1st International Conference on Tone and Intonation (TAI)
6-9 December 2021, Sonderborg, Denmark

Those who shout the loudest – Do they sound more charismatic?

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Abstract

Intensity, i.e. loudness or vocal effort, is known to contribute to the perception of speaker charisma, but, compared to the other domains of prosody, very few details are known about this contribution. We address this research gap based on 51 public speeches and associated investment-based charisma ratings of 50 listeners. The question was, if and to what degree various level, variation, and spectral-distribution measures related to vocal effort can connect the public-speaking performances with their charisma ratings – in the sense of significant correlations. Results show that variation and distribution measures yield more and stronger significant correlations than level measures, but with notable sex-specific differences. We discuss our results in terms of links between vocal effort and voice quality and with respect to the general status of loudness in charisma perception.

Index Terms: investor pitch, prosody, charisma, variation.

1. Introduction

A speaker's charisma is one of those phenomena that are "easy to sense but hard to define" [1]. In fact, it is not too long ago that charisma was considered not to be definable at all [2]: It was a talent that people either possessed – or not. Charisma thus eluded a scientific approach. Today, this view has changed, mainly thanks to research in psychology and leadership [3]. It is common understanding now that speaker charisma represents a changeable, trainable skill [4,5].

Skills manifest themselves as effects of a person on his or her external environment. For such effects to occur, a person's skills must interact with this environment. That is why the basis of an ascribed skill is always a physically observable, measurable stimulus or, in other words, a *signal* associated with this stimulus. Thus, the shift in the conceptualization of charisma from a mere talent to a trainable skill turned charisma simultaneously into a system of signals. Intensive research over the past decades showed that the signals underlying the impression of charisma form a complex, multi-layered bundle of various signal types from at least two modalities: acoustics and vision. Age and height [6,3] affect the perceived charisma of a person, as do clothing [7,8] and status [9] or familiarity [10] with a person, as well as the situation in which the interaction takes place (e.g., public speeches vs. interviews [10]).

As regards communicative signals, a number of effective verbal charisma triggers have been determined experimentally, for example, those that form the core of the Charismatic Leadership Tactics (CLTs) of Antonakis et al. [4], see also [11]. These include, for example, rhetorical questions (to be used only in combination with a real question intonation [12]), contrasts, three-part lists, figurative language, as well as the use of present tense and 1st person singular or plural [10]. Beyond these stylistic devices, however, the content of a speech itself does not seem to have any significant influence on the speaker's charisma [13]. In fact, for speeches rich in content, the influence can even be a negative one [10]. Regarding body language, opening gestures (especially with palms up) [14], an erected trunk as well as a set of specific hand gestures [11,14,15], dominated by rhythmical (beat) and indexical (deictic) movements [16], as well as an occasional smile [17] are conducive to a person's charismatic appeal.

Phonetic research made increasing efforts in the last decade to define speaker charisma in acoustic terms. The focus of these efforts was mainly on parameters associated with pitch or, in acoustic terms, the fundamental frequency (f_0) of a speaker's voice. In their seminal paper, Rosenberg and Hirschberg [10] found positive correlations between perceived speaker charisma and all measured f_0 parameters, i.e., mean f_0, f_0 variability (standard deviation), and maximum f_0. Later, Biasdy et al. [18] added f_0 range to this set of positive charisma-f_0 correlations. Strangert and Gustaffson [19] as well as Niebuhr et al. [20] and Niebuhr and Skarnitzl [21] have further refined this pattern of findings, for example, by showing that maximum f_0 is particularly relevant for charisma when measured on pitch-accented or emphatically stressed words, and that the frequency and type of pitch accent as well as the internal shape of the associated f_0 peak also play a role. High-pitched (H* or !H*) pitch accents are generally more charismatic than L* pitch accents, even more so if the speaker emphasizes the high f_0 underneath the accent peak by giving it a plateau-like or dome-like shape [20]. Similarly, but measured at phrase level, the skewness and kurtosis of f_0 values significantly determine speaker charisma [23].

A number of phonetic parameters that negatively correlate with charisma have also been identified. Besides the lowness of the phrase-final f_0 fall [22], these parameters primarily concern non-tonal features, such as, for example, the Hammarberg Index and similar spectral voice-quality measures, LTAS formant levels, the duration of prosodic phrases, the amount of abdominal breathing, and the frequency of occurrence of filled pauses [23,24,25,10,19]. This means that the ability to split up one's own messages into small phrasal "chunks" and to present the latter with a sonorous voice rich in overtones while producing not too many filled pauses makes a speaker sound more charismatic, though some of the effects may be language-specific [18,26].

However, not all non-tonal parameters are per se negatively correlated with charisma. For instance, with respect to the acoustic distinctiveness of vowel phonemes, research has shown that a clearer pronunciation of vowels makes a speaker sound more charismatic, albeit with increases of F1 and F2 distances supporting different ingredients of charisma. Larger F1 distances between vowels make speakers sound more passionate and committed, whereas larger F2 distances make speakers sound more competent and trustworthy [27]. Speaking

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rate [10,18] is also positively correlated with charisma; the same applies to the spectral center of gravity [22] and chest breathing [24].

In view of the fact that even parameters such as breathing and formant structure have already been examined with regard to their charismatic effect, it is remarkable that one of the four core dimensions of prosody [28], i.e. loudness or its major acoustic correlate referred to in phonetics as "intensity", has hardly been the subject of analysis so far. Rosenberg and Hirschberg [10] addressed intensity and found no significant correlation with charisma. However, they note that "variation in original recording conditions of the original tokens made a fuller analysis of the contribution of intensity to charisma perceptions impossible for this experiment" (p. 647). Biadsy et al. [18], in contrast, did find positive correlations of the level and variability (standard deviation) of intensity with charisma. Firstly, however, this finding is inconsistent with that of [22] for a derivative of intensity, which was negatively correlated with charisma. Secondly, the charisma-intensity correlations of Biadsy et al. have not yet been replicated for Western Germanic languages and with a substantial multi-speaker sample. And thirdly, unlike f_0, formant frequency or phrase duration, intensity is one of those parameters that can be measured in very different ways in the acoustic signal, partly also because louder speech (or, perhaps more appropriately, higher vocal effort) is not manifested in a linear increase in spectral amplitude, but also in flatter spectral slope, with higher frequencies being relatively strengthened [29].

These three points gave the impetus to our present study, which focuses specifically on intensity. In addition to the basic question of whether and to what degree vocal effort correlates with perceived speaker charisma in a larger English multi-speaker sample, we also address the additional question of what nature this correlation is – or, in other words, what acoustic measures can represent the intensity-charisma correlation(s) most consistently. For example, is it (primarily) the distributional, level, or dynamic features related to vocal effort that determine a speaker's charisma in the ears of listeners? Furthermore, similar previous studies on f_0 have shown that speaker gender can also play a role in which acoustic measure correlates with charisma to what extent [19,21]. Therefore, the factor gender is also separately taken into account in our study.

2. Method

2.1. Material

The measured speech material came from 51 post-graduate students (33 males, 18 females), aged 23–27 years, affiliated to Department of Technology Entrepreneurship and Innovation at the University of Southern Denmark. All the students were non-native but proficient L2 speakers of English, with their English command corresponding to the levels B2 or C1 as per the Common European Framework of Reference for languages (CEFR) – according to university-internal aptitude tests.

The speakers were recorded while holding a so-called "elevator speech", i.e., a short description of a start-up company or its underlying business idea presented with the intention to acquire external funding from investors. Presentations took place at the University of Southern Denmark in a theatre-like room that created sound-attenuated speaking conditions. The mouth-to-microphone distance in the recording setting was approximately constant (the about 5% variability included in the data is negligible, also because the variations were not systematic between individual speakers). We used 40–98 s presentation excerpts (ø 61.4 s) for our analyses, cut out at major prosodic-phrase boundaries from the middle of each elevator speech. To eliminate the effect of pauses on intensity values, silent portions were automatically removed using Praat's Vocal Toolkit [30].

2.2. Acoustic analyses

The acoustic analysis was performed in Praat [31]. To investigate whether loudness-related measures are correlated with perceived speaker charisma at all and if so, whether these correlations would apply equally to all measures, we analyzed a total of 15 acoustic parameters. Two groups of parameters included measures related to loudness level and range/change:

- root-mean-square (rms) amplitude of the signal
- mean sound pressure level (SPL), using default settings for the Intensity object in Praat
- median SPL
- 90th quartile of SPL
- SPL standard deviation
- 90th quartile of SPL minus median SPL
- 90th quartile of SPL minus mean SPL
- maximum SPL minus median SPL
- maximum SPL minus mean SPL

The motivation for extracting the 90th quartile of SPL stems from the fact that human perception is less sensitive to extreme values; apart from using maximum SPL, therefore, we also examined the 90th quartile.

The third group of parameters consisted of various indicators of spectral slope:

- the alpha measure, defined as the ratio of the energy of the 1–5 kHz band and of the 0–1 kHz band [29]
- a derived alpha (referred to here as alpha2), which considers high frequencies up to 8 kHz
- Kitzing's index [32], the ratio of the energy of the 1–2 kHz band and of the 0–1 kHz band
- Ternström's index [33], defined as the difference between the energy of the 2–6 kHz band and of the 0–1 kHz band
- two indices proposed by Volín [34], where the first corresponds to the ratio of the 0–1.1 kHz band and of the 1.8–5.5 kHz band (eliminating the linguistically charged frequency region of the *F*2), and the second including only 0.35–1.1 kHz in the low-frequency band (eliminating the f_0 region for the same reason)

It should be pointed out that the spectral slope measures are related not only to vocal effort, but also to voice quality [29]: voices with relatively more energy in higher frequencies are typically described as sharp and rich, while those with relatively little high-frequency energy are perceived as being soft or thin. The latter six measures are therefore expressions of both vocal effort and voice quality at the laryngeal level [35].

2.3. Speaker charisma ratings

The individual investor pitches were rated by fifty listeners with respect to perceived speaker charisma. The ratings were based on delexicalized speech, obtained by low-pass filtering which only preserved prosodic information in the signal. Delexicalization was performed in order to eliminate the effect of the lexical content of the elevator speeches on perceived speaker charisma.

Ratings were made indirectly based on the following question: "On a scale from 0-100%, how likely is it that you would dare to invest some of your own money into the speaker's company?". The speech excerpts were presented to respondents in individually randomized orders, and ratings were indicated by shifting a slider horizontally along on a visual analogue scale (0-100). Previous studies [21,23] showed that listeners found this scale easily applicable; and investment likelihood itself is closely associated with key attributes of charisma [10]. The mean percentages that the speakers received across all listeners (referred to below as "charisma rating") were subsequently correlated with the 15 acoustic measures; in the Results section, we report Pearson's product-moment correlation coefficients.

3. Results

Figure 1 displays the results for two of the three measures which relate to the level of acoustic energy. It is clear that both SPL mean and median correlate very weakly with perceived speaker charisma, with $r < 0.1$ for the overall analysis, r close to 0 for the male speakers and $0.18 < r < 0.3$ for the female speakers. The last level measure, the 90th quartile of SPL, is very similar to median SPL.

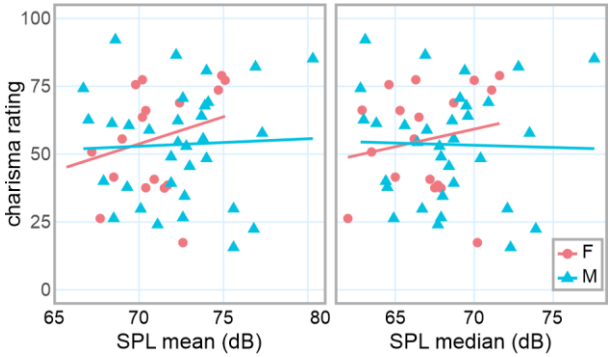

Figure 1: *Correlation of charisma ratings with mean (left) and median (right) SPL.*

It is clear, then, that the parameters related to the level of vocal effort showed no significant correlations. This is presumably also because the speakers differed relatively little in their mean and median SPL values, as can be seen from Figure 1. In other words, there were no speakers who stood out in terms of their overall loudness.

As for the variability of intensity-related parameters, correlations with perceived speaker charisma depend on the individual measures applied, and some of them also differ considerably with speaker sex. Interestingly, SPL standard deviation manifested zero correlation with listeners' scores (r = 0.05 for female and –.0.09 for male speakers). As can be seen in Figure 2, the difference between the 90th quartile and median SPL (shown on the left) manifested weak and insignificant correlations with speaker charisma (r = 0.28, p = 0.26 for female speakers; r = 0.22, p = 0.21 for male speakers). However, the difference between maximum and median SPL on the one hand and charisma ratings on the other yielded medium strong and statistically significant correlations for our male speakers (r = 0.38, p = 0.03) – that were virtually non-existent (r = 0.08) for the female speakers, though. The remaining "loudness" variability measures also manifested similarly divergent results for our male and female talkers, with most of them being stronger for males.

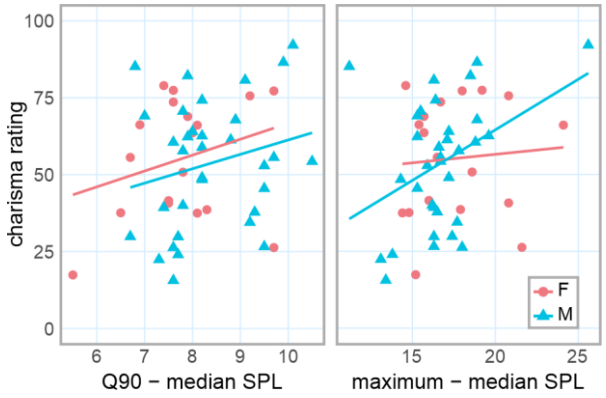

Figure 2: *Correlation of charisma ratings with two SPL range measures: the difference between the 90th quartile and median SPL (left), and the difference between maximum and median SPL (right).*

Turning to the spectral slope measures, Figure 3 shows the results for two of the examined parameters. The alpha value is one of the most frequently reported parameters and is known to correlate with loudness [29]. Indeed, as can be seen in the left panel of the figure, there was a moderate and marginally significant correlation of alpha with the perceived charisma of both the female speakers (r = 0.41, p = 0.09) and male speakers (r = 0.30, p = 0.09) in our dataset. The positive correlations suggest that louder voices, with relatively stronger high-frequency energy, convey more charisma (the high-frequency band is in the numerator of the equation, and the low-frequency band in the denominator). Practically identical results were obtained for the derived alpha measure, with the high-frequency band extending up to 8 kHz.

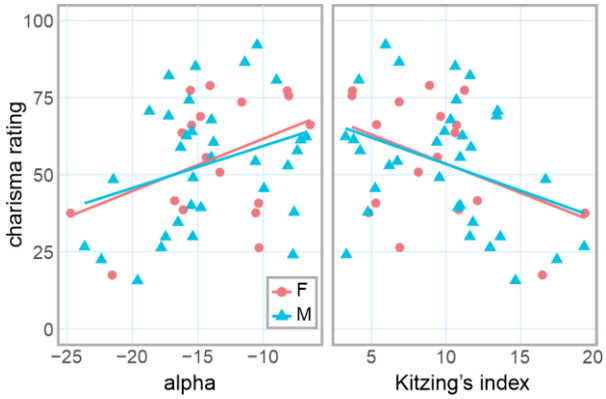

Figure 3: *Correlation of charisma ratings with the alpha value (left) and with Kitzing's index (on the right).*

However, it was Kitzing's [32] index that turned out to yield the most significant correlations, as shown on the right of Figure 3 – albeit not dramatically superior to the alpha value: r = –0.35 and p = 0.046 for the male speakers, and r = –0.41 and p = 0.09 for the female speakers. Notice that the slope of the relationship is negative here, opposite to that in the alpha measure. This is only due to the fact that this Kitzing's index has the low-frequency band energy in the numerator and the high-frequency energy in the denominator. The overall relationship with charisma is therefore similar to those of the alpha and alpha2 measures.

For the sake of more detailed comparison, Figure 4 displays the absolute values of correlation coefficients of the individual acoustic parameters and perceived speaker charisma, separately for the male and female speakers. Some of the results will be discussed in the following section.

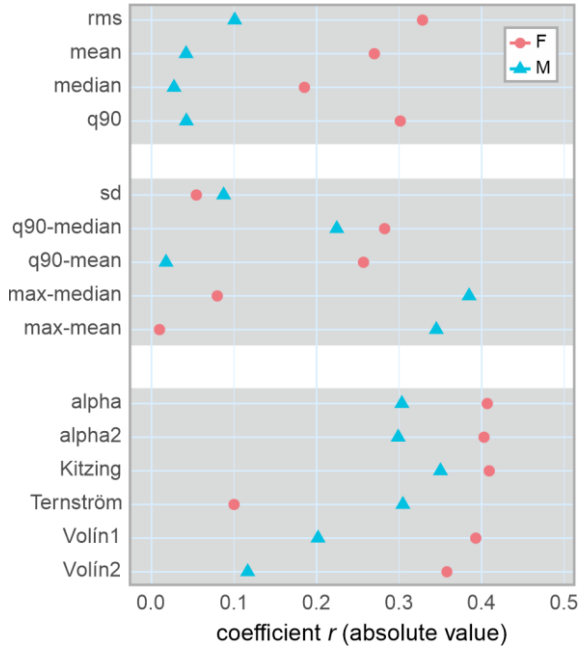

Figure 4: *Absolute value of correlation coefficients of individual acoustic measures and charisma ratings, for male and female speakers.*

4. Discussion

The analyses presented in this paper yielded three key results. First, vocal effort is correlated with perceived speaker charisma with respect to both acoustic energy (i.e., sound pressure level, frequently referred to as intensity) measures and spectral slope measures. However, correlation levels are generally quite weak and moderate at best ($0.0 < r < 0.45$) and only rarely reach statistical significance at the 0.05 alpha level. Compared to, for example, measures of melodic level or melodic variability (see also the Introduction), the effect of loudness-related measures found in this study can be considered quite weak. However, this is not surprising, as we know from previous studies that loudness is a less important charisma factor than pitch or its acoustic correlate f_0. In addition, there seem to be no extreme speakers in our dataset when it comes to mean or median SPL (Fig. 1) – i.e., no speakers were unusually loud or quiet in their presentations – so the weak correlations should not be surprising for that reason as well. The inclusion of too quiet or too loud speakers may render the observed relationships more robust.

Second, as is the case with various f_0 measures, acoustic measures of loudness correlate with perceived speaker charisma in a gender-specific fashion. Despite the weak correlations, we may tentatively summarize that female speakers' charisma is more strongly correlated with measures of loudness level (those shown in the first and third groups of parameters in Figure 4 above) than with measures of loudness change. The perceived charisma of male speakers seems to correlate more strongly with measures of loudness change (especially the difference between SPL maximum and mean or median, as shown in the second group of parameters in Figure 4).

Third, spectral-slope measures show the highest degrees of correlation with perceived speaker charisma. Since acoustic energy itself accounts only for part of the perception of loudness, this is perhaps not surprising: taking into consideration the associated imprint of loudness in spectral balance makes the correlation stronger. Since spectral slope reflects not only the loudness of the voice but also the type of phonation, it would be interesting to include, in a future study, speakers whose voices fall within the same loudness range as in the present sample but deviate more from modal phonation, to tease apart the effect of loudness and phonatory properties.

The latter is all the more important as earlier studies suggest that voice quality is more diversely and strongly associated with perceived speaker charisma than loudness [20]. For example, the same charisma ratings used here yielded almost twice as high correlation coefficients in combination with voice-quality measures ($r > |0.5|$ or even $r > |0.7|$ in absolute values). Such a parameter hierarchy, if confirmed in perception tests, would in fact also be consistent with the advice literature. Authors of such guidebooks repeatedly and consistently emphasize the charismatic relevance of a powerful, warm, or strong as well as a "rich, rolling, resonant voice" [36], i.e. they refer to voice qualities and emphasize their context-sensitive, variable use. In contrast, recommendations like the following are rarely found: "Have a clear speaking volume. Have a loud voice. You can never talk loud enough. Talking too softly is the problem!" [37].

Note, moreover, that even our reported correlations between investment-based charisma ratings and acoustic loudness measures need not mean that loudness itself is directly relevant to charisma. Loudness level, for example, is closely associated with a speaker's emotional arousal level [38]. Loudness change or variability is also a reflection of the speaker's ability to realize a pronounced, salient contrast between stressed and unstressed words when presenting, cf. [39]; and the spectral loudness measures are associated with proximity. That is, as the mouth-to-microphone distance decreases, the acoustic energy in frequencies above 0.8 or 2.0 kHz increases disproportionately. Larger alpha and smaller Kitzing's values could therefore also indicate that it is beneficial for a speaker's charisma if s/he is closer to the microphone – perhaps because this in turn supports the perceived closeness to the audience as well. It is known from visual perception that people of whom a smaller section can be seen in a photo, i.e. who were closer to the photographer's lens, appear also socially closer and more important to the viewer; they receive more attention and are remembered longer [40]. An analogous principle could manifest itself here in the spectral loudness measures on the acoustic level.

To conclude, our paper began with a question: Those who shout the loudest, do they sound more charismatic? The empirical data allow us to answer this question with a 'no' rather than a 'yes'; if anything, then higher loudness is a weak charisma advantage for women, but not for men. In general, it is the distributional and dynamic rather than the level measures of loudness to which charisma ratings react most sensitively. Yet, future studies must clarify to what extent loudness is directly relevant to charisma and to what extent the speaker's effort, arousal, proximity or accentuation characteristics are the actual constitutive factors behind the loudness-charisma link.

5. Acknowledgments

The first author is also the CEO and founder of the speech technology company AllGoodSpeakers ApS. Please visit https://oliverniebuhr.com for a conflict-of-interest statement.

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