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Prosodic variation of English in Dominica, Grenada, and Trinidad

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Abstract

Varieties of English in the Caribbean have been claimed to have characteristic pitch patterns. However, there is little empirical research on prosodic aspects of English in the region. This paper provides a comparative phonetic analysis of several pitch parameters (pitch level, range, dynamism, rate of change, variability in rate of change, and tone rate) in English language data from Dominica, Grenada, and Trinidad that comprises read and spontaneous speech from 243 speakers. The results show that a wide pitch range and a high degree of variability in pitch, as mentioned in previous works, are not necessarily characteristic of English in the Caribbean overall, but that there are considerable cross-territorial prosodic differences, with English in Trinidad showing more variability than in Dominica and Grenada, particularly among female speakers. Socioprosodic variation, largely specific to Trinidad, was also identified.

1 | INTRODUCTION

While most research on the phonetics and phonologies of world Englishes has been concerned with variation of segmental features, prosody is also a domain where endonormative re-orientation processes in postcolonial varieties can be observed (Grice, German, & Warren, 2020). In the anglophone Caribbean, prosody seems to be an important dimension where such endonormative tendencies manifest: English-based Creoles and English in the Caribbean are frequently claimed, often based on anecdotal observations, to have characteristic pitch patterns, namely a wide overall pitch range and a high degree of variability in pitch (Childs & Wolfram, 2008, p. 253 for The Bahamas; Walker & Meyerhoff, 2015, p. 132 for Bequia; Wells, 1982, pp. 573–575 for the Caribbean overall; Winer, 1993, for Trinidad). However, apart from recent studies on Trinidadian English (TrinE; Leung & Deuber, 2014; Meer & Fuchs, 2019, 2021), there is little empirical research on prosodic aspects of English in the Caribbean. It is thus unclear to what extent a wide pitch range, a high degree of variability in pitch, or other pitch parameters are indeed characteristic of English spoken in the region.

There are preliminary indications of cross-territorial differences vis-à-vis pitch parameters in varieties of English in the Caribbean. A popular stereotype suggests that TrinE has a distinct 'sing-song' prosody compared to other varieties in the region (Ferreira & Drayton, forthcoming, p. 30; Youssef & James, 2008, p. 334). Previous studies additionally point to some differences in the intonational phonologies of Caribbean Creoles, for instance Jamaican and Trinidadian English Creole (TEC; Gooden & Drayton, 2017). However, potential intra-Caribbean prosodic differences concerning varieties of English (as opposed to Creoles) are under-researched. Indeed, to date, there is a general dearth of empirical phonetic research on English spoken in the smaller islands in the Eastern Caribbean (but see, for example, Hänsel, 2021). Moreover, prosodic aspects that have been investigated predominantly concern intonational phonology (from an autosegmental-metrical perspective; Pierrehumbert, 1980) and word stress (Drayton, 2013; Gooden & Drayton, 2017). Phonetically oriented studies are only available for TrinE and have so far solely scrutinized global pitch variability, that is, level, range, and dynamism (Leung & Deuber, 2014; Meer & Fuchs, 2019, 2021). Evidence additionally suggests that the question of whether wide pitch ranges and high variability in pitch are characteristic features of Caribbean varieties may be linked to sociolinguistic variation. In a recent study, Meer and Fuchs (2021) observed only few overall differences between TrinE and standardized southern British (BrE) and standardized Indian English (IndE) in terms of pitch range and dynamism. Instead, larger differences were solely found among female speakers: Female Trinidadian speakers had overall more variable pitch (with respect to range and dynamism in spontaneous speech). Further sociolinguistic differences in TrinE were found to exist between speakers of different social groups, including younger/older and rural/urban speakers (see Section 2.2). Sociophonetic variation in prosody in other varieties of English in the region has not yet been systematically investigated.

To address these research gaps, this paper provides a comparative phonetic analysis of pitch variation in English spoken in three Eastern Caribbean islands (Dominica, Grenada, and Trinidad). It is based on read and spontaneous data from 243 speakers (64 Dominicans, 110 Grenadians, 69 Trinidadians). In line with the study's focus on English rather than Creole, the data were gathered from students and teachers recorded in a sociolinguistic interview context in a secondary (and tertiary) education setting, a domain generally associated with the use of (standardized) English in the Caribbean. Two other varieties (standardized southern British English and standardized Indian English, with around 20 speakers each) are included for the purpose of comparison: While earlier forms of BrE served as the historical input in the development of English in the Caribbean, standardized southern BrE was the exonormative standard in the colonial period and, to date, sometimes functions as a conservative, external standard in the region, including in the domain of education (Hänsel et al., 2022; Meer et al., 2019). Standardized southern BrE is thus important to consider with a view to the question of norm orientation in speech production. IndE is included as a representative of non-Caribbean New Englishes. Additionally, its intonational phonology is partially similar to that of TrinE, possibly as a result of related substrate influences in the historical development of both varieties (IndE/Hindi, TrinE/Bhojpuri; Meer & Fuchs, 2021, pp. 5–8).

The study extends research on Trinidad in that previous measures of pitch level and global variation in pitch (pitch range and dynamism; Meer & Fuchs, 2019, 2021) are complemented by (i) measures of small-scale changes in pitch throughout the articulation of utterances (rate of pitch change and variability in rate of pitch change) as well as (ii) a rate of phonetic highs and lows in the pitch contour (tone rate). Additionally, the study sets out to provide an exploratory analysis of sociophonetic variation in prosody in Dominica and Grenada, two smaller islands, where, in contrast to Trinidad (Meer & Fuchs, 2021), sociophonetic evidence concerning prosody is not yet available. Specifically, the following research questions are investigated:

RQ1 To what extent can differences between the Caribbean (Dominican, Grenadian, Trinidadian) versus non-Caribbean (British, Indian) datasets be observed in terms of pitch variation?
RQ2 To what extent are there differences between the three Caribbean datasets?
RQ3 Which sociolinguistic factors influence variation in pitch across the Caribbean datasets?

In the following, we first provide information on the sociolinguistic situation in Dominica, Grenada, and Trinidad and summarize previous research on (socio-)prosodic variation in these territories (Section 2). Section 3 describes the data, acoustic parameters, and statistical modeling. Subsequently, we scrutinize cross-territorial differences in the analyzed pitch parameters and explore sociophonetic variation in the datasets from the Caribbean territories (Section 4). Sections 5 and 6 provide the discussion and conclusion.

2 | BACKGROUND AND PREVIOUS RESEARCH

2.1 | The sociolinguistic situation in Dominica, Grenada, and Trinidad

Dominica, Grenada, and Trinidad form part of the island chain of the Lesser Antilles in the Caribbean. The twin island republic of Trinidad and Tobago is located at the very south of the island chain close to the Venezuelan mainland and is the largest country of the three with a population of 1.2 million.[1] Grenada is Trinidad and Tobago's small neighboring country to the north with 113,000 inhabitants. Dominica is located further north between Martinique and Guadeloupe. With 74,000 inhabitants, it is also one of the smallest independent island countries of the Eastern Caribbean. Trinidad's population is made up of about equal numbers of Afro-Trinidadians (34.2%) and Indo-Trinidadians (35.4%). The large majority of Grenadians and Dominicans are of African descent (82.4% and 84.5%, respectively); Indo-Grenadians make up about 2.2% of the Grenadian population. All three countries experienced a history of slavery and colonization by different European groups, which has shaped today's complex sociolinguistic situation on the islands.

As is generally characteristic of the anglophone Caribbean, English in Trinidad, Grenada, and Dominica exists alongside an English-based Creole. English is the official language, which is reserved for formal situations, including news media, the law courts, and the education system; the English-based Creole is the main vernacular of everyday interaction (Hackert, 2016, p. 95). However, actual usage can rather be described in terms of a linguistic continuum with substantial variation between the English and Creole poles (Hackert, 2016, p. 89). Research reports a considerable influence of the Creoles on English (Hackert, 2016, p. 90). This influence can either be direct, that is, the use of linguistic features shared with the Creole, but also indirect, as in the avoidance or distancing from salient or stereotyped Creole features (A. Irvine, 2004, p. 66). There is also considerable variation in the use of standardized English (for example, Hänsel, 2021) and an openness toward different local and foreign norms (for example, Meer et al., 2019). An explanation for this heterogeneity is that in the anglophone Caribbean, standardized English is often defined negatively by distance to Creole, which in turn opens up room for variation (A. Irvine, 2004). Further adding to the complex sociolinguistic situation, both Dominica and Grenada underwent extensive phases of French colonization. Trinidad, although it was never colonized by the French, nevertheless attracted large numbers of francophone settlers (Ferreira & Holbrook, 2001, p. 3). While in all three islands, a French-lexicon Creole used to be spoken, today, in Trinidad and Grenada knowledge of these Creoles is confined to a very small number of older citizens (Ferreira & Holbrook, 2001). Only in Dominica is this French-based Creole, also known as Kwéyòl, still spoken by a moderately large number of residents (the exact number of Kwéyòl speakers is difficult to determine; M. Irvine, 2020).

2.2 | Prosodic variation in the Eastern Caribbean

There is a general paucity of prosodic descriptions of English and English Creole in Dominica and Grenada, and of the former's French Creole as well. Systematic empirical research on prosodic aspects of these varieties is entirely lacking. Nonetheless, previous impressionistic observations provide some insights into possible prosodic aspects of English/English Creole as spoken in both islands: Roberts (2007, p. 101) suggests that English in Dominica shows a tendency toward having 'more rises and falls than other varieties of West Indian English.' Phonetically, this claim could indicate that English in Dominica might have more pronounced pitch dynamism, a higher phonetic tone rate, or more generally higher variability in pitch than other Caribbean varieties. Prosodic descriptions of English in Grenada are not yet available, but Kephart (2000, pp. 46–47) provides a brief impressionistic account of select prosodic features of the English Creole spoken in Carriacou, a small neighboring island with approximately 5,000 inhabitants that officially belongs to the state of Grenada. Carriacou English Creole is described as having 'sentence contours [that] are relatively even,' such that there is 'less distance between "high" and "low" pitch' and a 'base pitch [that] tends to be a little higher' compared to non-Caribbean English. These remarks might indicate a higher pitch level combined with a narrow range and overall less dynamic pitch than in non-Caribbean Englishes. However, it is unclear whether Kephart's observation can be generalized to English and/or Creole in Grenada itself.

More research is available on prosodic aspects of varieties spoken in Trinidad. In terms of intonational phonology, TEC has been found to show a characteristic pattern in that intonation phrases (IPs) are typically further structured into accentual phrases (APs; Drayton, 2013). APs in TEC are characterized by low pitch accents (L*) on stressed syllables and high (H) boundary tones, which leads to frequent variation between high and low tones in the pitch contour (Drayton, 2013). On the phonological level, this intonational pattern has been argued to be mainly responsible for the above-mentioned lay perception of TEC sounding 'lilting' or 'sing-song' (Drayton, 2013, p. 260; see Meer & Fuchs, 2021 concerning the phonetic level). The prosody of TrinE is said to be heavily influenced by that of TEC and to include accentual phrasing with the characteristic L* H pattern (Ferreira & Drayton, forthcoming; Youssef & James, 2008, p. 334), but systematic empirical research on TrinE in an autosegmental-metrical framework (Pierrehumbert, 1980) is currently not available. A likely reason for this characteristic pattern is contact-induced, crosslinguistic influence from Bhojpuri in the historical development of TEC/TrinE (Gooden & Drayton, 2017), considering that Bhojpuri is the main substrate language formerly spoken by the Indo-Trinidadian population (Youssef & James, 2008, p. 323). In the early 20th century, accentual phrasing and frequent L* H alternation below the IP was common solely among Indo-Trinidadian speakers, most of whom had come to Trinidad in the late 19th and beginning of the 20th century during large waves of immigration of indentured Indians. Presently, however, the pattern is well-established not only among Indo- but also Afro- and mixed-identifying Trinidadians (Gooden & Drayton, 2017). In contrast to Trinidad, substrate influence of this type and degree (including from other Indo-Aryan languages) is likely not shared by Grenada and Dominica, given that their populations are largely of African descent. IndE itself has historically been subject to substrate influence from languages closely related to Bhojpuri, such as Hindi, and its intonational phonology today bears a certain degree of resemblance to that of TrinE in that pitch accents are also often realized with low tones (Maxwell, 2014).

Apart from phonological studies on TEC, recent empirical research has also begun to investigate phonetic aspects of the prosody of TrinE (Leung & Deuber, 2014; Meer & Fuchs, 2019, 2021). An important finding of this research is that patterns of pitch variation in TrinE with regard to pitch level, range, and dynamism are not homogenous but systematically conditioned by social variables such as age and rurality (see Section 1 on the importance of gender).[2] With regard to the factor of age, Meer and Fuchs (2021) have observed a change in apparent time that can be seen as an inverse trend of developments in TEC in favor of accentual phrasing with frequent alternation between high and low tonal targets (that is, increasing pitch variability phonetically speaking): In TrinE, younger speakers show a tendency toward less variability in pitch (narrower pitch ranges and lower dynamism scores) compared to older speakers. The authors interpret this as a possible result of speakers defining standardized TrinE prosody negatively, in opposition to TEC (see Section 2.1), such that features associated with Creole, including a high degree of variability in pitch, are avoided in standardized TrinE. Socioprosodic variation further seems to include an urban-rural divide: Urban speakers, possibly for similar reasons, have lower pitch levels, narrower ranges, and less dynamic pitch (in spontaneous speech) (Meer & Fuchs, 2021, pp. 20–28).

TABLE 1 Number of speakers by gender and territory

		Gender		
		Female	Male	Total
Comparison group	S. England	6 (27.3%)	16 (72.7%)	22
	India	10 (50.0%)	10 (50.0%)	20
Caribbean group	Dominica	37 (57.8%)	27 (42.2%)	64
	Grenada	66 (60.0%)	44 (40.0%)	110
	Trinidad	45 (65.2%)	24 (34.8%)	69
Total		164 (57.5%)	121 (42.5%)	285

3 | DATA AND METHOD

3.1 | Data

The present study draws on read and spontaneous English language data from Dominica, Grenada, and Trinidad as well as southern England and India. The data are generally comparable, but small differences exist between the individual datasets concerning recording contexts, size, and distribution of speakers. The collection of the Caribbean data followed the same protocol across territories and involved a total of 243 speakers: 64 from Dominica, 110 from Grenada, and 69 from Trinidad. The speakers are students and teachers; they were recorded in a sociolinguistic interview context in secondary schools (two Dominican, four Grenadian, and seven Trinidadian schools). The Grenadian data additionally includes recordings of students and teachers from two tertiary educational institutions. The interview context was relatively formal and aimed to elicit standardized speech. In the reading task, speakers were prompted to produce declarative sentences; questions were not included.[3] The spontaneous data consists of semi-structured, directed conversation about language topics, including language use in school, at home, or with friends. Teachers were recorded alone, students in pairs. The data were collected by the researchers during field trips in 2015 and 2016.[4] All recordings were made with Zoom H4n recorders equipped with external SHURE cardioid MX150B/C clip-on microphones with a 44.1 kHz sampling rate and 16-bit quantization. Recordings mostly took place in separate rooms provided by the schools and generally have a good signal-to-noise ratio.

The non-Caribbean datasets include 22 speakers from southern England and 20 from India. The British data is taken from the DyViS Project (Nolan et al., 2006) and the Cambridge sub-component of the IViE corpus (Grabe, Post, & Nolan, 2001) and includes tertiary students at the University of Cambridge (DyViS) and secondary school students from Cambridge and the surrounding area. The Indian data was originally analyzed in Fuchs (2016, 2018)[5] and consists of recordings of tertiary students at universities in Hyderabad. Their first languages (defined as the main home language spoken during childhood) were Bengali and Hindi (both Indo-European) as well as Malayalam and Telugu (both Dravidian), with five speakers each (see Fuchs, 2016, 2018 for further details). The texts and prompts for the British DyViS and Indian data were identical. Like the reading passage used in the Caribbean data, the passage did not include any questions. The spontaneous data consists of staged police interviews involving a map task and mainly prompted speakers to produce declarative utterances. The IViE data consists of a reading passage, which includes a few questions but mostly declarative sentences (88%), and conversations.

The gender distribution in the Caribbean datasets is slightly imbalanced toward female speakers (Table 1), which is related to the fact that most secondary school teachers in the Caribbean are female (Trading Economics, 2016). The Indian data is balanced for gender; the British set includes more male speakers. The Caribbean data covers a range of age groups (Table 2). The majority of speakers are students in the younger age group (13–25 years).[6] The middle age group (26–45 years) is well-represented but there are only few older speakers (46–65 years). The middle and older

TABLE 2 Number of speakers by age group and Caribbean territory

	Age group			
	Younger (13-25 Yr.)	Middle (26-45 Yr.)	Older (46-65 Yr.)	Total
Dominica	55 (85.9%)	7 (10.9%)	2 (3.1%)	64
Grenada	87 (79.1%)	20 (18.2%)	3 (2.7%)	110
Trinidad	46 (66.7%)	17 (24.6%)	6 (8.7%)	69
Total	188 (77.4%)	44 (18.1%)	11 (4.5%)	243

TABLE 3 Number of speakers by stays abroad, rural vs urban residence, and Caribbean territory

	Stays abroad		Rurality		
	no	yes	rural	urban	Total
Dominica	59 (92.2%)	5 (7.8%)	na.†	na.†	64
Grenada	95 (86.4%)	15 (13.6%)	19 (17.3%)	91 (82.7%)	110
Trinidad	60 (87.0%)	9 (13.0%)	5 (7.2%)	64 (92.8%)	69
Total	214 (88.1%)	29 (11.9%)	24 (13.4%)	155 (86.6%)	243

†Information not available

group only consist of teachers, except for three tertiary students in the Grenadian subset. The British speakers all form part of the youngest age group; the Indian speakers cover the age range 20 to 28 years.

Further sociodemographic information is available for the Caribbean speakers (Table 3): Approximately half of the teachers (29/59 or 11.9% of all Caribbean speakers) – but none of the students[7] – had previously lived abroad for over a year, mostly in North America, elsewhere in the anglophone Caribbean, or England. These speakers were deliberately retained in the corpus, considering that a high degree of transnational mobility is common among educated Caribbean people (Orozco, 2020). The Grenadian and Trinidadian datasets differ in the number of speakers from urban and rural areas: While the Trinidadian data mostly consists of urban speakers, more rural speakers are featured in the Grenadian dataset (Table 3). Information concerning the urban-rural distinction is not available for Dominica.[8]

3.2 | Acoustic analysis

Our analysis was designed to determine long-term pitch features of each speaker. Long-term pitch characteristics include overall pitch height, how much and how fast speakers vary pitch (local variability), the typical maximal extent of pitch variation (global variability, that is, the tone height of highs and lows), how fast speakers typically change pitch (rate of pitch change), and how much they vary in how fast they change pitch (variability in rate of pitch change). This approach does not require manual annotation of phonological tones (see, for example, Mennen et al., 2012). It therefore permits the analysis of much greater amounts of data than a manual phonological analysis and is easily reproducible (for studies using related methods, see Keating & Kuo, 2012; Leung & Deuber, 2014; Fuchs, 2018; Meer & Fuchs, 2019, 2021).

All speech data was saved in wav format and automatically annotated on the phoneme level with the help of forced alignment (either FAVE or MAUS; Rosenfelder et al., 2014; Schiel, 2015).[9] In datasets for territories where phoneme boundaries had not already been corrected in the context of previous research, the locations of utterance boundaries were checked manually. Moreover, for this data, very short pauses of less than 150 ms (which may be erroneously introduced by the forced aligners, for example, in the closure phase of voiceless plosives) were automatically removed. Spot checks confirmed that these cases were indeed not actual utterance boundaries.

Subsequently, a dedicated Praat script (available at https://osf.io/qkea5/) determined F0 at 20 ms time steps in Hertz (Hz); this is a modified version of the method used in Meer and Fuchs (2021), supplemented by additional measures adapted from Barbosa et al. (2017) and Cavalcanti et al. (forthcoming). Frequency in Hz was additionally converted to semitones (st) with the formula 12 * log2(freq), that is, 12 times the binary logarithm of F0 in Hz, relative to 1 Hz. In addition, the first derivative of F0 in Hz was computed by subtracting, for every 20 ms timestep, F0 at timestep i – 1 from F0 at timestep i. Unvoiced speech was automatically excluded in the subsequent analysis, and the F0 derivative was only measured for the i + 1th time step after the onset or resumption of voicing.[10]

Based on this data, the following measures were computed for each speaker in each speaking style:

- **Pitch level**: Median F0 in Hz, as a measure of overall pitch height that is robust to outliers (Mennen et al., 2012)
- **Pitch range**: 80% range of F0 in st, that is, the difference between the 10th and 90th percentiles in the F0 distribution (Patterson, 2000) as a measure of distance between typical low and high values in the F0 distribution that is robust to outliers
- **Pitch dynamism**: The pitch dynamism quotient (pdq)[11] as a measure of overall variability of F0, defined as the standard deviation of the F0 distribution divided by its mean in Hertz (Cheng, 2020)
- **Rate of pitch change**: The median of the first derivative of F0 as a measure of the typical rate of change in F0 (adapted from Barbosa et al., 2017; Cavalcanti et al., forthcoming)
- **Variability in rate of pitch change**: The 80% range (that is, the difference between the 10th and 90th percentiles) of the first derivative of F0 as a measure of variability in the rate of change in F0 (adapted from Barbosa et al., 2017, Cavalcanti et al., forthcoming)
- **Tone rate**: Number of phonetically identified highs and lows in F0 contour normalized by speaking time (Cavalcanti et al., forthcoming)[12]

3.3 | Statistical analysis

The statistical analysis followed three approaches. First, cross-territorial differences in the pitch parameters between the five datasets were examined via a series of linear models,[13] one for each pitch parameter in each speaking style (see Meer & Fuchs, 2021, pp. 13–15 for a detailed description of reasons for this modeling strategy). Overall cross-territorial differences were tested for by including the main effect of TERRITORY. An effect for GENDER was added to control for (i) confounding physiological sex effects (Keating & Kuo, 2012) and (ii) sociolinguistic effects of gender on pitch parameters (Biemans, 1998).[14] We added an interaction term, TERRITORY*GENDER, since previous research has shown that different types and degrees of gender effects for pitch level, range, dynamism, and other parameters may be found across different languages and varieties (Cheng, 2020; Pépiot, 2014). Lastly, ARTICULATION_RATE was added as a covariate in the modeling of tone rate. This was done to avoid potential confounding effects, considering that, all else being equal, a higher articulation rate will lead to a higher tone rate. Articulation rate was operationalized as the number of phones relative to articulation time (excluding pauses; Gut & Fuchs, 2017). Table 4 presents an overview of all independent variables.

Second, we analyzed cross-territorial differences in the covariation of the parameters expressing variation in pitch (that is, excluding pitch level). Thus, we explored to what degree speakers across the datasets from the five territories may simultaneously have wide pitch ranges, very dynamic pitch, high rates of change, high variability in this rate, and a high tone rate. To that end, we first conducted a principal components analysis (PCA, using varimax rotation) to see how the different acoustic parameters covary and pattern overall. We then computed speaker-specific factor scores for the components extracted (using the regression method for the estimation of scores to maximize their validity; DiStefano, Zhu, & Mîndrilă, 2009) and examined cross-territorial patterns of covariation in the factor space.

TABLE 4 Independent variables and their levels

Models	Predictors	Levels
Section 4.1	TERRITORY	southern England, India Dominica, Grenada, Trinidad
	GENDER	female, male
	TERRITORY*GENDER	
Section 4.2	AGE	younger (13–25), middle (26–45), older (46–65)
	TERRITORY*AGE	
	LIVED_ABROAD	yes, no
	TERRITORY* LIVED_ABROAD	
	RURALITY	urban, rural
	TERRITORY*RURALITY	
Covariate (tone rate)	ARTICULATION_RATE	continuous

Third, we investigated socioprosodic variation in the Caribbean data by running a series of linear mixed-effects models. In line with previous research (Section 2), the following fixed effects were examined: AGE, LIVED_ABROAD, RURALITY, and their respective interactions with territory (Table 4). The effects of TERRITORY, GENDER, and TERRITORY*GENDER (as well as ARTICULATION_RATE in the case of tone rate) were included again to control for them during the analysis. Educational INSTITUTION was modeled as a random intercept[15] to take into account that speakers were (unequally) sampled from different schools and tertiary institutions.

The statistical analysis was conducted in SPSS 27. All linear models relied on maximum likelihood estimation, using the Satterthwaite method for degrees of freedom correction (Twisk, 2006, p. 29). The mixed linear models of socioprosodic variation in the Caribbean datasets were built in a (theoretically informed) manual backward elimination process, starting with a full model including the fixed and random effects specified above (Twisk, 2006, p. 82). Model fit was compared using the Akaike (AIC) and Bayesian information criteria (BIC). In the following sections, apart from observed measures of central tendencies, we report the means and confidence intervals estimated by the linear models for each fixed effect to control for confounding factors. Significant differences between these estimated means were investigated via Bonferroni-adjusted pairwise comparisons. Effects close to statistical significance are also reported to minimize Type II errors.

4 | RESULTS

4.1 | Cross-territorial comparison of pitch parameters

4.1.1 | Statistical modeling

Linear models revealed significant overall, gender-independent cross-territorial differences regarding almost all pitch parameters in both read and spontaneous speech (effect: TERRITORY; see Table 5). No significant overall effect was found for pitch range and tone rate in read speech and pitch dynamism in spontaneous speech; the main effect on pitch range in spontaneous speech is close to statistical significance ($p = .057$). Additionally, a significant main effect of GENDER was found on all pitch parameters in both speaking styles, and cross-territorial differences across the pitch parameters in both speaking styles are also mediated by gender (effect: TERRITORY*GENDER). However, the effect only approximates significance in the case of pitch dynamism in read and tone rate in spontaneous speech ($p = .074$ and $p = .116$).

TABLE 5 Summary of linear models (Type III tests of fixed effects) for pitch parameters in read and spontaneous speech

			Level (read)		Range (read)		Dynamism (read)	
	dfn	*dfd*	*F*	*p*	*F*	*p*	*F*	*p*
Intercept	1	285	10184.6	***	2439.4	***	4203.3	***
TERRITORY	4	285	16.2	***	1.0	.408	2.9	*
GENDER	1	285	567.4	***	11.8	**	26.9	***
TERRITORY*GENDER	4	285	12.0	***	3.6	**	2.2	.074
			Level (spont.)		**Range (spont.)**		**Dynamism (spont.)**	
	dfn	*dfd*	*F*	*p*	*F*	*p*	*F*	*p*
Intercept	1	285	11678.5	***	1416.5	***	2383.2	***
TERRITORY	4	285	17.7	***	2.3	.057	1.2	.322
GENDER	1	285	649.7	***	44.2	***	10.3	**
TERRITORY*GENDER	4	285	10.6	***	3.2	*	3.8	**
			Rate of change (read)		**Variability in rate of change (read)**		**Tone rate (read)**	
	dfn	*dfd*	*F*	*p*	*F*	*p*	*F*	*p*
Intercept	1	285	3053.4	***	3205.0	***	345.2	***
TERRITORY	4	285	4.5	**	3.9	**	0.9	.449
GENDER	1	285	240.2	***	267.0	***	22.9	***
TERRITORY*GENDER	4	285	6.9	***	7.3	***	7.0	***
ARTICULATION_RATE							11.6	**
			Rate of change (spont.)		**Variability in rate of change (spont.)**		**Tone rate (spont.)**	
	dfn	*dfd*	*F*	*p*	*F*	*p*	*F*	*p*
Intercept	1	285	1162.1	***	1549.3	***	828.9	***
TERRITORY	4	285	17.4	***	16.0	***	5.8	***
GENDER	1	285	70.1	***	117.9	***	12.7	***
TERRITORY*GENDER	4	285	4.4	**	4.8	**	1.9	.116
ARTICULATION_RATE							348.0	***

$p < .05$ (*), $p < .01$ (**), $p < .001$ (***)

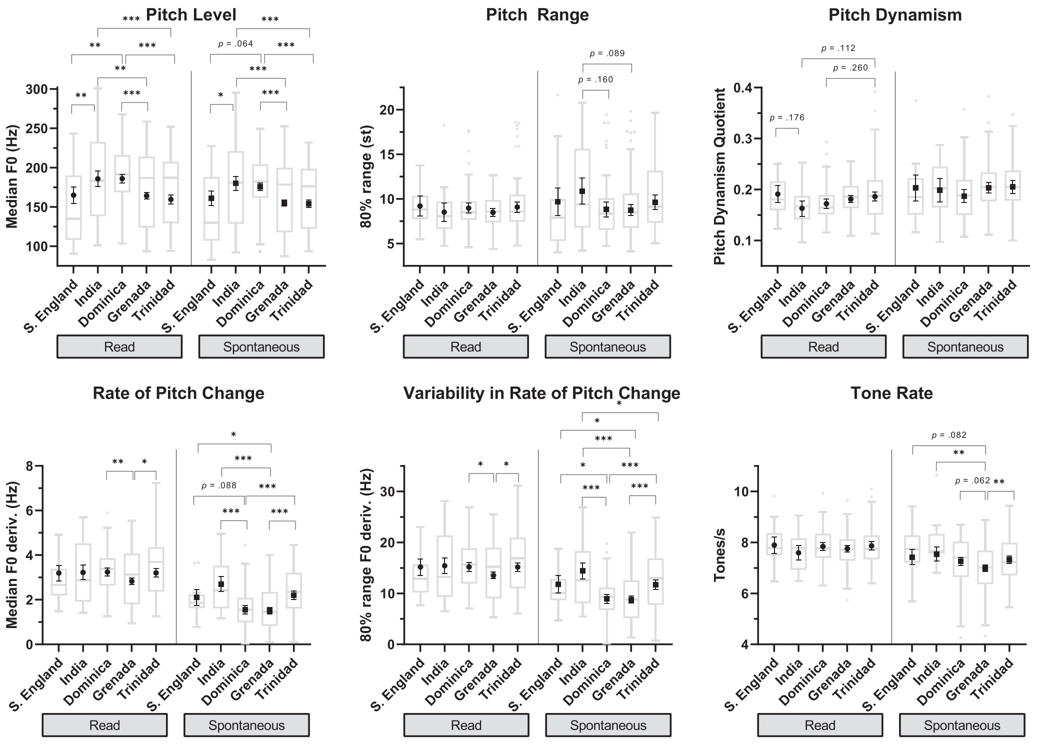

FIGURE 1 Overall cross-territorial comparison of pitch parameters in read and spontaneous speech. Estimated means and confidence intervals superimposed on Tukey boxplots of the observed distributions (medians as lines) for pitch level (median F0 in Hz), range (80% range in st), dynamism (pitch dynamism quotient), rate of pitch change (median F0 derivative in Hz), variability in rate of pitch change (80% range of F0 derivative in Hz), and tone rate (rate of phonetic highs and lows per second). Effect: TERRITORY. Levels of significance: $p < .05$ (*), $p < .01$ (**), $p < .001$ (***)

In the following sections, we explore the different effects and describe the observed variation in more detail.

4.1.2 | Territory

The cross-territorial differences are pitch parameter- and speaking style-dependent (see Figure 1). Pairwise comparisons across the parameters revealed that, overall, a greater number of significant between-territory differences exist in spontaneous speech and fewer ones in reading, with the exception of pitch level. Independently of speaking style, both India (read: 186 Hz, spont.: 180 Hz) and Dominica (read: 186 Hz, spont.: 176 Hz) have the highest mean pitch levels, followed by southern England (read: 165 Hz, spont.: 161 Hz), Grenada (read: 164 Hz, spont.: 155 Hz), and Trinidad (read: 159 Hz, spont.: 154 Hz) (see Figure 1 for the *p*-levels of the individual pairwise comparisons).[16]

Of the parameters expressing variation in pitch, both rate of pitch change and the corresponding variability metric show the greatest number of significant differences, followed by tone rate. Fewer significant differences exist concerning pitch range and dynamism. More specifically, the following style-specific tendencies exist with reference to read speech and spontaneous speech.

Read speech

In read speech, mixed patterns were found. With regard to dynamism, southern England shows the most dynamic pitch on average (pdq = 0.191), followed by Trinidad (pdq = 0.186), Grenada (pdq = 0.181), Dominica (pdq = 0.172), and

TABLE 6 Estimated means for female and male speakers for pitch parameters in read and spontaneous speech. Effect: GENDER

		Female	Male	*p*
Level	read	213 Hz	131 Hz	***
	spontaneous	204 Hz	126 Hz	***
Range	read	9.5 st	8.2 st	**
	spontaneous	11.2 st	7.9 st	***
Dynamism	read	0.193	0.164	***
	spontaneous	0.213	0.186	**
Rate of change	read	4.0 Hz	2.3 Hz	***
	spontaneous	2.5 Hz	1.5 Hz	***
Variability in rate of change	read	19.2 Hz	10.6 Hz	***
	spontaneous	14.2 Hz	8.0 Hz	***
Tone rate	read	8.0 tones/s	7.5 tones/s	***
	spontaneous	7.6 tones/s	7.1 tones/s	***

$p < .05$ (*), $p < .01$ (**), $p < .001$ (***)

India (pdq = 0.163), the only comparisons approaching significance being between southern England–India, Trinidad–Dominica, and Trinidad–India ($.3 > p > .05$; Figure 1). The pattern observed for pitch range resembles that for pitch dynamism in this style but did not reveal significant differences. For rate of pitch change and the associated variability metric, the pattern differs. The datasets from all territories have very similar and non-significantly different mean rates of change (3.2 Hz each) and associated variability in this rate (India: 15.4 Hz, Dominica: 15.2 Hz, southern England: 15.2 Hz, and Trinidad 15.1 Hz). The only exception is the Grenadian data, whose mean rate of change (2.8 Hz) and associated variability (13.5 Hz) are significantly lower than those of the Dominican and Trinidadian data (each at least at $p < .05$). Few (and non-significant) differences were found for tone rate.

Spontaneous speech

In spontaneous speech, an overall tendency exists such that, across all variability parameters with significant differences, India ranks highest, generally followed by both southern England and Trinidad, with Dominica and Grenada in the lowest position (Figure 1). Concerning pitch range, India has the widest range (10.9 st), followed by southern England (9.7 st), Trinidad (9.6 st), Dominica (8.8 st), and Grenada (8.8 st); only the differences between India–Dominica ($p = .160$) and India–Grenada ($p = .089$) approach significance. Regarding rate of change, pairwise comparisons suggest that the datasets cluster in two groups: (i) India (2.7 Hz), Trinidad (2.2 Hz), southern England (2.1 Hz), on the one hand, and (ii) Dominica (1.6 Hz) and Grenada (1.5 Hz) on the other hand. For variability in rate of change, the analysis suggests a similar but slightly different grouping: (i) India (14.4 Hz), (ii) southern England (11.8 Hz) and Trinidad (11.7 Hz), and (iii) Dominica (8.9 Hz) and Grenada (8.8 Hz) (see pairwise comparisons in Figure 1). Most cross-territorial differences for tone rate are subtle (India 7.5 tones/s, southern England 7.4 tones/s, Trinidad 7.3 tones/s, Dominica 7.3 tones/s), and only significant (or close to significance) in the case of comparisons with Grenada (7 tones/s).

4.1.3 | Gender

Across all datasets, female speakers have significantly higher mean pitch levels than male speakers (read: 63%, spont.: 62% higher; Table 6). Additionally, female speakers consistently show higher mean values for the pitch parameters expressing variability, particularly for (variability in) rate of pitch change but somewhat less for pitch range and dynamism and especially tone rate. All else being equal, female speakers have a higher rate of change (read: 74%, spont.: 67% higher), more variability in this rate (read: 81%, spont.: 78% more variable), a wider range (read: 16%, spont.: 42% wider), more dynamic pitch (read: 18%, spont.: 15% more dynamic), and slightly higher tone rates (read: 7%, spont.: 7% higher).

4.1.4 | Territory and gender

Different cross-territorial patterns exist within both gender groups (Figure 2). The data show overall more differentiated pitch patterns among female speakers, while more between-territory similarities were found in many cases in male speech. Additionally, these differences depend on speaking style, with different gender-mediated cross-territorial differences in read and spontaneous speech. In the following descriptions, we primarily scrutinize the more pronounced within-gender differences.

Male speech

For male speakers, the observed trends for pitch level mostly resemble the overall cross-territorial tendencies described above, in both speaking styles. Dominica (read: 163 Hz, spont.: 152 Hz) and, to a lesser extent, India (read: 134 Hz, spont.: 134 Hz) have the highest estimated mean pitch levels, followed by southern England (read: 121 Hz, spont.: 117 Hz), Trinidad (read: 120 Hz, spont.: 115 Hz), and Grenada (read: 119 Hz, spont.: 112 Hz) (see Figure 2 for *p*-levels of individual pairwise comparisons). The parameters expressing variability in pitch show rather mixed tendencies and subtle between-territory differences (Figure 2):

In male read speech, no significant cross-territorial differences were found for pitch range and dynamism. For rate of change, only the respective comparisons of Dominica (2.7 Hz) and southern England (2.5 Hz) to Grenada (1.5 Hz) were significant ($p < .001$). For variability in this rate, only the difference between Dominica (12.9 Hz) and Grenada reached significance (8.8 Hz, $p < .001$). Trinidad has the highest tone rate (7.9 tones/s); the other datasets mostly show lower and undifferentiated rates.

The patterns in male spontaneous speech match those in read speech. Few significant differences were found for pitch range and dynamism. Grenada has a significantly lower rate of change (1 Hz) than all other datasets ($p < .05$) except Dominica (1.4 Hz). The same pattern exists for variability in rate of pitch change. With regard to tone rate, together with India (7.6 tones/s), Trinidad (7.2 tones/s) again ranks highest compared to the other datasets.

Female speech

Among female speakers, relatively independently of speaking style, India (read: 238 Hz, spont.: 226 Hz) has the highest pitch level, followed by southern England (read: 209 Hz, spont.: 205 Hz), Dominica (read: 209 Hz, spont.: 199 Hz), Grenada (read: 209 Hz, spont.: 197 Hz), and Trinidad (read: 199 Hz, spont.: 193 Hz) (see Figure 2 for *p*-levels of individual pairwise comparisons). The parameters on variation in pitch show pronounced cross-territorial differences, usually with Trinidad and/or India having the highest degree of variability. Compared to the other Caribbean datasets, Trinidad consistently ranks in highest position, followed by Grenada and then Dominica, except for tone rate (see Figure 2). Specifically, the following style-dependent trends were observed:

In female read speech, Trinidad shows the highest mean pitch range (10.4 st). However, only the differences to Grenada (9.1 st) and Dominica (8.9 st) are statistically significant ($p < .05$). Similarly, Trinidad has the highest pitch dynamism score (pdq = 0.212); significant differences (or differences close to significance) were found compared to Grenada (pdq = 0.192, $p = .056$), Dominica (pdq = 0.182, $p < .01$), and India (pdq = 0.180, $p < .104$). Both India (4.4 Hz) and Trinidad (4.2 Hz) were observed to have the highest rate of pitch change. While the pairwise comparisons are not significant, the differences between Trinidad and Grenada (3.9 Hz, $p = .235$) and Dominica (3.7 Hz, $p = .068$) as well as India–Dominica ($p = .083$) approximate significance. The same pattern was found for variability in rate of pitch change, but between-territory differences are somewhat more pronounced. Both India (21.4 Hz) and Trinidad (20 Hz)

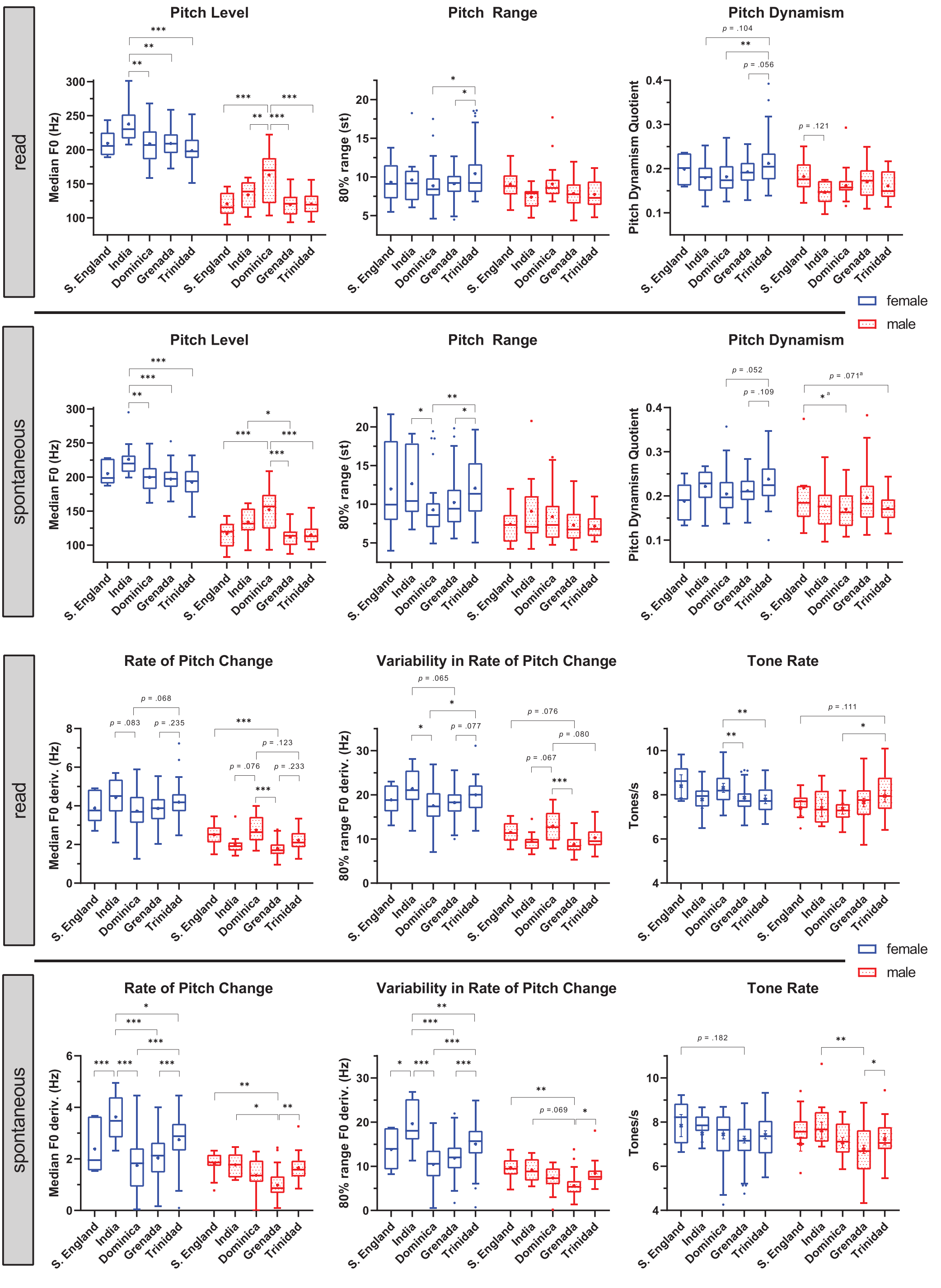

FIGURE 2 By-gender cross-territorial comparison of pitch parameters in read and spontaneous speech. Tukey boxplots of the observed distributions (medians as lines, means as dots). Estimated means and confidence intervals are shown for tone rate while controlling for articulation rate. Effect: TERRITORY*GENDER. Levels of significance: $p < .05$ (*), $p < .01$ (**), $p < .001$ (***) [Colour figure can be viewed at wileyonlinelibrary.com]

TABLE 7 Principal components analysis with varimax-rotated component loadings (values <0.4 suppressed)

		Component	
		Micro-variability in pitch (C1)	Macro-variability in pitch (C2)
Statistics	Eigenvalue	2.5	1.5
	Per cent of variance	49.9	29.7
Loadings	Rate of change	0.94	
	Variability in rate of change	0.92	
	Tone rate	0.63	−0.51
	Dynamism		0.84
	Range		0.81

demonstrate (near-)significantly more variability than Grenada (18.2 Hz) and Dominica (17.5 Hz), respectively (see Figure 2 for individual p-levels). A reverse trend was found for tone rate, such that India and Trinidad rank in lowest position. However, the only differences that reach significance are those between Dominica (8.3 tones/s) and Grenada (7.9 tones/s, $p < .01$) and between Dominica and Trinidad (7.8 tones/s, $p < .01$).

Female spontaneous speech generally shows similar cross-territorial tendencies. On average, female speakers from India (12.7 st) and Trinidad (12.1 st) have the widest pitch ranges, the only significant comparisons being the ones between Trinidad and both Grenada (10.2 st, $p < .05$) and Dominica (9.3 st, $p < .01$) as well as India–Dominica ($p < .05$). For pitch dynamism, Trinidad also ranks highest (pdq = 0.238), near-significantly higher compared to Grenada (pdq = 0.211, $p = .109$) and Dominica (pdq = 0.205, $p = .052$). The pattern for rate of pitch change is in line with that in read speech, but cross-territorial differences are more pronounced. India has a significantly higher rate (3.6 Hz) than all other datasets (Trinidad: 2.7 Hz, southern England: 2.4 Hz, Grenada: 2 Hz, Dominica: 1.7 Hz, each at least at $p < .05$). Trinidad shows a significantly higher rate of change than both Grenada and Dominica (each at $p < .001$). The significant pairwise differences and the overall pattern for variability in rate of pitch change match those of the rate proper (India: 19.7 Hz, Trinidad: 15.1 Hz, southern England: 13.8 Hz, Grenada: 11.9 Hz, Dominica: 10.4 Hz; see Figure 2). Little between-territory variation exists in terms of tone rate.

After exploring variation in each pitch parameter on its own, we now move on to the analysis of potential covariation of the parameters, for which the PCA revealed a two-component solution (eigenvalues above Kaiser's criterion of 1). Together, both components explain 79.6% of the total variance (Table 7). The first component (C1) includes rate of change, variability in this rate (each with a strong loading > 0.9), and tone rate. We call C1 *micro-variability in pitch* because all three parameters express relatively small-scale changes in pitch throughout the articulation of utterances. The second component (C2) comprises the parameters of pitch dynamism and pitch range (each with a strong loading > 0.8). Tone rate additionally has an intermediate negative loading onto this component, indicating that a wide range and very dynamic pitch are (somewhat) negatively correlated with tone rate. We call this component *macro-variability in pitch* because range and dynamism both account for global variability in pitch.

The aggregate analysis of all parameters revealed several territory-specific tendencies in terms of both micro- and macro-variability in pitch, most of them gender-dependent, which are shown in Figure 3 for read and spontaneous speech and across male and female speakers, based on speaker-specific factor scores for the extracted components. We here focus on an inspection of the style- and territory-specific scatterplots to take into account within-territory variation and overall distributional tendencies. To facilitate interpretation of the plots, we describe the patterns with a view to the four quadrants in the coordinate system. For instance, quadrant I indicates both high micro- and high macro-variability in pitch; quadrant III, by contrast, indicates both low micro- and low macro-variability.

While the results of the aggregate analysis generally reflect what was observed for the individual pitch parameters, they provide additional insights into between-territory differences that involve several parameters. Overall,

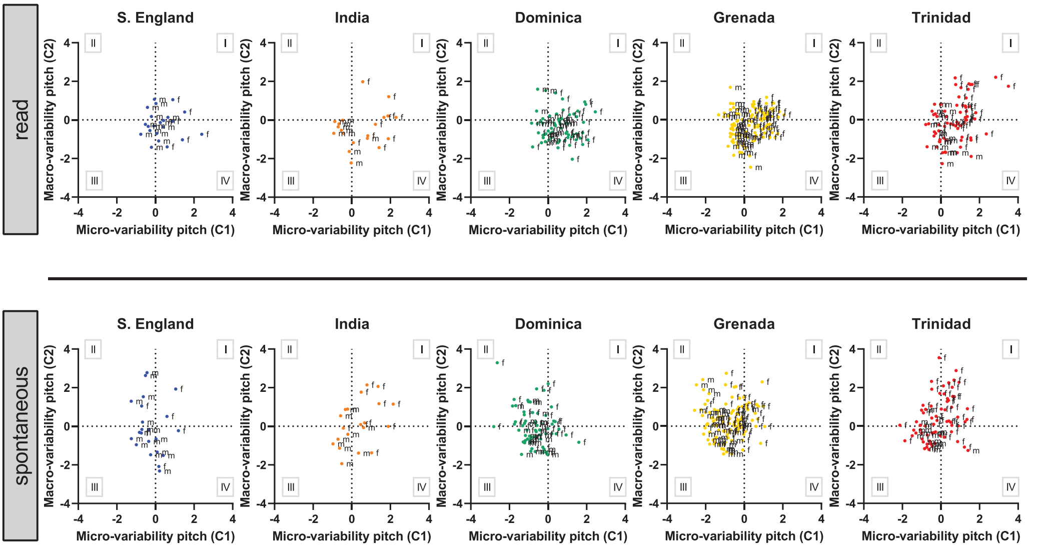

FIGURE 3 Cross-territorial covariation patterns in read and spontaneous speech across male and female speakers. Speaker-specific factor scores for the components extracted in the principal components analysis, micro-variability (C1) and macro-variability in pitch (C2), with point labels providing information on gender. Quadrant numbers shown [Colour figure can be viewed at wileyonlinelibrary.com]

few between-territory differences exist among male speakers. Relatively independently of speaking style, most male speakers across all datasets are located in quadrant III and thus show low micro- and macro-variability in pitch. Some male speakers from southern England further form part of quadrant IV, suggesting that a greater number of male speakers in this territory have higher micro-variability in pitch. A similar pattern exists among some male speakers from Dominica and Trinidad, but only in read speech. Additionally, among male speakers from southern England and Grenada, some individuals are located in quadrant II; these speakers have relatively high macro- but little micro-variability in pitch.

Female speakers from India and Trinidad are exceptional in that most of them are placed in quadrant I; they generally have high micro- and macro-variability in pitch. A secondary but nonetheless pronounced difference concerns the exact location of the speakers in this quadrant: While female Indian speakers show particularly high micro-variability (C1 score $>$ 1), there are more female Trinidadian speakers with particularly high macro-variability in pitch (C2 score $>$ 1). Female speakers from other territories generally either have low micro- and macro-variability in pitch (quadrant I) or show mixed patterns: Speakers from southern England are mostly located between quadrants I and IV, but the number of female southern English speakers is overall small and their placement in the factor space generally diverse. Dominican and Grenadian speakers are placed between quadrants I and IV in read speech but do not show higher levels of macro-variability in pitch (C2 score $<$ 1). In spontaneous speech, most Dominican and Grenadian speakers are located in quadrant II with higher levels of macro- but low micro-variability in pitch. Additionally, some Grenadian speakers are between quadrants I and IV.

4.2 | Socioprosodic variation in the Caribbean data

Having explored variation in pitch patterns across datasets and genders, we now move on to the analysis of socioprosodic variation in the three Caribbean datasets. The next subsection provides a brief overview of the results, after which each social variable is discussed in turn.

4.2.1 | Overview

Mixed-effects modeling showed a (near-)significant main effect of AGE on several pitch parameters, including level, range, dynamism, (variability in) rate of change (in spontaneous speech only), and tone rate (Table 8). The effect was shown to be mediated by territory in the case of pitch level (spontaneous speech only), range (read speech only), dynamism, and tone rate (effect: TERRITORY*AGE). Overall little variation was conditioned by LIVED_ABROAD, but (near-)significant effects were found for pitch range, dynamism, and rate of change, each in read speech only. Lastly, a difference between urban and rural speakers (from Grenada and Trinidad) was found for pitch level (in read speech), pitch range, (variability in) rate of change, and tone rate (in read speech) (effect: RURALITY). In most cases, the effect was mediated by TERRITORY*RURALITY.

4.2.2 | Age (and territory)

There are significant age-related differences in pitch level in read and spontaneous speech. Younger speakers have higher levels (read: 173 Hz, spont.: 164 Hz) than both middle-aged (read: 162 Hz, spont.: 153 Hz, each at $p < .01$) and older speakers (read: 148 Hz, spont.: 143 Hz, each at $p < .01$), who, in turn, do not differ significantly from each other.[17] Similar apparent-time trends can be observed across all pitch variability parameters where significant overall AGE effects were found. Overall, pitch range (in read speech), dynamism, and (variability in) rate of change (in spontaneous speech) decrease in apparent time (each at least at $p < .05$), with older speakers generally having the highest mean values, followed by middle-aged and younger speakers (see Table 9 for individual values). The exception to this trend is tone rate, which shows a tendency of increase in apparent time, at least when comparing older and middle-aged speakers. Furthermore, the overall AGE effect is mediated by the interaction of TERRITORY*AGE, such that most differences between age groups are not significant in Grenada and Dominica (except for pitch dynamism in the latter).

4.2.3 | Stays abroad

Independent of the territory, teachers with longer stays abroad were found on average to have a significantly narrower pitch range and less dynamic pitch in read speech than teachers that had always resided in their respective home territories (each at $p < .05$; see Table 10). They were further observed to have a lower rate of change in this style ($p = .070$). The respective effects of LIVED_ABROAD in spontaneous speech were not significant.

4.2.4 | Rurality and territory

The effect of RURALITY is mediated by territory. In Trinidad, urban speakers show significantly lower values with regard to pitch range, rate of change, variability in this rate (each in spontaneous speech), and tone rate (in read speech) than rural speakers (each at least at $p < .05$) (Table 11). No significant differences between urban and rural speakers were observed in Grenada.

TABLE 8 Summary of best-fit linear mixed-effects models (Type III tests of fixed effects) for pitch parameters in read and spontaneous speech. Effects reported while controlling for TERRITORY, GENDER, and TERRITORY*GENDER (not listed here, see Table 5)

	Level (read)				**Range (read)**				**Dynamism (read)**			
	dfn	*dfd*	*F*	*p*	*dfn*	*dfd*	*F*	*p*	*dfn*	*dfd*	*F*	*p*
Intercept	1	243	4025.5	***	1	243	1033.7	***	1	243	2261.1	***
AGE	2	243	10.6	***	2	243	3.5	*	2	243	6.1	**
TERRITORY*AGE					4	243	1.6	.165	4	243	1.3	.258
LIVED_ABROAD					2	243	4.0	*	2	243	3.7	*
(RURALITY)	1	18.1	4.0	.062	1	179	3.0	.087				
(TERRITORY*RURALITY)												
	Level (spont.)				**Range (spont.)**				**Dynamism (spont.)**			
	dfn	***dfd***	***F***	***p***	***dfn***	***dfd***	***F***	***p***	***dfn***	***dfd***	***F***	***p***
Intercept	1	243	4073.3	***	1	28.7	579.3	***	1	243	1330.2	***
AGE	2	243	9.7	***	2	234.3	1.4	.241	2	243	8.1	***
TERRITORY*AGE	4	243	2.6	*					4	243	1.0	.385
LIVED_ABROAD												
(RURALITY)					1	43.6	5.9	*				
(TERRITORY*RURALITY)					1	44.2	7.3	*				

(Continues)

TABLE 8 (Continued)

	Rate of change (read)				Variability in rate of change (read)				Tone rate (read)			
	dfn	*dfd*	*F*	*p*	*dfn*	*dfd*	*F*	*p*	*dfn*	*dfd*	*F*	*p*
Intercept	1	243	1908.2	***	1	243	3887.3	***	1	185.1	254.0	***
AGE									2	223.0	1.3	.288
TERRITORY*AGE									4	221.4	1.8	.134
LIVED_ABROAD	2	243	2.7	.070								
ARTICULATION_RATE									1	220.8	16.7	***
(RURALITY)					1	179	1.0	.328	1	18.1	3.8	.068
(TERRITORY*RURALITY)									1	18.6	8.5	**
	Rate of change (spont.)				**Variability in rate of change (spont.)**				**Tone rate (spont.)**			
	dfn	*dfd*	*F*	*p*	*dfn*	*dfd*	*F*	*p*	*dfn*	*dfd*	*F*	*p*
Intercept	1	243	461.1	***	1	243	653.2	***	1	243	578.2	***
AGE	2	243	5.4	**	2	243	6.6	**	2	243	5.2	**
TERRITORY*AGE									4	243	1.1	.369
LIVED_ABROAD												
ARTICULATION_RATE									1	243	287.1	***
(RURALITY)	1	179	4.0	*	1	179	4.2	*				
(TERRITORY*RURALITY)	1	179	2.2	.138	1	179	2.6	.107				

$p < .05$ (*), $p < .01$ (**), $p < .001$ (***)

TABLE 9 Estimated means for different age groups overall and across the Caribbean datasets for pitch parameters in read and spontaneous speech. Effects: AGE and TERRITORY*AGE. Trends in apparent time indicated for significant effects

			Older	Middle	Younger	*p*	Trend
Overall	Range	read	10.5 st	8.3 st	9.3 st	*	↓†
		spont.	10.6 st	8.9 st	9.1 st	.241	
	Dynamism	read	0.231	0.188	0.185	**	↓
		spont.	0.251	0.211	0.193	***	↓
	Rate of change§	read					
		spont.	2.1 Hz	2.0 Hz	1.7 Hz	**	↓
	Variability in rate of change§	read					
		spont.	12.1 Hz	11.2 Hz	9.4 Hz	**	↓
	Tone rate	read	7.4 t./s	7.8 t./s	7.8 t./s	.288	
		spont.	6.9 t./s	7.4 t./s	7.1 t./s	**	↑‡
Trinidad	Range	read	10.1 st	7.4 st	9.7 st	*	↓†
		spont.					
	Dynamism	read	0.243	0.186	0.188	**	↓†
		spont.	0.278	0.206	0.195	***	↓
	Tone rate	read	7.5 t./s	8.2 t./s	7.7 t./s	*	↑‡
		spont.	6.6 t./s	7.6 t./s	7.2 t./s	**	↑†
Grenada	Range	read	10.8 st	8.7 st	8.8 st	.347	
		spont.					
	Dynamism	read	0.201	0.190	0.190	.861	
		spont.	0.235	0.206	0.202	.444	
	Tone rate	read	7.3 t./s	7.6 t./s	7.7 t./s	.447	
		spont.	7.0 t./s	7.1 t./s	6.9 t./s	.234	
Dominica	Range	read	10.6 st	8.8 st	9.3 st	.620	
		spont.					
	Dynamism	read	0.248	0.189	0.178	*	↓
		spont.	0.239	0.219	0.182	*	↓
	Tone rate	read	7.5 t./s	7.6 t./s	7.8 t./s	.582	
		spont.	7.1 t./s	7.5 t./s	7.1 t./s	.243	

$p < .05$ (*), $p < .01$ (**), $p < .001$ (***)
†Not fully linear trend but difference between younger and middle-aged speakers not significant.
‡Not fully linear trend; middle-aged speakers in the lead, with the difference between younger and middle-aged speakers being significant.
§Overall AGE effect only. No significant interaction of TERRITORY*AGE.

5 | DISCUSSION

This study set out to provide a comparative phonetic analysis of pitch parameters in English language data from Dominica, Grenada, and Trinidad, drawing on a corpus of speech from 243 speakers. The study compared several parameters – pitch level, range, dynamism, rate of change, variability in rate of change, and tone rate – in read and

TABLE 10 Overall estimated means of teachers who had (not) previously lived abroad for pitch parameters in read and spontaneous speech. Effect: LIVED_ABROAD. Trends for significant effects indicated (abroad compared to not abroad)

		Not abroad	Abroad	*p*	Trend
Range	read	10.4 st	8.8 st	*	↓
	spontaneous				
Dynamism	read	0.216	0.200	*	↓
	spontaneous				
Rate of change	read	3.3 st	2.8 st	.070	↓
	spontaneous				

$p < .05$ (*), $p < .01$ (**), $p < .001$ (***)

TABLE 11 Estimated means of rural and urban speakers overall and in Grenada and Trinidad individually for pitch parameters in read and spontaneous speech. Effects: RURALITY and TERRITORY*RURALITY. Trends for significant effects indicated (urban compared to rural)

			Rural	Urban	*p*	Trend
Overall	Level	read.	164 Hz	154 Hz	.062	
		spont.				
	Range	read	9.9 st	9.0 st	.087	
		spont.	11.7 st	9.6 st	*	↓
	Rate of change	read				
		spont.	2.4 Hz	2.0 Hz	*	↓
	Variability in rate of change	read	15.0 Hz	14.3 Hz	.328	
		spont.	13.2 Hz	11.2 Hz	*	↓
	Tone rate	read	8.1 t./s	7.7 t./s	.068	
		spont.				
Trinidad	Range	read				
		spont.	14.2 st	9.9 st	**	↓
	Rate of change	read				
		spont.	3.0 Hz	2.3 Hz	*	↓
	Variability in rate of change	read				
		spont.	16.0 Hz	12.5 Hz	*	↓
	Tone rate	read	8.7 t./s	7.6 t./s	*	↓
		spont.				
Grenada	Range	read				
		spont.	9.2 st	9.4 st	.780	
	Rate of change	read				
		spont.	1.8 Hz	1.7 Hz	.606	
	Variability in rate of change	read				
		spont.	10.3 Hz	9.9 Hz	.664	
	Tone rate	read	7.5 t./s	7.7 t./s	.327	
		spont.				

$p < .05$ (*), $p < .01$ (**), $p < .001$ (***)

spontaneous speech recordings of students and teachers in secondary (and tertiary) education contexts across the three territories. Additionally, the study offered a comparison to standardized southern BrE and standardized IndE as well as an exploratory analysis of sociophonetic variation in prosody in the Caribbean datasets.

The findings provide empirical insights on whether a wide pitch range, or more generally a high degree of variability in pitch, are characteristic features of English in the Caribbean compared to non-Caribbean Englishes (RQ1), as has been claimed based on anecdotal observations (for example, Wells, 1982, pp. 573–575). These observations are not confirmed by our analysis, which did not indicate an overall wider pitch range or more variability in pitch in the Caribbean than the southern British or Indian data. Indeed, for none of the parameters expressing variability in pitch were there cross-territorial differences that would indicate a clear patterning of Caribbean vs. non-Caribbean datasets. Rather, the results suggest a high degree of between-territory prosodic differences. Across the parameters, the highest variability in pitch was generally found in the Indian and Trinidadian (and, to a somewhat lesser degree, southern British) data, in most cases without substantial differences between the former two. The observed similarities between the Indian and Trinidadian data might be linked to shared aspects in the intonational phonologies of both varieties and related former substrate influence (Gooden & Drayton, 2017; Maxwell, 2014; see Section 2.2). Dominican and Grenadian speakers tended to show smaller degrees of pitch variation, for instance with regard to pitch range or dynamism, but overall differences compared to Indian and Trinidadian (and southern British) speakers were in most cases only significant for rate of pitch change, variability in this rate, and, to a lesser degree, tone rate in spontaneous speech.

The observed differences between the Trinidadian data, on the one hand, and the Dominican and Grenadian datasets, on the other (RQ2), might be related to the popular stereotype of TrinE having a distinct 'sing-song' prosody among varieties of English in the region (Ferreira & Drayton, forthcoming, p. 30; Youssef & James, 2008, p. 334). The between-territory differences concerning parameters expressing variation in pitch may potentially be explained by understanding them as phonetic consequences of different underlying intonational phonologies in English spoken in the three islands: Accentual phrasing and frequent alternation between L* pitch accents and H boundary tones – a feature specific to TrinE (and TEC) likely due to historical crosslinguistic influence from Bhojpuri – may lead to higher variability in pitch on the phonetic level in English in Trinidad compared to Grenada and Dominica (Gooden & Drayton, 2017).

Crucially, however, the findings indicate a high level of gender-based prosodic variation in the Caribbean (RQ3). In accordance with previously observed gender-related, physiological and sociolinguistic effects on pitch parameters (for example, Keating & Kuo, 2012), female speakers showed overall higher variability in pitch across all parameters, independent of territory. The results further revealed that cross-territorial differences between Dominica, Grenada, and Trinidad are strongly mediated by speaker gender. There were generally mixed tendencies and only subtle differences among male Caribbean speakers. By contrast, among female speakers, cross-territorial variation was well-pronounced and consistent in that Trinidadians showed (significantly) higher degrees of variation in pitch with respect to range, dynamism, and (variability in) rate of change than Grenadians and Dominicans. An aggregate cross-territorial covariation analysis of all variability parameters using PCA confirmed these tendencies: The Trinidadian data was distinct in that female speakers showed high degrees of micro- and especially macro-variability in pitch (including compared to the southern British and Indian data). A possible reason for this trend could be seen in the interplay of sociophonetic variation and the underlying intonational phonology: While male and female Trinidadian speakers are both said to show accentual phrasing and the characteristic L* H alternation pattern at the phonological level (Drayton, 2013; Ferreira & Drayton, forthcoming; Gooden & Drayton, 2017), and do not differ substantially in a close acoustic correlate, tone rate, female Trinidadian speakers seem to be generally more expressive and varied in a phonetic sense (Biemans, 1998). Thus, while the characteristic intonational phonology of TrinE might be a pre-condition, the observed patterns highlight an additional sociophonetic component in female Trinidadian speakers leading in pitch variability.

The Caribbean data further show distinct types and degrees of sociolinguistic variation in prosody (RQ3). English in Trinidad is not only distinct in its high pitch variability (among female speakers), but also the socioprosodic patterns of variation that exist there. By and large, significant age-stratified variation did not occur in Dominica and Grenada;

the apparent-time change toward decreased pitch variability in terms of range, dynamism, and (variability in) rate of change was found to be limited to Trinidad. Similarly, urban-rural differences regarding the above parameters and tone rate were only significant in Trinidad but not Grenada. These findings extend previous observations on socio-prosodic variation in TrinE with regard to macro-variability in pitch and the factors of age and rurality (Meer & Fuchs, 2021) to parameters expressing micro-variability in pitch (rate of change, variability in rate of change, tone rate). It is likely that these findings are indirectly related to the specific sociolinguistic situation in Trinidad and corresponding changes in the prosody of TEC, such as earlier processes of ethnic convergence concerning accentual phrasing (Gooden & Drayton, 2017; Meer & Fuchs, 2021; see Section 2.2). While, over and above common gender-based differences, the findings seem to suggest a certain degree of similarity in English prosody in Dominica and Grenada, future research will have to investigate whether this still holds when further sociolinguistic variables are examined.

The present study has its limitations, and future complementary research would be needed to further elucidate the findings. The study observed an effect of LIVED_ABROAD in read speech but possible reasons for this are not clear. Apart from this, the findings on age-stratified variation are restricted by the limited number of speakers in the older age group. Furthermore, it would be desirable for future studies to analyze the intonational phonologies of English in Dominica, Grenada, and Trinidad (in line with previous research on selected Caribbean Creoles, see Drayton, 2013; Gooden & Drayton, 2017); this would provide a basis to verify (or falsify) the hypothesis that differences in the datasets from the different territories in terms of pitch variability at the phonetic level might be related to underlying differences in the intonational phonologies. Finally, research on the prosody of French Creole in Dominica would also be of interest for the present considerations; given the complete absence of prosodic research on this variety, potential influence on pitch parameters of English spoken in the island remains unknown.

6 | CONCLUSION

The study has shown that a wide pitch range and a high degree of variability in pitch, as mentioned in previous works, are not necessarily characteristic of English in the Caribbean overall, but that there are considerable cross-territorial prosodic differences, with English in Trinidad showing more variability than in Dominica and Grenada, particularly among female speakers. Socioprosodic variation, largely specific to Trinidad, was also identified. Thus we have not only extended previous prosodic research on English in Trinidad but added a wider Caribbean perspective that includes first findings on prosodic aspects of English in Dominica and Grenada, which should be fruitful to expand on in future research.

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ENDNOTES

[1] All demographic data were obtained from the CIA World Factbook <https://www.cia.gov/the-world-factbook/> (accessed September 22, 2021). The two islands of Trinidad and Tobago form a unitary state. However, as the present research has been conducted on the island of Trinidad and cannot be generalized to Tobago given its different sociolinguistic situation, we will only refer to Trinidad in the remainder of this paper.

[2] Another important factor is ethnicity (Leung & Deuber, 2014; Meer & Fuchs, 2021). However, ethnicity-based prosodic variation is not described here given that (i) the variable is specific to Trinidad and (ii) ethnic differences can almost only be observed regarding pitch level and much less so for measures of pitch variability (Meer & Fuchs, 2021), the latter being in focus in the present study. For a large-scale analysis, see Meer and Fuchs (2021).

[3] Virtually the same reading passage was used for elicitation of read speech across all datasets, but the passage in Dominica included slightly fewer words. Additionally, a few younger male students in the Dominican set were given a different, shorter reading passage in order not to overwhelm younger speakers and ensure reading fluency. This reading passage solely included declarative sentences except for one question.

[4] Dagmar Deuber and Véronique Lacoste recorded the Dominican, Eva Hänsel the Grenadian, and Philipp Meer the Trinidadian data.

[5] An analysis of the Trinidadian data compared to the British and Indian datasets is provided in Meer and Fuchs (2021).

[6] The younger group almost exclusively features students, but also seven (out of 188) teachers (two from Dominica, four from Grenada, one from Trinidad).

[7] Some students, especially in the Dominican and Grenadian (but not the Trinidadian) datasets spent the first months after birth (up until early toddlerhood) abroad. These cases were not considered here.

[8] The recordings were made in schools in the capital, Roseau, but there are also students from more rural locations in the surrounding areas and this information was not systematically elicited.

[9] While segment-level aligner performance may slightly vary, alignment quality at the utterance level can be considered comparable (Meer, 2020).

[10] On a technical level, measurement of F0 involved the conversion of audio data to a Praat manipulation object (parameters: time step 0.01 s; min. pitch 75 Hz for men, 100 Hz for women; max. pitch 300 Hz for men, 500 Hz for women) followed by the extraction of the pitch tier.

[11] Also commonly labeled coefficient of variation.

[12] Highs and lows were identified by a Praat script through conversion of individual utterances to a pitch object, followed by smoothing (threshold = 10), interpolation, conversion to a matrix and conversion to a PointProcess.

[13] It was not necessary to include SPEAKER as a random effect in statistical models throughout this paper given that each model only included a single datapoint per speaker.

[14] This research design, however, does not allow distinguishing anatomical and social effects. Articulatory phonetic research is needed to gauge the degree of the former.

[15] By-institution random slopes were not modeled, since their inclusion (examined in a forward manner; Twisk, 2006, p. 82) often resulted in non-convergence or reduced model parsimony.

[16] In the following sections, territory names are used as a shorthand for 'data from…' to simplify the description of the results.

[17] Pairwise comparisons showed that, by and large, differences between younger and middle-aged/older speakers are only significant in Dominica, at least in spontaneous speech. This might be the result of the sampling of students in each island: Students in Dominica were younger on average (M = 14.8 yrs., SD = 1.9 yrs.) than in Grenada (M = 16.7 yrs., SD = 3.3 yrs.) and Trinidad (M = 17.4 years, SD = 1 yr.). Given that these tendencies are likely related to age-dependent physiological differences, they are not further scrutinized here.

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