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The intonation patterns of Ibbi Yemeni Arabic: An acoustic phonetic study

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Abstract

This paper aimed at offering an acoustic linguistic phonetic description of the intonation patterns of Ibbi Yemeni Arabic (IYA) dialect in terms of tonal inventory, intonation systems and pitch movements associated with different grammatical patterns. Using a corpus of controlled spontaneous speech samples of four male speakers comprising 11 elicited grammatical patterns including declaratives, interrogatives, imperatives, exclamatives and vocatives, the three systems of IYA intonation: tonality, tonicity, tone were examined and identified. Data analysis was done both perceptually through phonemic transcription and acoustically using Praat programme (Boersma & Weenink 2023). The key findings showed that IYA has six tones: fall, low rise, high rise, fall rise, rise fall, and level tones. IYA is characterized by post-lexical nuclear accent and tonicity, a level tone in declaratives, narrow pitch range and accentuation which is unattested in other Arabic dialects, and more varied intonation patterns than Taizi Yemeni Arabic (TYA) and Sanaani Yemeni Arabic (SYA). The study outcomes situate the IYA dialect on equal footing with other colloquial Arabic dialects, highlighting differences in pitch contours for questions, statements, or emotional expressions, emphasizing cultural nuances of intonation to enrich communication competence.

Keywords: Acoustic Phonetics, Ibbi Yemeni Arabic, Intonation patterns, Tonality.

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أنماط التنغيم في اللهجة الإبّية اليمنية العربية: دراسة صوتية فيزيائية (أكوستيكية)

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الملخص:

هدَف هذا البحث إلى تقديم وصفٍ صوتيٍ فيزيائي لغويٍ يعتمد على المسح الطيفي لأنماط التنغيم في اللهجة الإبّية اليمنية من حيث عدد أنماط وأنظمة التنغيم، وحركات درجة الصوت المرتبطة بالأنماط النحوية المختلفة. وشملت بيانات الدراسة 11 عبارة كلامية شبه تلقائية لأنماط نحوية متعددة كالجمل الخبرية والاستفهامية والأمرية والتعجب والنداء تم استنباطها من محادثات لأربعة متحدثين ذكور من مدينة إب اليمينة بهدف تحديد الأنظمة التنغيمية الثلاثة (التقسيم النغمي للجمل الى أجزاء، والتركيز النغمي، ونوع نبرة التنغيم). وتم تحليل البيانات عبر الاستماع الصوتي والتجريبي باستخدام المسح الطيفي الاكوستيكي للأصوات باستخدام برنامج *Praat* إعداد وتصميم (Boersma & Weenink 2023)، وقد أظهرت النتائج أن اللهجة الإبّية اليمنية تضم ست أصناف من النغمات الصوتية: النغمة الهابطة، والصاعدة المنخفضة، والصاعدة المرتفعة، والهابطة-الصاعدة، والصاعدة-الهابطة، والمستوية. وتتميز هذه اللهجة بتركيز نغمي في أواخر الجمل، ومستوى نبر مستوي في الجمل الخبرية، ونطاق ضيق لمستوى تردد نغمة الصوت لم يسبق الكشف عنها في اللهجات العربية الأخرى، إضافةً إلى تنوعٍ أكبر في أنماط التنغيم مقارنةً بلهجتي تعز وصنعاء اليمنيتين، واستناداً إلى النتائج، تتضح مكانة اللهجة الإبّية على قدم المساواة مع اللهجات العربية العامية الأخرى، مع إبراز الاختلافات في تشكيلات درجة الصوت للأسئلة والجمل الخبرية أو التعبيرات التي تحمل في طياتها مشاعر متعددة، مؤكدةً على الدلالات الثقافية بأدق تفاصيلها للتنغيم تلعب دورا في تعزيز الكفاءة التواصلية.

الكلمات المفتاحية: علم الصوتيات الفيزيائي؛ اللهجة الإبّية اليمنية؛ أنماط التنغيم، التقسيم النغمي للجمل.

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1. Introduction:

Intonation, the linguistic use of pitch variations, duration and intensity in spoken language, is inevitable in speech (El Zarka, 2011; Tench, 1996). Deemed as the salt of utterances (Bolinger, 1972), it plays a crucial role in conveying meaning, attitudes and emotions, occupying central position in speech production and perception, and functioning at the heart of effective genuine communication and better intelligibility (Wells, 2006). Notably, in developmental linguistics, intonation is recognized as the earliest linguistic feature acquired by children during language development (Al-Khulaidi, 2018), preceding the mastery of lexical or syntactic structures. This suprasegmental phenomenon contributes to the perception as well as production of utterances, shaping the speaker's intention and helping the hearer to understand the purpose of the message, coupled with basic attitudinal, accentual, grammatical, and discourse functions (Allens, 1954; Collins & Mess, 2003). Universally across languages (including Arabic), intonation not only distinguishes different speech acts and sentence types (e.g., declarative, interrogative, imperative) but also encodes sociocultural nuances such as politeness, emphasis, and regional identity (Hellmuth, 2020).

Arabic, a diverse language with significant dialectal variation, serves as a vital locus for linguistic, sociolinguistic and phonetic research (El Zarka, 2017; Khalafallah et al., 2023) to understand its broader linguistic landscape (Alvarez & Issa 2020; Li et al., 2024). Nevertheless, further scholarly inquiry is yet to be systematically done with reference to intonation and its acoustic parameters of understudied Arabic dialects in terms of prosodic variations beyond words literal meanings. While some major Arabic dialects such as Egyptian Arabic (EA) (El Zarka, 1997, 2013a; 2017; Hellmuth, 2006; Rifaat, 2005a), Lebanese Arabic (LA) (Chahal, 2001; Chahal & Hellmuth, 2014), Jordanian Arabic (JA) (de Jong and Zawaydeh, 1999), Emirati Arabic (EmA) (Blodgett etal., 2007), Hijazi Arabic (HA) (Alzaidi, 2014), and Gulf Arabic have been extensively studied, regional varieties particularly those from Yemen - with the exception of Sanaani Yemeni Arabic (SYA) (Hellmuth, 2014) and Taizzi Yemeni Arabic TYA (Ali, 2000; Salim et al.,2020) - remain underrepresented in the literature. Among these, IYA, spoken in the Ibb Governorate of southwestern Yemen, presents a unique phonological and prosodic system shaped by its historical, cultural, and geographic isolation. Despite its linguistic distinctiveness, the intonation patterns of IYA have yet to be systematically analyzed, leaving a gap in both Arabic dialectology and the broader understanding of prosody in Semitic languages. This study aims to addresses this gap by undertaking the first preliminary acoustic phonetic analysis of intonation patterns in IYA in terms of basic tones based on the recorded data using auditory perception and acoustic correlational analysis. It seeks to describe and classify the intonation patterns of IYA, identify the acoustic parameters that distinguish different intonation categories and contribute to the documentation and understanding of Arabic

dialectal variation through comparing the findings of this study with prior research on Yemeni and other Arabic dialects

The study derives its importance from being one of the few acoustic phonetic descriptions of the intonation patterns of IYA dialect to take its due place among Arabic dialects. The significance of this work is manifested in multiple ways. Situated at the intersection of phonetics, sociolinguistics, and Arabic dialectology, this study's outcomes will yield a key acoustic profile of IYA intonation, while also informing broader discussions on the role of prosody in dialectal differentiation, and advancing theoretical debates on the universality of prosodic systems, particularly whether shared syntactic structures across Arabic dialects (e.g., verb-subject-object word order) correlate with similar intonational realizations. For linguists, educators, and language planners, the study underscores the necessity of integrating suprasegmental features into dialect documentation and revitalization strategies. Ultimately, by illuminating the melodic architecture of IYA, this work seeks to amplify the visibility of understudied dialects in global linguistic scholarship. With this in mind, the present study attempts to find answers to the following questions:

1. What are the characteristic pitch contours (e.g., rising, falling, plateau) associated with declaratives, interrogatives, and imperatives, and other illocutionary exclamative, vocative, warning acts in IYA?

2. To what extent do IYA intonation patterns align with or diverge from those documented in other Yemeni or Arabic dialects?

2. Literature Review

2.1. Intonation: Key aspects & Functions

In the context of linguistics, intonation is a multifaceted aspect of speech that involves variations in pitch, stress, and pauses to convey meaning, emotion, and structure in spoken language (Frota, 2016; Mukumbek, 2021). It is a crucial aspect of prosody, which encompasses all suprasegmental features of speech, including pitch, duration, amplitude, and voice quality. Often used interchangeably with prosody, intonation specifically focuses on the melodic aspect. It involves the phonologically structured variation in phonetic features, primarily pitch, to express phrase-level meanings (Xu, 2019).

In contrast to the arbitrary nature characteristic of segmental phonology, intonation operates as a predominantly iconic system, largely aligned with inherent mechanisms of speech production and auditory perception (Gussenhoven, 2004). Its primary roles encompass the conveyance of emotional states and speaker attitudes. Nonetheless, intonation also fulfills a significant structural linguistic function. Chief among these is its capacity to organize the information communicated by the speaker, thereby facilitating the listener's cognitive processing. Specifically, prosodic phrasing segments the continuous speech stream into cognitively manageable units that semantically cluster related elements. Additionally, intonational

accentuation serves to highlight salient or newsworthy information by enhancing the prominence of particular segments within the utterance. A further well-documented linguistic function of intonation involves the differentiation of sentence types - such as declaratives and interrogatives - primarily through tonal modulation, utilizing pitch contours characterized by rises and falls (El Zarka, 2017).

2.2. British School of Intonation: Halliday's Systemic Functional Linguistics (SFL) and Intonation Model

Intonation systems have been a significant area of study within linguistics, particularly within the framework developed by Halliday and the British School. Halliday's systemic functional linguistics (SFL) provides a comprehensive approach to understanding how intonation functions within the broader system of language (Aso et al., 2020). The British School, known for its contributions to phonetics and phonology, has also significantly contributed to the study of intonation

Halliday's SFL views language as a resource for making meaning, emphasizing the relationship between language and its functions in social contexts (Pavlova & Freydina, 2020). In SFL, intonation is not merely a superficial aspect of speech but an integral part of the grammar, contributing to the overall meaning of an utterance. Halliday's work, particularly "Intonation and Grammar in British English" (Peng, 2015; Sypacheva & Shamina, 2024) laid the groundwork for understanding how intonation patterns in British English convey different meanings. The key aspects of Halliday's approach to intonation include tones and the three intonation systems of tonality, toncity and tone. As for tones, Halliday identified a set of basic tones in English, each associated with a specific meaning. These tones, such as falling, rising, and fall-rise, signal different communicative functions, including statements, questions, and expressions of surprise or uncertainty (Liu & Reed, 2021). Concerning tonality, tonicity, and tone, Hallidayan intonation analysis involves the identification of the tonic syllable (the most prominent syllable in an intonation unit), the tone (the pitch movement on the tonic syllable), and the tonality (the division of speech into intonation units) (Erteschik-Shir, 1999). Tonality refers to the segmentation of spoken discourse into discrete intonation units (Erteschik-Shir, 1999).

2.3. Arabic Language

The landscape of Arabic, encompassing both its standard and dialectal forms, represents a vibrant and essential area of linguistic and phonetic inquiry. This field is characterized by its structural complexity, rich evolutionary history, and the ongoing efforts to adapt it to the digital age through advancements in Natural Language Processing (NLP) and Artificial Intelligence (AI) (Alnosairee & Sartini, 2021; Hashem, 2021; Rifaat, 2021). Arabic exhibits a diglossic nature, with Modern Standard Arabic (MSA) serving as the formal, written language and a multitude of dialectal Arabic (DA) varieties used in everyday spoken communication (Habash

et al. 2012; McCulloch 2018). This dichotomy creates a fascinating area of study, exploring the relationship between MSA and the various dialects, their mutual influence, and the challenges they pose for natural language processing (NLP) (Alnajjar & Hämäläinen 2024; Hashem 2021; Zahir 2022). Arabic phonology, with its 28 consonant phonemes and a varying number of vowel phonemes across dialects, offers a rich ground for phonetic analysis (Alqarhi 2019). Instrumental studies in Arabic phonetics have utilized acoustic and articulatory methods to investigate various aspects, including syllable structure, assimilation, and the unique characteristics of guttural and emphatic consonants. Dialectal Arabic differs significantly from MSA in phonology, morphology, lexicon, and syntax, making it essential to develop dialect-specific resources and NLP systems (Althobaiti, 2021; Habash et al., 2012). Figure 1 below depicts Arabic standard and dialectal landscape concisely.

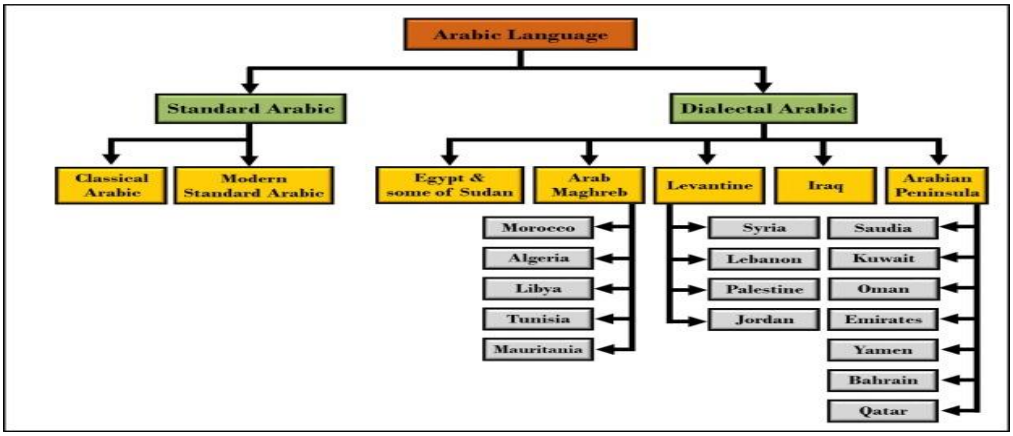


Figure 1 Arabic Language Standard and Dialectal Landscape adapted from Khalafallah et.al. (2023)

A close look at Figure 1 above reveals that Yemeni Arabic is situated in its geographical distribution among Gulf dialects in the Arabian Peninsula, and may have some intonation patterns in common with those dialects.

2.4. (Ibbi) Yemeni Arabic dialect

Yemeni Arabic, similar to other regional Arabic vernaculars, has been relatively understudied in linguistic scholarship. While certain Yemeni dialects, including Sana'ani, Adeni, and Hadrami, have garnered some academic scrutiny, the Ibbi dialect, with the exception of (Alfaifi & Qasem, 2024; Alshawsh & Shormani, 2025; Shormani, 2019) linguistic accounts, remains markedly under-researched. Spoken in the historic urban center of Ibb, this dialect exhibits distinctive linguistic properties that distinguish it from Modern Standard Arabic (MSA) and neighboring regional varieties, a divergence rooted in its sociohistorical and cultural milieu (Al-Wer & de Jong, 2011). Phonologically, the Ibbi dialect diverges from MSA through distinct vowel realizations and consonantal articulations, shaped by localized phonetic evolution and historical linguistic

shifts. These phonological features not only define its auditory profile but also underpin its role in preserving oral traditions within the community.

Alfaifi & Qasem's (2024) study of Yemeni Ibbi Arabic (YIA) acquisition analyzes phonological substitution errors (e.g., fronting, backing, lateralization) in three monolingual children (1;9–3;6 years). Grounded in phonological acquisition theory, the research examines these patterns through the lens of consonant acquisition stages, the substitution Phonological Pattern (sPP) hypothesis, markedness, and Natural Phonology. Findings indicate substitutions reflect developmental challenges tied to specific acquisition phases and articulatory complexity. The data empirically support the sPP hypothesis, demonstrating children's strategic adaptations, and align with markedness principles by showing a preference for less complex phonological structures. This contributes evidence on the interplay of universal developmental tendencies and language-specific patterns in Arabic acquisition.

Lexically, the Ibbi dialect incorporates region-specific terminology reflective of indigenous cultural practices, ecological knowledge, economic activities, and historical contact with adjacent languages and societies (Al-Jurafi, 2005). This lexical inventory is further enriched by borrowings and hybridized terms, a testament to cross-cultural exchange, which imbue expressions with contextual nuance. Syntactically, the Ibbi dialect employs grammatical configurations and sentence structures that deviate from MSA norms, including variations in word order, clause construction, and pronominal usage, which collectively shape its discourse patterns and communicative strategies (Al-Wer, 2007). Such syntactic divergences highlight the dialect's autonomous structural conventions relative to formal Arabic registers.

A comprehensive analysis of these phonological, lexical, and syntactic features is essential for elucidating the dialect's cultural significance and communicative functions. Systematic investigation into these linguistic dimensions not only advances understanding of intra-Arabic dialectal diversity but also illuminates the sociocultural dynamics unique to Ibb's historical urban context. Such scholarship enriches broader Arabic dialectological studies, offering critical insights into the interplay of regional linguistic variation and identity formation.

2.5. Acoustic phonetics and analysis of intonation

Acoustic phonetics is a subfield of phonetics that focuses on the physical properties of speech sounds. It involves the study of sound waves generated during speech production and their acoustic characteristics, using instruments to analyze these sound waves (Neel, 2010). This field is essential for understanding how speech is produced, transmitted, and perceived (Tavakoli et al., 2024). Utilizing visual representations of sound waves to measure and relate them to phonetic features and the physiological components of speech production (Chuang et al., 2021), the key areas within acoustic phonetics include two important stages. The

first is speech production which is concerned with analyzing the anatomy and physiology of speech organs, articulatory phonetics, and the acoustic theory of speech production (O'Shaughnessy, 2013). The second stage is acoustic analysis, Studying the acoustic properties of vowels, consonants, and suprasegmental features like intonation. Acoustic analysis plays a crucial role in the study of intonation (McLarty, 2018). Researchers use various tools and techniques to measure and analyze pitch, duration, and other acoustic parameters of speech which allow for detailed examination of intonation patterns in different varieties of English and other languages (Frances et al., 2025).

2.6. Previous studies

Prior literature on the intonational patterns of spoken Arabic dialects is limited, but in recent years a growing number of descriptions of individual dialects have been published. In the context of Arabic dialects intonation variations, considerable research has been done. The following are some key studies. A study by Abbas and Jun (2021) proposes an Autosegmental-metrical model of intonational phonology of Farasani Arabic, an under-documented dialect of Arabic spoken in the Farasan Islands, Saudi Arabia. Tonal patterns of utterances, produced in neutral and narrow focus contexts, were examined by varying the length of a word and a phrase, the location of stress, syntactic structures, and sentence types. Results suggest that Farasani Arabic has three prosodic units higher than a word: Intonational Phrase > Intermediate Phrase > Accentual Phrase (AP). An AP is defined by a rising tonal pattern, [L Ha], without including a pitch accent, even though the language has stress. This is unique among Arabic dialects and also typologically unusual. So far, only a few languages (e.g., Kuot, Uyghur) have been claimed to be an exception to the association between stress and intonational pitch accent. (El Zarka, 2017). A further unique feature of Farasani Arabic is that a pitch accent (H*) does occur on the stressed syllable of a word when the word is emphasized.

Alzaidi et al. (2023) conducted an acoustic and computational modeling study of intonation in Emirati Arabic (EmA), revealing distinct prosodic encoding of focus types: contrastive focus triggers pitch excursion expansion, lengthening, and intensity increase in focused words, while information focus does not. Both focus types induce prosodic reduction (lowered pitch and intensity) in post-focus words and compression (reduced pitch range and duration) in pre-focus words. Their model further demonstrates that EmA intonational contours are governed by an interplay of information structure (focus type/position) and prosodic hierarchy (lexical stress, syllable weight, prosodic word structure). Perceptual validation confirmed that synthetic contours replicating these patterns were functionally adequate in conveying focus and perceived as highly natural, supporting the theoretical account of multi-factor prosodic organization in this understudied dialect.

In the local context, Yemeni Arabic intonation descriptions are scarce and incomprehensive by nature. Ali (2000) reports that intonation of Yemeni Arabic with reference to Taiz dialect is characterized by the following: the nuclear word is at the end of sentence; falling tone is used with statements, wh-questions, commands, exclamations, warnings and re-assurances; rising tone is used in question tags only and fall rise tone is used in yes-no question. No reference has been made to level tones at all and to rising falling tone in exclamations.

In her study, Hellmuth (2014) provides a first description of the intonational patterns of San'aani Yemeni Arabic (SYA), the dialect of Arabic spoken in the capital of Yemen) and a comparison of these patterns with those observed in Cairene Arabic (CA), revealing differences between the two varieties which mirror cross-linguistic prosodic variation. The SA analysis is based on qualitative transcription of portions of a multi-level corpus, including read speech sentences, a narrative retold from memory and a sociolinguistic data collection tool which yields free conversation data in the desired variety as well as information that can be used to confirm which variety is being used. Key findings revealed SA has a larger pitch accent inventory than CA and that the distribution of pitch accents is sparser in SA than in CA. SA has a rising-falling tone in yes-no interrogatives.

Another study by Salem and Pillai (2020) offers an Acoustic Analysis of Intonation in the Taizi variety of Yemeni Arabic. Data were elicited from 30 female TYA speakers from two age groups: 20 to 25 years and 60 to 65 years old. The fundamental frequency (F0) of global and local contours of utterances in two main different speaking contexts were analysed: read text and more spontaneously produced speech. The latter included (i) talking about one of the topics assigned to them, and (ii) producing interrogatives. The findings revealed that statements found to display global and local F0 declining patterns, whereas yes/no questions showed a global F0 increase and a local declination.

The above studies addressed specific Arabic dialects and two Yemeni Arabic dialects using controlled speech and constrained methodology. The distinctiveness of IYA has not been examined in terms of prosody and intonation patterns. Hence, the need for this study is well grounded.

3. Methodology:

3.1. Research design

The study adopts a mixed quantitative (acoustic measurements) qualitative (context-based interpretation) research design and framework which is descriptive and exploratory in nature and uses phonemic approach and acoustic evidence as a method for analyzing the intonation patterns of Ibbi speakers of Yemeni Arabic. Methodologically, the study leverages acoustic analysis to quantify prosodic features mainly fundamental frequency (F0), duration, and intensity. Speech data is elicited through

controlled tasks (e.g., spontaneous interactions and role-plays), ensuring a balance between validity and experimental rigor. Data was validated by inter-rater experts both perceptually and instrumentally to ensure consistency. Recordings are analyzed using Praat, a software tool for speech visualization, and annotated according to Halliday intonation framework, adapted to accommodate dialect-specific features.

3.2. Participants

Eight native speakers of Ibb dialect of Yemeni Arabic were recorded initially over a period of two weeks. The speech samples of four speakers only were selected while the four others were excluded due to noise and too much artificial rendering of utterances. All speakers, aged between 25 to 33 years, were males with no exception, all living in the city of Ibb, Yemen for the last 27 years. Speakers were recorded in more than one session without being aware of being recorded. They were divided into pairs and their spontaneous conversations on given topics were recorded. None of the speakers reported any speech problem.

3.3. Recording

Utmost care was taken during the process of recording since the study is based on recorded data. The speakers were recorded in quiet surroundings. The researcher personally recorded all speakers in different settings depending on their convenience. A sampling frequency of 44100 KHz was used,16 bits depth and stereo channel. A Sony voice recorder model A1428 was used for recording the four speakers. The method used for recording and analyzing the speech of the speakers was as follows: each pair of speakers initiated spontaneous conversations with one another on various daily common topics in a quiet room for about 20 minutes. From these recordings of spontaneous speech, random utterances representing different grammatical patterns were selected. These included statements, questions of wh-type and yes-no type, commands, exclamations, vocative, and warnings. Then the recordings were converted into a wave format in the Phonetics lab of the English and Foreign Languages University, Hyderabad, India. Prior official permission was obtained from the university.

3.4. Analysis of Data

The data analysis was based mainly on auditory perception and acoustic evidence, after listening to the utterances chosen a quite enough number of times. Phonemic transcription was followed while analyzing the data on the basis of auditory impression. The recordings were later transcribed and marked in terms of tone group division, tonic placement and choice of tones. Each transcript was analyzed several times to ensure consistency. A part from that, a quantitative analysis of the acoustic cues of fundamental frequency range of each speaker was made by means of Praat software(Boersma & D, 2023). The pitch movement variations for each grammatical pattern were described in relation to the attitudes of the speaker. The analysis procedure is basically phonemic and also in part makes use of Halliday's (1967,1970) model in terms of tonality, tonicity

and primary tone identification as well as low rise tone. On the other hand, the analysis was auditory-based and adopts the model proposed by Roach (2000), in which intonation has five basic tones: falling, rising, level, falling-rising, and rising-falling. These five tones have an essential role in shaping the meaning of utterances. The falling tone is that type of tone which descends from a higher to a lower pitch and this fall gives an impression of "finality". The rising tone as well as the low rise is "a tone movement from a lower pitch to a higher one which is generally used to state non-finality". The level tone can be produced when the pitch remains at a constant level; it means that there is no pitch change that accompanies the production of utterances. In addition to these simple tones, there are two complex tones which are the falling-rising tone which "consists of two pitch movements fall and then rise. It may occur on a single syllable in the case of a tail after the tonic-syllable", and the rising-falling tone which "consists of a rise followed by a fall and it may occur on a single syllable or may extend over more syllables if the tonic-syllable is followed by a tail" Roach (2000, pp. 170-172). A description of major pitch movements is given relative to other pitch movements in the utterance. The fundamental frequency range as well as the position of the tonic was provided with acoustic evidence for each utterance.

4. Results

The results of this study are classified into three aspects: the distinctive intonation patterns and tonal inventory of IYA as illustrated in Table 1. below. Then the intonation variations for each grammatical illocutionary act category was identified. Finally, findings of IYA are compared to previous research work done on Arabic and Yemeni Arabic dialects. The data analysis uncovered key distinctive acoustic features of IYA Intonation system as illustrated in Table 1. Below

Table 1

Acoustic Features of IYA Intonation system patterns & Tonal Inventory

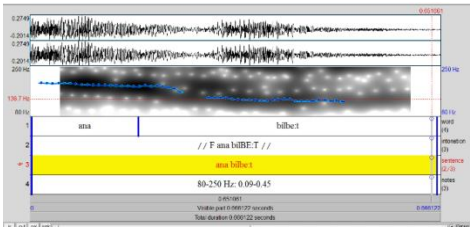
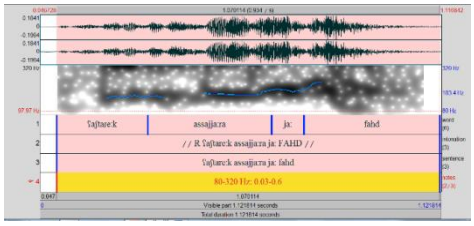
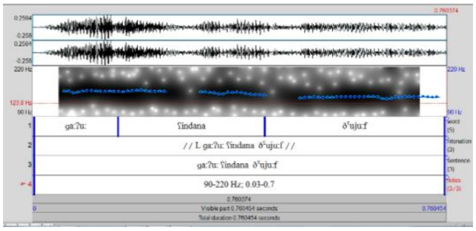
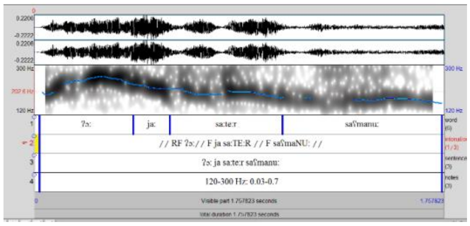
Figure 1. Falling tone, declarative //ﷺ F ana bilBE:T // S3 "I am at home".  Pitch range F0 =St. 210 Hz – End. 110 Hz	Figure 2. Rising tone, Yes-no Interrogative //ﷺR ☆a♦tare:k assajja:ra ja ﷺ //S1 "Have you bought the care Fahd?"  Pitch range F0 = St.105 Hz -200 Hz

Figure 3. Level tone – plateau, declarative // L ✇ ♑♋:✍u: ✰indana ✎🕛uju:f // S3 " Guests came to our house".



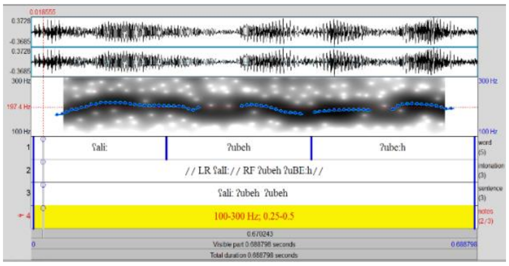
Pitch range F0 =St. 135 Hz – End. 134 Hz

4. Figure 4. Rising-falling tone, exclamative // RF ✓ ✍u: // F➩ ja sa:te:r // F➩ sa✰manu: // S4. " Oh! My God! How big it is!"



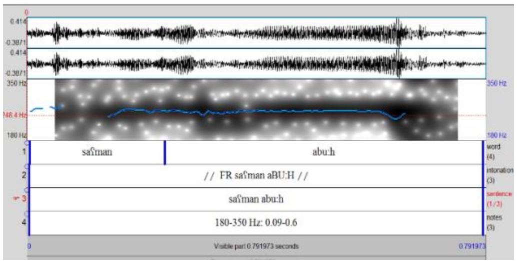
Pitch range F0 =St. 202 Hz – Peak= 280 Hz- End. 210 Hz

Figure 5. Low rise tone, Vocative // LR✍ ✰ali: // ✓ ✍ubeh ✍ube:h // S2. " Ali, attention attention"



Pitch range F0 =St. 175 Hz – End. 205 Hz

Figure 6. Falling-rising tone, Exclamative // FR ☒ sa✰man abu:h // S1. " How big it is!"



Pitch range F0 =St. 158 Hz – Min.= 230 Hz- End. 150 Hz

Responding to the first question of the study: What are the characteristic pitch contours (e.g., rising, falling, plateau) associated with declaratives, interrogatives, and imperatives, and other illocutionary exclamative, vocative, warning acts in IYA?, acoustic analysis of the data indicate that IYA has six distinctive tones: falling, high rising, low rising, falling rising, rising falling, and level tones as illustrated in Table 1 above. Additionally, answers to the second question: To what extent do IYA intonation patterns align with or diverge from those documented in other Yemeni or Arabic dialects? are provided in the results and discussion where tonal variations were perceived in the majority of the grammatical patterns elicited from the study data. These variations are depicted in Table 2 below

Table 2

showing grammatical patterns and tonal variations of IYA compared to Arabic & YA dialects

Grammatical pattern	Tone	Conformity to ADs	Divergence from Ads
Declarative	Falling	LA, EA, HA, SA, KA, JA	KA, MA
	Level		LA, EA, HA, SA, KA
Interrogative (wh)	Falling	LA, EA, HA, SA, KA, JA, TA	

	Rising	KA	
Interrogative (yes-no)	Rising	LA, EA, HA, SA, KA, JA	SA
	Falling-rising	TA, EA	
Imperative	Falling	EA, KA, MA	
Exclamative	Rising-falling	EA	
	Falling	EA, KA, MA, TA	
	Falling-rising		LA, EA, HA, SA, KA, JA, TA
Vocative	Low-rise	LA, JA, MA, EA	
Warning	Rising-falling	?	?

From Table 2 above, it is observed that seven grammatical patterns were investigated in the study data elicited from controlled spontaneous dialogue role-plays by four Ibbi Yemeni Arabic natives. The intonation features varied in four grammatical classes: the declaratives, interrogative (wh), interrogative (yes-no) and the exclamative. There was no intonation variation in imperative, vocative and warning illocutionary acts.

5. Discussion

- **Declarative sentences**

Two declarative utterances were selected and acoustically analyzed here. The first sentence // F ana bilbe:t // " I am at home" showed neutral tonality (default pause one tone group), neutral tonicity (focus on last content word 'be:t') and neutral tone -falling tone associated with declaratives, implying finality and assertion. The pitch range is about 100 Hz falling from 210 Hz into 110 Hz. In terms of tonality, this declarative in IYA aligns with the fact that prosodic boundaries (tone groups) coincide with syntactic constituent boundaries (El Zarka, 2011) and with Hellmuth (2016) findings on EA where the dominant pattern was not to produce a phrase boundary after the subject in SVO sentences, unless the subject is heavy or needs emphasis, in sharp contrast to JA where Jordanian speakers routinely produced phrase break even after light subjects. As for tonicity and prominence, the above declarative shows prominence peak of the penultimate word /BE:T/. This finding diverges from Cangemi et al. (2016) where IYA showed no significant contrastive and non-contrastive focus as MA and KA. The tone used in the above sentence is a gradually declining contour, falling, similar to findings reported by (Alharbi, 1991; Alzaidi, 2014; Chahal, 2001; Hellmuth, 2006; Mitchell, 1993; El Zarka, 1997; Rifaat, 1991), on KA, EmA, EA, HA, LA.

On the other hand, declarative 2 // L ga:u: indana uju:f // S3 " guests came to our house", shows a neutral tonality where a syntactic constituent coincides with one prosodic IP boundary without pauses as shown by El Zarka (2011). The above sentence has a changed VS order and shows marked tonicity where focus is

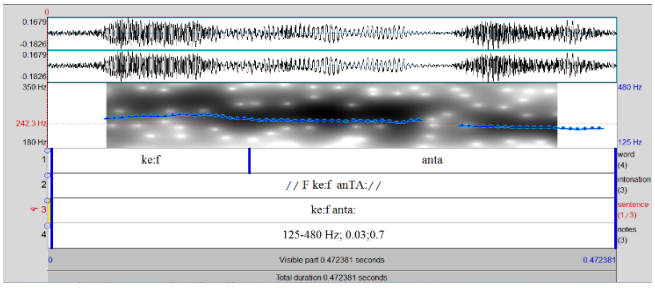
shifted to first word / ga:ʔu / 'came'. Like English, IYA shares change of focus with the possibility of changing nucleus location (Mitchell, 1993) and other Arabic dialects as JA (Rammuny, 1993), LA (Chahal, 2001), KA (Alharbi, 1991) and EA (El Zarka, 2013a). This marked tonicity comes in sharp contrast with Cangemi et al. (2016) where Yemeni Arabic YA showed no significant contrastive and non-contrastive focus as Moroccan Arabic MA and Kuwaiti Arabic KA, and also with Ali (2000) on Taizi Yemeni Arabic where findings indicated prominence in last lexical word only. IYA tonic syllable is not always at the last lexical item; it shifts to initial lexical element in a changed word order. The tone used is a marked one – level tone – implying less involvement and interest on the part of the speaker. This finding diverges form all previous intonation accounts across Arabic and Yemeni Arabic dialects. Level tone has not been yet attested and is a distinctive feature of IYA intonation. The acoustic characteristics of this distinct IYA level tone are illustrated in Figure No. 3 in Table 1. A level stretch extends all over the utterance with a pitch range starting at 135 Hz and ending in 134 Hz, in sharp contrast to Benkirane's (1985) findings on MA where level stretch is extends until the rise-fall nuclear pitch is realized in declaratives, and findings reported by Chahal and Hellmuth (2014) in LA short declaratives, and finally Ghazali et al. (2007) acoustic rise-level-fall acoustic characteristics of Syrian Arabic.

- **Interrogative of wh- type questions**

The analysis of data shows that there are two pitch movement variations in the two elicited wh-questions selected for acoustic analysis.) Most descriptions of Arabic note a falling contour over the whole utterance. Thus, the whole tune is similar to the English wh-question tune. The first interrogative (wh-question) in this study is: // ʔ F **ke:f** anta // " how are you?", illustrated in Figure 7 below with neutral tonality as one Intonational Phrase IP and / or Tone Group (TG), neutral falling tone., a neutral tonicity where prominence is placed on the question word / ke:f / evidenced by the major pitch change initiated in the first word beginning the question. n most Arabic varieties, where the question word occupying the initial slot of a sentence is commonly regarded the focus of the utterance, usually associated with a strong prominence, frequently constitutes the nuclear accent of the whole phrase (El Zarka, 2011).

Figure 7

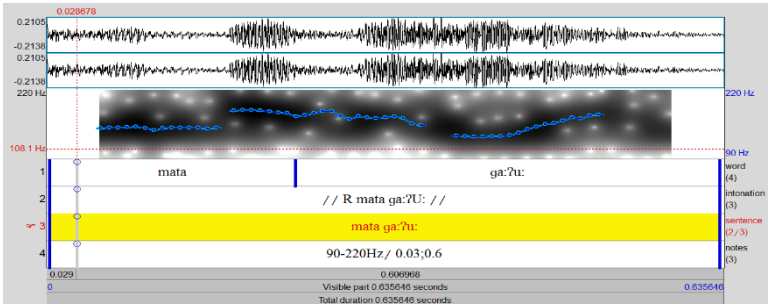
*showing spectrogram of interrogative (wh-type) // ʔ F **ke:f** anta // " how are you? with a falling tone. S.4*



As shown in Figure 7 above, it is observed that the pitch range of this declining pitch contour starts from 255 Hz down to 150 Hz. The tonic nuclear accent This aligns with most Arabic dialects including EA (El Zarka, 2011), Taizi Yemeni Arabic (Ali, 2000), Jordanian Arabic JA (Rammuny, 1989).

The second wh-type question: // ᛝR mata ga:✍u: // 'When did they come?' S1 is realized with neutral tonality, marked tonicity with prominence on last lexical word not the question word and marked rising tone.

Figure 8 Spectrogram of interrogative (wh-type)// ᛝR mata ga:✍u: // 'When did they come?' S1 with a rising tone



In Figure 8 above, it is observed that the pitch change takes place in the tonic syllable post lexically in the last word / ga:✍u: /, not in the initial question word, in contrast to what is common in most Arabic varieties. The pitch range starts with 115 Hz and goes up to 187 Hz. Major pitch change is evident in the last tonic syllable in the word / ga:✍u: /. This distinctive acoustic feature of IYA intonation pattern sets it apart from other investigated Arabic dialects in terms of tonicity where prominence is shifted to final position of the wh-question instead of the initial question word. Regarding rising tone, IYA in the instance aligns with Kuwaiti Arabic KA as reported by Alharbi (1991) where 90% of wh-questions carried a rising final contour, and similarly with Syrian Arabic SA (Mitchell, 1993). Previous Yemeni Arabic dialects including SYA (Hellmuth, 2014) and Taizi Arabic (Ali, 2000; Salem and Pillai, 2020) diverge from IYA in this wh-question pattern.

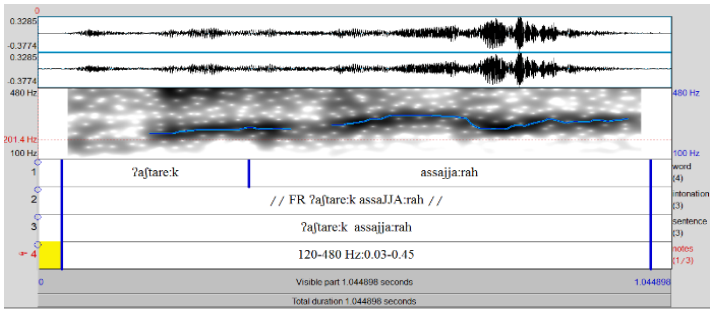
- **Interrogative of (Yes/No) Polar question type**

Two polar questions were elicited and selected for acoustic phonetic analysis. The first polar question is // ᛝR ☆a♦tare:k assajja:ra ja **fahd** // S1 " have you bought the car, Fahd?" is acoustically illustrated in Table 1, Figure 2. The question is realized with marked tonality (two clauses in one tone group) in line with Alharbi (1991) findings on KA IPs coinciding with more than one clause or subclause. The above yes-no question is realized with neutral rising tone and tonicity. The acoustic cues fir this rising tone are observed in the pitch range through which the rising pitch extends starting with 105 Hz going up to 200 Hz. The major pitch change is also seen in the last lexical word / **fahd** /constituting the nuclear accent of the entire utterance Rising intonation in polar questions has been attested in EA (Chahal and Hellmuth, 2014; El Zarka, 1997), JA (de Jong and Zawaydeh, 1999; Rammuny,

1989), LA (Chahal, 2001; Chahal and Hellmuth, 2014), KA (Alharbi, 1991). Final rise tonicity is observed in this polar question, similar to JA as reported by (de Jong and Zawaydeh,1999; Rammuny,1989; Salem & Pillai, 2020).

The second yes/no question example // ☒ FR ✍a♦tare:k assajja:**rah** // " have you bought the car?" shows a neutral tonality where the question is realized as one IP and 1 tone group with no pauses, neutral tonicity where prominence is given to the last tonic syllable of the last lexical word / assajja:**rah** /, and a marked tone- a falling rising pitch contour. The acoustic parameters for this tone are illustrated in Figure 9 below:

Figure 9 showing spectrogram of interrogative (polar yes-no) // ☒ FR ✍a♦tare:k assajja:**rah** // " have you bought the car?" S2. With a falling-rising tone

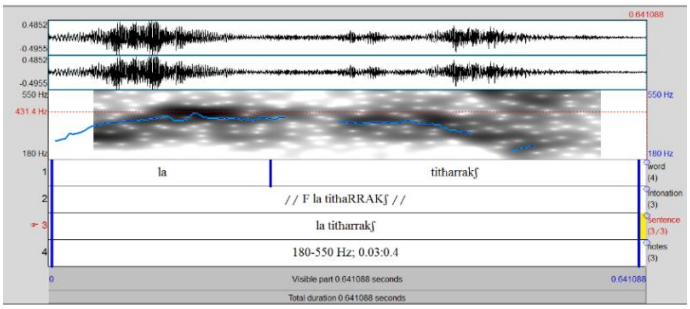


In Figure 9 above, it is observed that the pitch movement for the falling rising tone is realized on the last lexical word / assajja:**rah /** with a major fall from 330 Hz lower down to 215 Hz and again a rising pitch going up to 345 Hz. The major pitch change is noticed last word, mainly on the last tonic nuclear syllable / **rah /.** Comparing this tone of IYA with earlier Arabic dialects, it aligns with Ali (2000) intonation patterns of TYA in polar questions. However, it diverges from the rising tone in TYA reported by (Salem and Pillai, 2020), and the rise–fall intonation contour seen in yes/no questions in Yemeni Arabic from Ṣanʕāʔ (Hellmuth, 2014).

Imperative Utterances

Imperatives in the recorded speech data have shown no pitch movement variation. The example: // ☜ F la tit❻arrak♦ // S4. " don't move" given in Figure 10 below shows a neutral tone- falling tone and neutral tonality – one IP / TG and tonicity – marking focus on last lexical item, along with their acoustic cues.

Figure 10 *Spectrogram of imperative // ☜ F la tit❻arrak♦ // S4. " don't move" with a falling tone*



In Figure 10, it is noticed that major pitch change is initiated in the last word's final tonic nuclear syllable / rak♦ /, with a steep fall of 200 Hz. Pitch range of the declining tone starts at 420 Hz declining down to 200 Hz.

The data analysis reveals that imperatives in IYA are characterized a falling contour just as is the case with some Arabic dialects including EA (El Zarka, 1997), KA (Alharbi, 1991), and MA (Benkirane, 1998). However, IYA command intonation pattern has a distinctive high falling pitch movement, higher than declaratives and interrogative wh-questions, which diverges from MA command intonation patterns reported by Benkirane (1998). This IYA intonation pattern functions to convey emotional forceful attitude on the part of the speaker. Another interesting feature of IYA intonation pattern of marking focus is that the verbal negation prefix does not carry the nuclear accent which falling in statements, contrary to the fact that eastern negative Arabic dialects prefix typically carries the nuclear accent, which is falling in statements and rising in questions (Mitchell, 1993). However, IYA imperative intonation tonicity pattern aligns with EA, where prominence is placed on the verb, not the particle /la/ (Mitchell, 1993) and Tripoli Arabic (Caron et al., 2015).

- **Exclamations**

Like imperatives, exclamations are associated with a falling pitch movement contour as attested in different Arabic dialects. In this study, the three exclamatory utterances selected for analysis show three different intonation variations: rising falling, falling, and falling rising respectively as follows:

1. // ✓ RF ✍u: // Oh. S3
2. //🡻F ja sa:te:r // 🡻F sa✯manu: // " My God! How big it is!" S3
3. // ☒ FR sa✯man abu:h // " How big it is!" S1

The acoustic parameters for the intonation patterns in the first two utterances are indicated in Figure 4 in Table 1 above, while the third utterance is acoustically illustrated in Figure 6. In Table 1. The pitch range observed in the three intonation variations of exclamations is not as high as in imperatives. For the rise fall tone, the pitch range was as follows: St. 202 Hz – Peak= 280 Hz- End. 210 Hz as seen in Figure 4, Table 1 above.

The falling tone in utterance 2 in the two-tone groups shows a pitch range stretching from 210 Hz down to 170 Hz, with major pitch change on the last syllables of each tone group as indicated. In utterance 3, the falling-rising major pitch change and movement is observed in the last lexical item as indicated in Figure 4. Table 1 above. The analysis showcased that IYA exclamation falling tone intonation pattern is similar with other Arabic dialects including EA (El Zarka, 1997), KA (Alharbi, 1991), MA (Benkirane, 1998) and TYA (Ali, 2000). However, the rising-falling and falling-rising pitch movements of IYA are distinct and set it apart from other Arabic dialects.

- **Vocative and Warning**

Vocative calling contours have been reported for EA to be rising-falling (El Zarka, 1997), IYA shows a distinct low rise tone. In the study, vocative and warning categories are examined in the elicited utterance // Low Rise ☆ali: // ✓ RF ✍ubeh ✍ube:h // " Ali, attention attention", S2, as illustrated in Figure 5, Table 1 above, shown as an instance comprising two grammatical categories in two distinct IPs and TGs tone groups. The first tone group is an initial vocative which is realized with a low rising tone that conveys a sense of non-finality and continuity. Continuity is signaled in Arabic varieties by a final rise as attested by IYA vocative, similar to finding reported in EA (Rifaat, 2005; Hellmuth, 2006; El Zarka, 2013a), LA (Chahal, 2001; Chahal and Hellmuth, 2014); JA (Rammuny, 1989); MA (Benkirane, 2000). or a rising-plateau contour as in EA (El Zarka, 1997; El Zarka 2013a), LA (Chahal, 2001; Chahal and Hellmuth, 2014), JA (Rammuny, 1989; de Jong and Zawaydeh, 1999), MA (Benkirane, 1998). While earlier studies on Yemeni Arabic intonation reported falling tone on vocative (Ali, 2000), IYA shows a low rise tone with a pitch movement parameters indicated in Figure 5, Table 1 above.

Warnings have been characterized with a falling tone in YA, namely TA as reported by Ali (2000). In this study, warning is analyzed in the utterance // ✓ RF ✍ubeh ✍ube:h //S2, as depicted in Figure 5, Table 1, second tone group where it was realized as a rising-falling tone. This sets IYA apart from TYA (Ali, 2000).

This study has answered the two study questions and revealed interesting features of IYA intonation patterns which can be summed up as follows:

- Ibbi Yemeni Arabic has six distinctive tones: falling tone, rising tone, low rising tone, falling rising tone, rising falling tone and level tone (distinct IYA contour), associated with its declarative, interrogative, imperative, exclamatory, vocative and warning statements.
- Tonality & Intonation Phrasing Boundaries coincide with syntactic constituent boundaries as is the case in most Arabic dialects, with the exception of marked tonality in a few instances.
- IYA has a nuclear tonic accent post-lexically on the last lexical item except for few exceptions when it moves to initial position and medial position in VSO order.
- Grammatical patterns of declaratives were realized with falling and level tones, interrogatives (wh-questions) with falling and rising tones, interrogatives (yes-no) questions with rising and falling-rising tones, exclamatory statement with falling, rising-falling and falling-rising tones. Intonation variations were observed and perceived in these aforementioned grammatical categories. Imperatives (Falling tone), vocatives (Low Rising tone) and warnings (Rising-falling tone) showed no intonational variations.
- In IYA, Like previous phonetic descriptions on Arabic dialects intonation patterns, falling tone comes with statements, commands, wh- questions, exclamations to indicate finality, assertion, certainty and

emphasis, while rising tone comes with yes/no questions and with wh-questions to indicate politeness and friendliness, and low rise with vocative to imply continuity.

- Level tone is a distinct IYA intonation feature in declaratives.
- IYA, unlike SYA where rise fall tone is attested, uses rising and falling rising tone in yes/no questions,
- Rising falling tone is used with exclamations and warnings in IYA.
- Unlike other Arabic dialects including Levantine Arabic, pitch movement range in IYA is narrow except in commands.

Conclusions and future research directions

This study has provided an acoustic phonetic analysis of intonation patterns in (YIA), a relatively under-researched dialect, based on the recorded speech samples of four Ibbi Yemeni Arabic native speakers. The findings reveal specific characteristics that contribute to its unique linguistic identity and valuable data to the theories of intonation and prosody. YIA employs distinct intonational patterns and strategies for various communicative functions. These patterns likely involve specific pitch contours, duration variations, and amplitude changes that differentiate YIA from other Arabic dialects and Modern Standard Arabic

In terms of linguistic variation, the study underscores the importance of examining dialectal variation to understand the full scope of intonational possibilities within the Arabic language family. Future research should investigate the interplay between intonation and other prosodic features such as stress and rhythm in YIA. Additionally, exploring the perception of YIA intonation by speakers of other dialects would provide valuable insights into the role of intonation in cross-dialectal intelligibility. Finally, examining the acquisition of YIA intonation by children (Alfaifi & Qasem, 2024) would contribute to our understanding of how intonational competence develops. Such comprehensive investigations will further illuminate the rich phonetic and phonological landscape of IYA.

This study is limited to 11 sentences, questions, and expressions comprising different grammatical patterns elicited from spontaneous speech and dialogues of four Ibbi Yemeni Arabic speakers. A better, more comprehensive corpus study with more intonation variations and bigger sample of participants could yield well-grounded results and extend our understanding of the nature and intricacies of YA and IYA intonation patterns. Further research could employ more advanced acoustic analysis techniques to gain a deeper understanding of the subtle nuances of YIA intonation.

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