Asia, 4 in North America and 5 in South America. A total of 596,289,920 voters cast their votes.

2.2. Acoustic analysis

The recordings from YouTube were downloaded using YTD Video Downloader, and the recording from Vimeo was downloaded using Savevideo.me. The downloaded recordings were cut using Filmora video software, so that each file contained only the speech of a presidential candidate. The recorded videos of the 102 candidates were then converted, using Any Video Converter ultimate freeware, to mp3 format at a rate of 128 kbps. Next, 5 seconds of uninterrupted voice sample was randomly selected from each candidate's speech. Following previous studies (Klofstad, 2015; Klofstad, personal communication, April 4, 2016), each sample was aurally and visually inspected for quality and, if satisfactory, used in further analysis.

Vocal characteristics F_0 and F_{0SD} were measured using Praat voice analysis software (version 5.4.09). In accordance with the programmers' recommendation (Boersma & Weenick, 2016) for analyzing male voice, pitch floor was 75 Hz, and pitch ceiling was 300 Hz.

3. Results

The data were analyzed using *R*, version 3.2.5 (R Core Team, 2016), packages *ResourceSelection* (Lele, Keim, & Solymos, 2016), *pscl* (Jackman, 2015), *effects* (Fox, 2003), *interplot* (Solt & Hu, 2015), *lmtest* (Zeileis & Hothorn, 2002), and *car* (Fox & Weisberg, 2011). Descriptive values of the candidates' vocal characteristics are presented in Table 1. Univariate normality was tested for all variables; Skewness and Kurtosis indices (see Kline's (2011) criteria of normal distribution), as well as Kolmogorov–Smirnov test results, point to a normal distribution for both variables.

The correlation between F_0 and F_{0SD} was found to be significant and positive, and to have a moderate magnitude, $r = 0.456$, $p < .001$. Next, *t* tests were used to assess the differences in vocal characteristics between presidential election winners and losers. Results show that the election winners have a lower F_0, [t (100) = 2.24, $p = .027$, $d = 0.34$], and a lower F_{0SD}, [t (86.75) = 2.06, $p = .043$, $d = 0.21$]. These results imply greater masculinity of winners' voices. There is also a small-to-moderate negative correlation between F_0 and percentage of votes ($r = -0.195$, $p = .05$), and a marginally insignificant correlation in the same direction between F_{0SD} and percentage of votes ($r = -0.179$, $p = .07$).

Furthermore, binary logistic regression was used to predict the election outcome based on candidates' vocal characteristics. Election losers were coded with 0 and winners with 1. The results of the three models tested are presented in Table 2. We started with the simple Model 1, using only F_0 as a predictor of election outcome. This model was significant and was in line with our main prediction, showing that lower-pitched voices increased the probability of winning the election. Due to the correlation between voice characteristics, F_0 and F_{0SD} were entered as predictors simultaneously in Model 2. However, this model had a poorer fit than Model 1 and was not significant. Considering this result and the moderate correlation between the two predictors, we decided to add their interaction terms to the model. The interpretation of regression coefficients in a model with an interaction is based on holding the value of other coefficients at 0. However, if predictors do not have a meaningful 0 value (such as is the case with voice pitch), it is suggested that the data should be centered around the mean. This procedure also helps to solve potential multicollinearity issues (Jaccard & Turrisi, 2003). Therefore, in Model 3, in which we tested the interaction terms, each predictor was centered around the mean prior to the analysis. Model 3 had the best fit, as indicated by lowest AIC and highest McFadden's Rho coefficient. The two predictors were not significant, but their negative interaction significantly predicted the election outcome.

The easiest way to interpret interaction effects in binary logistic regression is to visualize the data (Gelman & Hill, 2007). In order to do so, we fixed centered F_{0SD} values at five points: minimum, first quartile, mean, third quartile and maximum, with the values −16.35, −6.26, 0, 4.36, and 26.77, respectively (Fig. 1). For each of these points, keeping the F_{0SD} values fixed, the effect of F_0 on the probability of winning the election was assessed (see Fox, 2003).

Fig. 1 shows different relationships between F_0 and probability of winning the election at different fixed values of F_{0SD}. At the lowest fixed values of F_{0SD} (−16.35 and −6.26), the probability of winning the election increases as F_0 increases, meaning that there is a positive relationship between F_0 and the likelihood of winning. Also, with the increase of the fixed value of F_{0SD} from the minimum (−16.35) to the first quartile (−6.26), the slope changes, and there is a smaller, albeit still positive, association between F_0 and probability of winning. Furthermore, at the mean (0) and higher fixed values of F_{0SD} (4.36 and 26.77), the probability of winning the election increases as F_0 decreases. In addition, with the increase of the fixed value of F_{0SD} from the third quartile (4.36) to its maximum value (26.77), slope change is again noticeable. This change implies that the negative association between F_0 and probability of winning becomes higher as the fixed value of F_{0SD} increases. The interaction effect of F_0 and its variability on the election outcome indicates that, when F_{0SD} is high, the likelihood of winning the election increases as F_0 decreases. On the other hand, when F_{0SD} is low, the probability of winning the election increases as F_0 increases. If a candidate has a voice with low variability, his likelihood of winning the election increases with F_0 (less masculine voice). On the other hand, if a given candidate has a more variable voice, his likelihood of winning increases as his F_0 decreases (more masculine voice).

To sum up the results of this study, election winners, on average, have lower F_0 and F_{0SD}. In addition, the higher percentage of votes a candidate has won, the lower was his F_0. However, if F_{0SD} is low, i.e. the candidate shows greater vocal stability and more monotone voice, the probability of winning the election increases as the candidate's F_0 increases. On the other hand, if the candidate's voice is unstable, he has a higher probability of winning the election if he has a lower-pitched voice.

Table 1
Descriptive statistics of presidential candidates' vocal characteristics.

	Elections winner					Elections loser				
	M	*SD*	SI	KI	K-S	*M*	*SD*	SI	KI	K-S
F_0	122.80	17.43	0.45	−0.37	0.777	131.00	19.14	0.12	−0.96	0.867
F_{0SD}	22.38	6.35	0.04	1.36	0.871	25.69	9.59	0.44	−0.54	0.896

SI – Skewness index, KI – Kurtosis index, K-S – *p* value for Kolmogorov–Smirnov test for normality.

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Table 2
Results of binary logistic regression predicting winning the election.

Variable	Model 1			Model 2			Model 3		
	Estimates	*p*	OR	Estimates	*p*	OR	Estimates	*p*	OR
Constant	3.096 (1.441)	.032	22.114	3.090 (1.451)	.033	21.985	0.204	.369	0.000
F_0	−0.024 (0.011)	.030	0.975	−0.018 (0.012)	.147	0.982	−0.018 (0.013)	.179	1.080
F_{0SD}				−0.033 (0.029)	.239	0.967	−0.033 (0.031)	.283	1.601
$F_0 \times F_{0SD}$							−0.0039 (0.0017)	.021	0.996
Model test (χ^2)	4.963	.026		6.383	.041		12.774	.005	
Likelihood ratio (χ^2)	−68.22	.026		−67.509	.233		−64.315	.005	
Wald (F)	4.699	.033		1.385	.241		2.807	.043	
AIC	140.44			141.02			136.63		
H-L (χ^2)	14.253	.076		7.848	.448		12.63	.125	
McFadden's Rho^2	0.035			0.045			0.09		
Nagelkerke R^2	0.063			0.081			0.157		
Correct prediction	56.9%			57.8%			63.7%		

Note: F_0 – voice pitch, F_{0SD} – voice pitch variability, OR – odds ratio; H-L – Hosmer–Lemeshow test. Regression coefficients are presented with standard errors in parentheses; significant Likelihood ratio and Wald test show that additional predictors make a significant contribution to the model (Peng, Lee, & Ingersoll, 2002); lower AIC points to better goodness-of-fit (Gelman & Hill, 2007); insignificant Hosmer–Lemeshow test results point to a good fit for the model (Peng & So, 2002); higher McFadden's Rho^2 points to a better goodness-of-fit (Peng & So, 2002).

4. Discussion

Previous studies showed that there is a relationship between political candidates' F_0 and their vote shares in political elections held in the U.S. (Gregory & Gallagher, 2002; Klofstad, 2015). Specifically, candidates with lower-pitched voices had greater likelihood of election victory. The present study extends previous findings by including the outcomes of presidential elections held across the world, and by investigating the contribution of F_{0SD} in predicting the election outcomes.

Reported differences in average F_0 and F_{0SD} between election winner and loser confirmed our main prediction. Winners have lower-pitched voices and less vocal variability, which implies greater perceived masculinity. Negative correlations between F_0 and vote share also support our hypothesis. Similar results were reported in previous studies using voice samples of real candidates (Klofstad, 2015), and in studies using manipulated voices in laboratory settings (Anderson & Klofstad, 2012; Klofstad et al., 2012; Tigue et al., 2012). These results could be explained with regard to findings demonstrating that lower-pitched voices were perceived as more attractive (Feinberg et al., 2005; Feinberg et al., 2008), were related to physical and social dominance (Puts et al., 2006), and were perceived as more dominant (Borkowska & Pawlowski, 2011). In addition, the present results are in line with the previously-found association between preference for candidates' lower-pitched voices and voters' perceptions that the speakers with the lower voices have greater integrity and physical prowess (Tigue et al., 2012). These features could be desirable characteristics of a national leader. However, the finding regarding the interaction effect of F_0 and F_{0SD} on election outcomes is mixed with respect to our hypothesis. By entering F_0 as a predictor of the election outcome, analysis indicated that candidates with lower voice were more likely to win. Klofstad (2015) reported the same finding. But entering the interaction of the two vocal characteristics demonstrated that candidates with lower-pitched voices have a greater likelihood of winning if their voices show more variability. On the other hand, if candidates have higher-pitched voices, their chances of becoming a president increase when their voices are less variable. Contrary to our hypothesis, it seems that, in order to increase the probability of winning the election, only one of the two vocal characteristics should be perceived as masculine.

We propose an explanation based on the assumption that a lower F_{0SD} is associated with a flat monotone voice, which might sound dull and/or less enthusiastic. Higher F_{0SD} might be related to a friendly context and signal safety and affiliation, instead of dominance and intimidation (Hodges-Simeon et al., 2010). Considering these assumptions, we argue that a low-pitched monotone voice might sound too intimidating and/or unfriendly. In a similar vein, candidates with high-pitched voices with more variability might be perceived as less masculine and less competent, and therefore less favorable. In contrast, low-pitched voices with greater variability might be perceived as masculine, but friendly and enthusiastic. Given that people with low-pitched voice are perceived as masculine (Collins, 2000; Feinberg et al., 2005; Feinberg et al., 2006; Puts et al., 2006; Sell et al., 2010), and those with high-variability voice as more friendly (Hodges-Simeon et al., 2010),

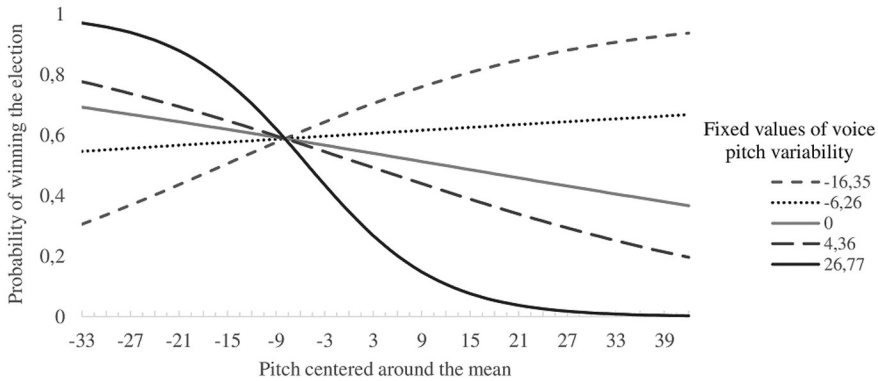

Fig. 1. The relationship between voice pitch and probability of winning the election depending on the voice pitch variability.

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candidates with these vocal characteristics might be perceived as capable and competent, but also as a friendly and sympathetic leader. Thus, the reported relationships might not be surprising. Taken together, our data demonstrate the importance of including additional vocal characteristics in investigating the role of candidates' voices in predicting election outcomes. The present study succeeded in replicating and expanding previous findings on voice-pitch perception in political elections. Future research in this field should consider other vocal characteristics (such as F_{0SD}) that could be important in investigating the relationship between political candidates' voices and voters' decisions.

There are a few limitations of the present study that should be addressed. This study was not conducted in a controlled environment, nor in a laboratory setting. Therefore, we cannot make strong claims about the exact mechanism by which vocal characteristics affect election outcomes, nor can we talk about causality. It is also noteworthy that the video recordings were not made in standardized conditions. There is a great amount of heterogeneity among the voice recordings, especially regarding surroundings, interviewers, debate moderators (in some of the videos), and the number of other speakers in the studio. In addition to this, F_0 can be temporarily influenced by the emotional state of the speakers (Wittels, Johannes, Enne, Kirsch, & Gunga, 2002), which could not be controlled in this type of study. While using voice recordings that are available to the electorate does increase the ecological validity of the study, it lacks control for other potentially significant factors. Moreover, the presidential candidates were not recorded while speaking identical utterances. Hence, control for content-based variability in vocal characteristics was not possible. However, we tried to annul the effects of all of these potential influences by using random sampling of speech segments. We would also like to note that using the YouTube service as the main source of voice samples could affect recording quality due to sound compression. Each sound file has been compressed or converted at least twice (during uploading to YouTube and during downloading). However, Bulgin, De Decker, and Nycz (2010) reported no significant differences between lossless .wav format and compressed .mp3 format when assessing F_0 and the first four formant frequencies.

Furthermore, the voters' decision is (or could be) based on very broad and varied factors, ranging from the candidate's perceived personality traits, through party affiliation, to the candidate's positions on various policy issues (e.g. Dalton & Wattenberg, 1993; Huckfeldt, Mondak, Craw, & Mendez, 2005). What is more, it could depend on conditions in the environment, e.g. whether the environment is life-threatening or safe. For example, Tigue et al. (2012) reported that the importance of voice characteristics that signal dominance increased during a wartime scenario. This could imply that a strong, masculine, and dominant leader would be favorable when the group is in danger. Today, economic crisis, poverty, high mortality rates etc. could pose a threat to the community, and these potential mediators should be investigated in future studies.

To conclude, this study offers an external validation of previous experimental evidence that candidates' vocal characteristics are related to election outcome. It also extends previous findings that were based on U.S. elections only. The present findings might serve as a good starting point for future research within the relatively new field of political evolutionary psychology.

Supplementary materials

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.evolhumbehav.2016.10.012.

Acknowledgment

We thank the editor and two anonymous reviewers for their valuable suggestions and constructive comments to improve our manuscript. We also thank Dr. Casey Klofstad for his help and suggestion regarding methodology procedure.

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Please cite this article as: Pavela Banai, I., et al., Vocal characteristics of presidential candidates can predict the outcome of actual elections, *Evolution and Human Behavior* (2016), http://dx.doi.org/10.1016/j.evolhumbehav.2016.10.012

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Please cite this article as: Pavela Banai, I., et al., Vocal characteristics of presidential candidates can predict the outcome of actual elections, *Evolution and Human Behavior* (2016), http://dx.doi.org/10.1016/j.evolhumbehav.2016.10.012