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The sound of complaints

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Complaining is a social act in which a speaker often verbally conveys feelings of suffering to gain empathy from listeners. The present study investigated the acoustic profile of complaints to identify which prosodic features are used in this context and to explore differences in their cultural expression in two variants of French. A stimulus set composed of 336 complaints and 336 prosodically neutral utterances produced by two cultural groups, French and Québécois (French-Canadian), was analyzed along 15 acoustic parameters. Utterances were also judged by listeners to determine whether complaints were perceptually associated with particular emotional characteristics. Relative to neutral statements, complaints displayed increases in fundamental frequency (mean, variability, and range), loudness, and high-frequency energy, and several rhythmic modulations. Complaints were also characterized by systematic changes in parameters related to voice quality and increased vocal control (decreased shimmer, increased harmonics-to-noise ratio), which could exemplify the speaker's strategic use of emotive cues. Perceptually, complaining voices were most associated with sadness, anger, and surprise. Complaints produced by French and Québécois speakers demonstrated shared central tendencies but also differed both acoustically and perceptually. Our results provide new insights into the acoustic and perceptual profiles of emotive "complaining" speech patterns meant to elicit empathy in social interactions.

KEYWORDS

prosody, emotive speech, interpersonal communication, culture, acoustic

1 Introduction

A complaint is the verbal exposition of a painful or annoying situation to another person. The present paper focuses on third-party complaints, which are addressed to a person unrelated to the issue expressed (Drew, 1998; Kowalski, 2002). Contrary to direct complaints, which seek a cessation or apology (Laforest, 2002), many third-party complaints are non-instrumental in nature (Alicke et al., 1992; Traverso, 2009). Instead, they seem to serve a social purpose: that of creating empathy and affiliation (Drew and Walker, 2009). The social-expressive function of complaints is revealed by their interactional structure; they usually refer to bound, distinct topics in a conversation, introduced with no or very little context (Drew, 1998), and initiate a collaborative negotiation of listener affiliation (Drew and Walker, 2009).

An important question that has not yet been addressed is: what does a complaint actually sound like? Research suggests that a speaker's prosody is likely critical for communicating the speaker's social pain and for eliciting empathy (Meconi et al., 2018; Regenbogen et al., 2012). However, very little is known about the acoustic structure of (third-party) complaints. The objective of this study was to close this gap in the literature and assess how prosody is used in complaining speech. In social interactions, speech must effectively convey the affective state of the speaker in order to trigger empathic mechanisms, as exemplified in the Emotions As Social Information (EASI) model (Van Kleef, 2009). Beyond the verbal description of a situation, a powerful way to convey affective information is through prosody (Jiang and Pell, 2017; Truesdale and Pell, 2018). Prosodic variations have been associated with specific forms of emotional expressions and are also used to communicate affect in various ways (Eyben et al., 2016; Juslin and Laukka, 2003; Kreiman and Sidtis, 2011). For example, listeners use acoustic

cues to evaluate the intensity or arousal level of the speaker in relation to their message (Juslin and Laukka, 2001; Scherer, 2003). Additionally, prosody can play an important role in processes underlying emotional mirroring (Aziz-Zadeh et al., 2010; Lang et al., 2011). These findings emphasize that prosody helps listeners to both *feel* and *understand* the speaker's affective state. The power of prosody is not lost on the speakers, who can display emotional signals purposefully (Scherer and Bänziger, 2004, Scarantino, 2017). Fundamental frequency, in particular, often follow a set of display rules (a "frequency code"), signaling for example distress and vulnerability with higher pitch (Ohala, 1984). Initial findings suggest that prosody serves a similar role in the communication of complaints; in a recent perceptual study, Mauchand and Pell (2021) reported that prosodic information is consistently used by listeners to infer whether (and how much) a speaker is complaining.

Although the "sound of complaints" is not clear, it has been suggested that complaints provide increased emotive intensity in their prosodic signal (Ogden, 2010). A few studies report increases in pitch and pitch variability when people complain (Acuña-Ferreira, 2002; Rao, 2013). Speakers may also modulate the rhythm and energy of their voice to accentuate certain words (Acuña-Ferreira, 2002; Mauchand and Pell, 2021). Some researchers have drawn parallels between the acoustic structure of complaints and certain emotional expressions, such as anger (Selting, 2010), sadness, or surprise (Rao, 2013). As an expression of (social) pain, the acoustic structure of complaints could also contain elements found in vocalizations of physical pain, such as increased pitch range, voice roughness, and intensity (Koutseff et al., 2018; Lautenbacher et al., 2017). However, concrete data on the acoustic properties of complaints is scarce, as most of the research is based on qualitative analyses of complaints in conversation (Acuña-Ferreira, 2002; Selting, 2010). To date, quantitative analysis of complaining prosody in a controlled testing environment has only been performed by Rao (2013), who focused on intonational contours, and by Mauchand and Pell (2021) who identified certain acoustic measures as mediators of complaint perception. A complete, thorough assessment of the acoustic profile of complaints is therefore overdue.

Although complaints may resemble emotions in some manner, they are socially complex expressions in which affect is intentionally reconstructed, one aspect of *emotive* communication (Acuña-Ferreira, 2002; Selting, 2010). This reconstruction seems to have an interactional role in empathy-seeking: strategic use of linguistic and prosodic emotional cues as described above has been linked to increased engagement and affiliation in complaining behavior (Drew and Walker, 2009; Selting, 2010). Hence, complaints are highly dependent upon social-relational factors (Van Kleef, 2009), which may include cultural-specific norms in language usage (Rao, 2013). Emotive strategies are likely rooted in the speaker's social and cultural experience; indeed, empathy is a cultural process and its expression and effects vary across groups and individuals (Cheon et al., 2010; Chopik et al., 2017). The populations studied in the present paper, French and Québécois (French-Canadian), are known for their differences in communicative styles and social behaviors. Québécois have been reported to produce speech with a lower pitch, but increased pitch range compared to French speakers (Ménard et al., 1999); they also tend to express their emotions more readily than French (Kircher, 2012) and elicit different implicit and explicit attitudes (Mauchand and Pell, 2022b). The importance of the sociocultural context in communication thus makes it crucial for an acoustic and perceptual characterization of complaints to consider these factors, as they will not only enrich the surface knowledge about complaining prosody but may also reveal deeper processes that govern the production of everyday speech acts across individuals, cultures, and social groups.

The present study aimed to establish acoustic and perceptual patterns associated with complaining speech, based on a robust set of complaining and neutral utterances that are likely to occur in everyday conversations. Potential socio-cultural effects were also assessed by studying two distinct cultural groups, French and Québécois. The choice of these two groups was motivated by their common language (French), which allowed the creation of verbally identical stimuli, thus ensuring consistency and control in both acoustic and perceptual measures. As a secondary goal, we aimed to capture basic information about the perceived emotional characteristics of complaints and how these features may differ between the cultural groups. Based on the small existing literature, we predicted that complaints would resemble vocal expressions of negative emotion associated with pain or high arousal, characterized by increases in pitch and pitch variability, as well as alterations of voice quality. It was expected that major acoustic strategies used to express complaints would be relatively similar for the two cultural groups, although some group variation could emerge given the importance of social-relational factors in complaining behavior and potential differences in communicative style.

2 Methods

2.1 Materials

Eighty-four (84) short sentences describing the behavior of a hypothetical person (third-party) were written in French. The sentences all started with a personal pronoun followed by an action, e.g., "Il a dit que j'étais stupide" (*He said I was stupid*). The complete list of sentences can be found in Supplementary Table S1. For the purposes of another experiment, these sentences were constructed in pairs that differed only in their final word ("Il a dit que j'étais stupide/sorti"—*He said I was stupid/outside*). The last word dictated whether the sentence had direct negative consequences for the speaker based on the linguistic message. As the present study focuses on prosodic properties of the stimuli, distinctions in the linguistic message will not be examined here. Prior to recording the sentences, each written sentence was evaluated by two Québécois and two French speakers to confirm that the lexical content and phrasing of the utterance was natural to orally express in both dialects. Note that sentences were somewhat variable in length; this variability was corrected during the analysis step by implementing by-Statement random intercepts and slopes.

2.2 Speakers

Four Québécois (2 males, 2 females, age: M = 24.00, sd = 4.24) and four French Speakers (2 males, 2 females, age: M = 23.25, sd = 2.87) were recruited in the Montreal area to produce complaining and neutral utterances. Speakers were recruited on the basis of having

acting experience; in each group, two speakers were undergraduate students doing part-time acting and two were young actors in early career. All speakers in the French group were born and lived in France until adulthood and had moved to Montreal to pursue education or employment opportunities (Mean time in Quebec: 3–8 years). All speakers in the Québécois group were born and living in Québec. Each speaker was raised in a francophone-only environment and were using French as their main everyday language at home and at work. Speakers gave informed consent before participating, and the experiment was approved by the Institutional Review Board of McGill Faculty of Medicine.

2.3 Recording

Speakers completed the recordings in pairs during a single session, involving one male and one female from the same cultural group. In total, four recording sessions were held (two per cultural group). Recordings were digitally captured in a sound-attenuated chamber with a high-quality head-mounted microphone onto a Tascam recorder (sampling rate of 44.1 kHz, 16-bit, mono, .wav format). During a session, each speaker was assigned half of the utterances and produced each utterance in the direction of their partner, in order to simulate natural conversation and to minimize input from the experimenter. Since each speaker in the pair produced a different half of the utterances, they could not directly imitate the other speaker when it was their turn. Speakers were presented the sentences individually on a tablet computer and were asked to first produce it in a neutral way, as if simply reporting a past event that was already familiar to the listener ("Neutral" prosody condition). Then, they were instructed to produce it as if complaining to their interlocutor ("Complaint" prosody condition). Every sentence was produced in both Neutral and Complaining prosody (irrespective of their linguistic content). While sentences were presented as written text, speakers were asked not to read out the sentences but instead direct their speech to their interlocutor. A basic definition of third-party complaints was provided at the beginning of each recording session, but no advice or model demonstrating how to produce the utterances was given by the experimenter. Each utterance was repeated at least twice, and speakers were allowed to continue until both communication partners were satisfied with the production. The same utterances produced by a female (or male) speaker in one group were randomly assigned to a speaker of the same sex from the other cultural group when their session was held. Thus, each utterance was produced by one male and one female speaker from each of the two cultural groups. Each speaker was given the same instructions.

Each utterance was then edited in Praat (Boersma and van Heuven, 2001) into short .wav audio files. Since each utterance was repeated multiple times, only the "best" version was kept; by default, this was the last production of the speaker, except in cases of noisy recordings or unclear pronunciation when another version was chosen by the examiner. A total of 672 utterances were selected, 84 per speaker (2 groups) (French, Québécois) × 4 speakers × 42 sentences × 2 prosody types (Neutral, Complaint). Exemplars of the stimuli are available through the Open Science Framework (Foster and Deardorff, 2017).[1] Since each sentence was produced in both prosodic conditions in each speaker group, acoustic differences between conditions may only arise from prosodic or accent effects, and not from lexical/phonetic discrepancies.

2.4 Acoustic measures

Acoustic features of each of the 672 selected utterances were extracted using the Geneva Minimalistic Acoustic Parameter Set—GeMAPS (Eyben et al., 2016). This parameter set, found in the publicly available openSMILE toolkit (Eyben et al., 2010), has been developed as a standardized baseline set of affect-related acoustic measures (for more details on the computation and implementation of the measures, see Eyben et al., 2016). Parameters were selected based on what could be applied to the stimuli and the comparisons of interest. Except for F0 SD, F0 range, Loudness SD, and utterance/final word duration, all parameters were averaged over the utterance. The following parameters were gathered:

1) Fundamental frequency parameters:

   a) F0 M, fundamental frequency, indexing mean pitch on a logarithmic semitone scale.
   b) F0 SD, standard deviation of the fundamental frequency, indexing pitch variability on a logarithmic semitone scale.
   c) F0 range, range between the 20th and 80th F0 percentile, indexing pitch range on a logarithmic semitone scale.

2) Voice quality parameters:

   a) F1, first formant center frequency, indexing resonance of the vocal tract in Hertz.
   b) Jitter, indexing aperiodicity (instability) of the vocal signal—voice "creakiness."
   c) Shimmer, the difference of the peak amplitudes of consecutive F0 periods, indexing voice roughness indexing voice roughness, in dB.
   d) Harmonics-to-Noise Ratio (HNR), indexing the relative amount of additive noise in the voice.

3) Amplitude parameters:

   a) Loudness M, indexing mean loudness in a more perceptually relevant manner than intensity or amplitude measures, on a logarithmic scale.
   b) Loudness SD, indexing loudness variability on a logarithmic scale.

4) Spectral parameters:

   a) Mean spectral slope in the 500–1,500 Hz range, indexing energy as a function of frequency in these ranges.

1 https://osf.io/w4e7p/?view_only=2ec429b5cd0047c4baba11c92ab209ca

b) Hammarberg index, the difference between the strongest energy peaks in the 0–2,000 Hz and 2,000–5,000 Hz ranges, indexing energy at very high frequencies compared to lower frequencies.

5) Temporal parameters:

a) Number of voiced segments per second.
b) Mean length of voiced segments (s).
c) Utterance total duration (s).
d) Final Word Duration (s).[2]

The last two parameters, which were not part of the GeMAPS, were extracted using Praat software (Boersma and van Heuven, 2001).

2.5 Emotional association task

To explore basic information about the perceived emotional characteristics of complaints between groups, participants judged which emotional qualities they associated with the prosody of the stimuli. Participants assessed the perceived intensity of the standard 6 basic emotions: happiness, sadness, anger, surprise, fear, and disgust (Elfenbein and Ambady, 2002; Shiota, 2024) in complaining and neutral utterances. This procedure was conducted to better understand how acoustic features of our stimuli may refer to subjective impressions of basic emotions.

2.5.1 Participants

20 Québécois (11 M, 9F, age: M = 28.05, sd = 4.15) and 20 French (10 M, 10F, age: M = 24.75, sd = 3.42) participants were recruited via the online recruitment platform Prolific Academic (Peer et al., 2017) to judge the emotional characteristics of the stimuli. All had French as their mother tongue and were born and living in Québec or France, respectively.

2.5.2 Selected stimuli

A subset of 48 utterances was selected, 6 utterances (3 complaints and 3 corresponding neutral) from each speaker, ensuring sentences were the same between groups. The selection was based on "complaining" scores obtained in a previous study (Mauchand and Pell, 2021), in which 31 French and 27 Québécois participant evaluated "how complaining" each stimulus from their own group sounded. To ensure that differences in verbal content would not bias emotion ratings, only statements describing a painful situation were selected for this part of the study. Best exemplars were considered to be utterance pairs in which the Complaining condition scored highest while the Neutral condition scored lowest on the complaining score, and the best three pairs were selected for the present study. As the goal of this analysis was to determine if complaints are associated with particular emotional qualities, it was reasoned that individual speakers were relatively homogeneous in their strategies for expressing complaints (and neutral utterances), allowing us to focus on only a subset of items for each speaker.

2.5.3 Procedure

For each utterance, participants were prompted to evaluate the perceived intensity of 6 basic emotions (happiness, sadness, anger, surprise, fear, and disgust) using sliders. Each slider ranged from 0 (emotion absent) to 10 (emotion perceived as extremely intense). Participants could listen to each stimulus as many times as they wanted. After hearing a stimulus, the 6 emotion sliders appeared, and participants were to freely position each slider to what was appropriate to them. For example, if they perceived a lot of anger and a bit of surprise, they could position the "anger" slider at 8, the "surprise" slider at 4, and leave all other sliders at 0.

3 Results

3.1 Acoustic analysis

A summary of the acoustic features of complaints compared to neutral utterances produced by each group is displayed in Table 1. Linear Mixed-Effects Models were built to fit the results (Bates et al., 2015; Kuznetsova et al., 2017). Models compared complaints to neutral utterances for each acoustic parameter, and how it differed between the two cultural groups. For each acoustic measure, a model was built with Prosody and Culture as fixed factors and Speaker and Token as random intercepts. To first assess how the participants responded as a whole, regardless of culture, fixed factors were rescaled: for Prosody, Neutral was coded −0.5 and Complaint was coded 0.5; for Culture, French was coded −0.5 and Québécois was coded 0.5. Summaries of the models for each parameter are displayed in Supplementary Table S2. Complaints were significantly differentiated from neutral utterances in terms of fundamental frequency parameters (increased F0 M, F0 SD, F0 range), as can be visualized in the pitch contours from Figure 1. Complaining was also marked by significant changes in loudness (increased loudness M and SD), voice quality (decreased shimmer, increased HNR, increased F1 M), spectral profile (increased energy at higher frequencies), and temporal parameters (decreased voiced segments per seconds, increased unvoiced segment length and final word duration).

When data for the two cultural groups were compared, results suggest that speakers from each culture employed slightly different acoustic strategies when complaining: French complaints showed greater increases in F0 M, loudness and HNR, and a decrease in Shimmer, compared to Québécois complaints. In addition, the total duration of French complaints was greater than corresponding neutral utterances. In contrast, Québécois complaints showed greater increases in F0 variability (F0 SD, F0 range) and F1 M compared to French complaints.

3.2 Emotional association

Inter-rater reliability was high among French listeners (ICC = 0.93) and Québécois listeners (ICC = 0.94). The average emotional ratings of the utterances are displayed in Figure 2. Linear Mixed-Effect Models were fitted on R (R Core Team, 2018) with the

2 A temporal measure of the sentence-final word was added due to our manipulation of this word in the broader stimulus set, allowing us to explore whether speakers provided local acoustic cues to mark complaints in this position.

TABLE 1 Summary of acoustic measures from neutral and complaining utterances, averaged for all speakers and for French and Québécois speakers separately.

Acoustic parameters	All speakers		French		Québécois	
	Neutral	Complaint	Neutral	Complaint	Neutral	Complaint
F0 parameters						
F0 M	29.77	35.35	29.04	34.92	30.50	35.78
F0 SD	0.10	0.12	0.10	0.11	0.10	0.13
F0 range	3.50	5.73	3.40	4.45	3.60	7.00
Loudness parameters						
Loudness M	0.19	0.21	0.19	0.22	0.18	0.19
Loudness SD	0.57	0.60	0.52	0.54	0.62	0.65
Voice quality parameters						
HNR	7.29	9.07	7.10	9.63	7.47	8.51
Jitter	4.19×10^{-2}	4.17×10^{-2}	4.24×10^{-2}	3.67×10^{-2}	4.15×10^{-2}	4.66×10^{-2}
Shimmer	1.21	1.04	1.22	0.99	1.20	1.10
F1 M	513.60	542.01	529.02	542.82	498.17	541.19
Spectral parameters						
Slope 500–1,500 Hz	-2.05×10^{-2}	-1.87×10^{-2}	-2.08×10^{-2}	-2.06×10^{-2}	-2.03×10^{-2}	-1.69×10^{-2}
Hammarberg index	30.95	30.38	32.36	31.84	29.54	28.91
Temporal parameters						
Voiced per sec	3.29	3.13	3.35	3.08	3.24	3.18
Mean voiced length	0.25	0.26	0.26	0.28	0.24	0.24
Mean unvoiced length	0.09	0.10	0.08	0.09	0.09	0.11
Duration	1.30	1.38	1.17	1.31	1.44	1.46
Final word duration	0.42	0.50	0.39	0.46	0.46	0.54

F0, fundamental frequency; F1, first formant center frequency; Slope, spectral slope in the specified bandwidth; Voiced per sec, number of voiced segments per seconds; mean voiced/unvoiced length, mean length of voiced/unvoiced segments.

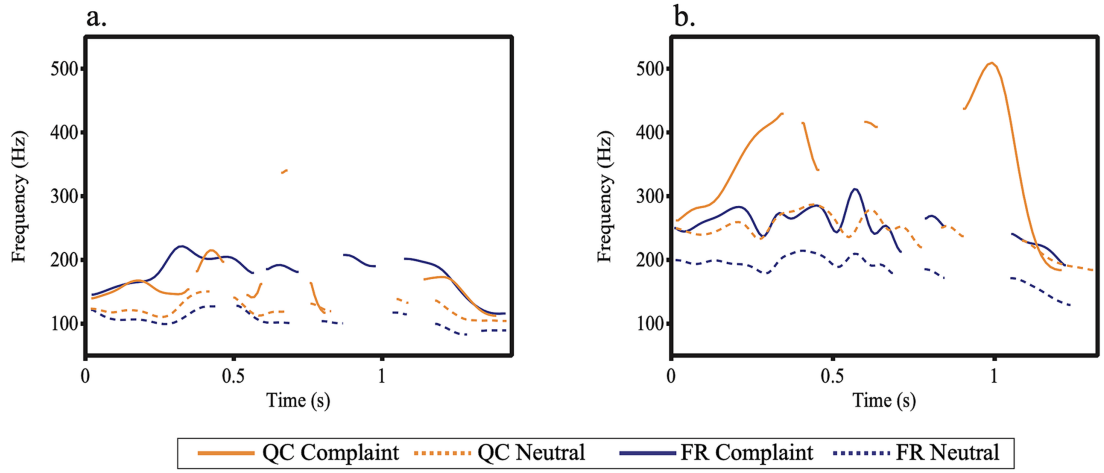

FIGURE 1
Example of pitch contours extracted from complaining and neutral versions of two sentences, uttered by one speaker from each group. **(a)** He said I was stupid, uttered by male speakers. **(b)** They asked me to leave, uttered by female speakers.

packages lme4 and lmerTest (Bates et al., 2015; Kuznetsova et al., 2017) to compare the emotion ratings of complaints to those of neutral utterances by cultural group. For each emotion, a model was built with Prosody, Speaker Culture and Listener Culture as fixed factors and Listener and Token as random intercepts. Summaries of the models are displayed in Supplementary Table S3.

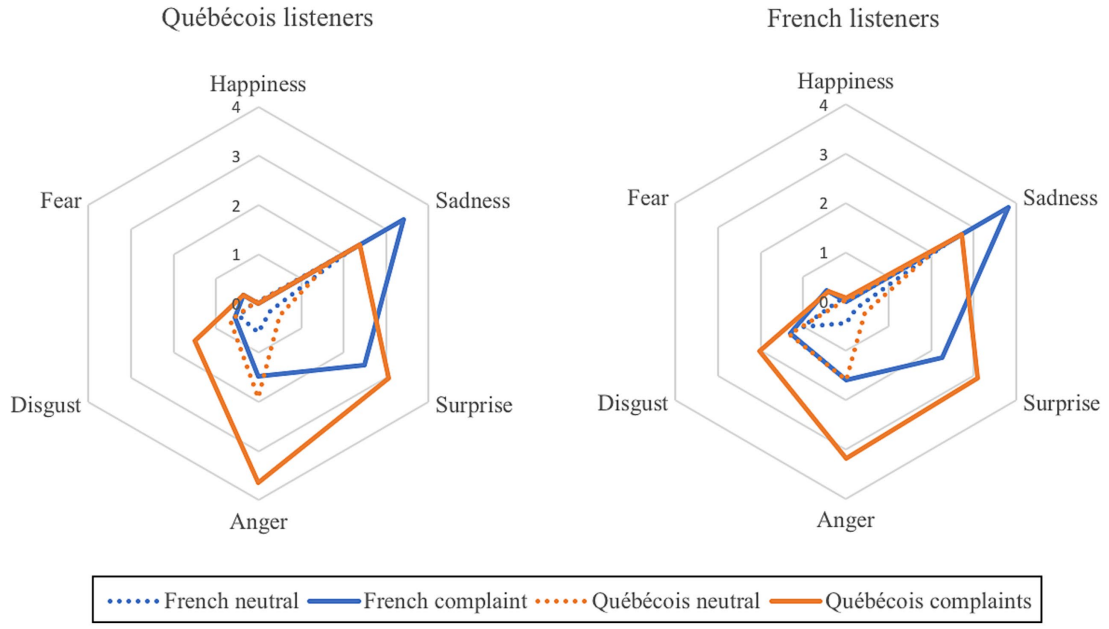

FIGURE 2
Mean emotional ratings assigned by Québécois and French listeners to complaints and neutral utterances produced by Québécois and French speakers.

Anger: Participants rated complaints as more angry than neutral utterances overall, and Québécois speakers were generally rated as more angry than French speakers. These two variables interacted, as Québécois complaints were perceived as more angry than French complaints whereas neutral utterances showed only marginal cultural differences. An interaction of Speaker × Listener Culture was also found, as Québécois listeners rated Québécois speakers more angry than French speakers, but this difference was less pronounced for French listeners.

Surprise: Listeners perceived more surprise in complaints than in neutral speech. This effect tended to be larger for complaints expressed by Québécois versus French speakers.

Sadness: Complaints were generally rated as more sad than neutral utterances. This difference was more pronounced for French utterances than for Québécois utterances.

Fear: Complaints were overall perceived as containing more fear than neutral utterances.

Disgust: Listeners perceived more disgust in complaints than in neutral utterances, and perceived Québécois speakers as sounding more disgusted than French speakers. These two factors interacted, showing that only Québécois (and not French) complaints differed significantly from neutral utterances along this dimension. Interestingly, French listeners gave higher disgust ratings than Québécois listeners overall.

Happiness: Effects for happiness were negligible as all utterances were almost systematically rated 0 on this dimension.

4 Discussion

Based on a newly created corpus of utterances in which French speakers from two cultures expressed third-party complaints, our acoustic analyses provide new perspectives about a potential "sound of complaints" and its perceptual features. As reported previously (Acuña-Ferreira, 2002; Ogden, 2010; Rao, 2013), complaints were distinguished by large increases in F0 mean, variability and range; our results extend these findings to a new linguistic context (French) and to a richer set of third-party complaints. While modulation of F0 parameters is critical in many forms of affect expression, simultaneous increases in F0 mean and range, together with higher amplitude, is often linked to increased muscle tension associated with a speaker's arousal (Juslin and Laukka, 2003; Scherer and Bänziger, 2004). Complainers may exploit this mechanism to strategically communicate affective arousal to their listeners, as described by the Frequency code (Ohala, 1984). Speakers may also increase their F0 to mimic signals of non-aggression and submissiveness (Frick, 1985; Gussenhoven, 2004) as another means for gaining empathy from listeners.

Complaints may be encoded by other acoustic cues that speakers appear to selectively provide in this social context. High-frequency energy, indexed here by an increased spectral slope, low Hammarberg index, and increased first formant frequency, have been frequently linked to vocal expressions of negative emotions, especially anger and despair (Banse and Scherer, 1996; Eyben et al., 2016). Interestingly, this acoustic profile exhibits important similarities to pain vocalizations (Lautenbacher et al., 2017; Raine et al., 2019), re-emphasizing that complaints embody an expression of pain. Temporal modulations also contributed to how complaints were communicated, with a slower speech rate than neutral utterances reminiscent of sadness or disgust (Laukka et al., 2016). Additionally, we observed systematic elongation of the final word which, in the present design, carried crucial semantic information about the complaint. While final emphasis may not be a generic characteristic of complaints, it could indicate a tendency for speakers to intentionally accentuate relevant emotional content (here, the final word). Although our study was not designed to examine the local emphatic structure

of complaints, these temporal changes suggest an important interplay between lexical-semantic and prosodic information in the communication of complaints (Pell and Kotz, 2021).

Social-pragmatic influences on complaint expression may also be revealed by voice quality measures, as we noted significant reductions in shimmer and noise in the speech signal when complaints were compared to neutral utterances. Shimmer is usually taken to index voice control, showing large values for irregular and rough speech (Latoszek et al., 2018). Increases in Harmonics-to-Noise Ratio tend to indicate less noisy, more harmonic speech. The observation that vocal control and clarity were greater when speakers complained seems to contrast with other acoustic tendencies linked to arousal (e.g., increased F0, amplitude), as it is typically expected that speech produced in conditions of high arousal exhibits increased shimmer and noise (Juslin and Laukka, 2003; Laukka et al., 2016). This could exemplify that complaints are by nature a *controlled* expression of affect. Interestingly, a recent study by Raine et al. (2019) on simulated pain also found that while most acoustic measures were consistent with natural pain, indexes of voice control decreased with the intensity of the pain intentionally conveyed by speakers. Alternatively, reduced shimmer and noise have been attributed to vocal expressions of sadness (Laukka et al., 2016), an emotional quality that was often associated with complaints according to our new data.

Complementing the acoustic findings, the exploratory emotional association task revealed that complaining prosody is *perceptually* associated with a range of negative emotional qualities. Based on a representative sample of complaining and neutral utterances, we found that complaints were associated with discrete emotional qualities consistent with their prosodic attributes (Acuña-Ferreira, 2002; Ogden, 2010). Listeners perceived mostly sadness, anger, and surprise in complaints. While the perceived intensity of certain emotions varied somewhat between speaker groups (see below), the emotional associations attributed to complaints by French and Québécois listeners were qualitatively similar, reinforcing that complaining prosody was perceived as strongly *emotive* and *negative* in a systematic manner by all participants. These results exemplify that speakers can intentionally display emotion-related signals to trigger affective reactions (the perception of emotions) and inferential processes (the recognition of a complaint) as described, for example, in the Emotions as Social Information Model (Van Kleef, 2009). This emotional exploration remains limited by sample size, as well as the restricted number of emotions being judged. Although the six "basic" emotions system is a standard in cross-cultural emotion recognition (Elfenbein and Ambady, 2002; Shiota, 2024), the complexity of complaints may be underlined by other emotional features, including more positively valenced emotions (Kowalski, 2002; Boxer, 1993).

In terms of culture, French and Québécois speakers alike produced a consistent set of acoustic features associated with complaints, with a few potential cultural-specific strategies. Québécois speakers, when complaining, were perceived as angrier and more surprised than French speakers; in contrast, French complaints evoked more sadness. Acoustically, this was paralleled by changes in F0: Québécois complaints displayed greater F0 variation and larger range, denoting increased expressivity and arousal, whereas French complaints displayed larger increases in mean F0 with less variability, potentially reducing any perceived aggression associated with these utterances (Frick, 1985). Certain differences in voice quality and temporal/rhythmic differences were also observed (e.g., French speakers produced complaints more slowly relative to neutral statements, whereas Québécois speakers seemed to alter their speech rate within the utterance). These differences underscore that complaining is a socialized form of affect expression that, while meant to communicate pain (Lautenbacher et al., 2017; Raine et al., 2019), is shaped by pragmatic conventions which dictate how members of a particular culture communicate their emotions for expressive purposes (Van Kleef, 2009). However, given the small number of speakers we examined in each cultural group, our conclusions regarding the cultural aspect of complaining remain tentative and await further investigation.

Our study is one of the few quantitative analyses of complaints in a controlled environment (Mauchand and Pell, 2021; Rao, 2013). While this controllability may come at the cost of ecological validity as posed expressions often exhibit exaggerated features, our results generally align with qualitative descriptions of spontaneous complaints derived from natural discourse contexts. For example, our stimuli were characterized by pitch-related emotivity (Acuña-Ferreira, 2002), displays of anger and surprise (Selting, 2010), emphatic accentuations (Selting, 1994) and a general hyperbolic style (Drew and Walker, 2009) over many acoustic dimensions. Moreover, our results are novel in demonstrating that changes in voice quality are systematically associated with complaining speech, which could not be identified in previous qualitative work. Future research would benefit from exploring methods to capture more ecologically valid stimuli, perhaps through analyzing "running speech" from semi-naturalistic interactions or validated corpora of real-world speech.

5 Conclusion

Our data suggest that complaints are speech acts with ostensive emotive qualities, perceptually associated with negative valence/increased arousal, with features resembling anger, sadness, and/or surprise. Moreover, it constitutes a new step in defining an eventual "sound of complaints," which exhibit differences in fundamental frequency and voice quality when compared to statements produced in a neutral tone, as well as a few culture-specific strategic modulations. These acoustic and perceptual attributes appear to reinforce the expressive function of complaints to elicit empathy; this idea is supported by recent evidence that complaining voices are perceived as more salient and increase early cortical responses in listeners when compared to identical utterances produced in a neutral manner (Mauchand and Pell, 2022a; Mauchand et al., 2024). Our conclusions are limited by our small speaker sample and the fact that we examined complaints outside of natural interactions; since complaining depends highly on context and can yield heterogeneous types of interactions, our acoustic and perceptual data may not fully capture this variability in more ecological settings. Still, our study highlights one of the ways that speakers use prosody as an emotive device to guide the listener's response in a quest to promote interpersonal affiliation.

Data availability statement

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession

number(s) can be found at: https://osf.io/w4e7p/?view_only=2ec429b5cd0047c4baba11c92ab209ca.

Ethics statement

The studies involving humans were approved by Research Ethics Office (IRB) of the Faculty of Medicine and Health Sciences at McGill University. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

MM: Methodology, Formal analysis, Data curation, Writing – review & editing, Writing – original draft, Conceptualization, Investigation. MP: Writing – review & editing, Supervision, Conceptualization, Writing – original draft, Resources, Funding acquisition.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The authors declare that no Gen AI was used in the creation of this manuscript.

Publisher's note

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fcomm.2025.1592994/full#supplementary-material

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