

Exploring prosody in questions: a pilot study of speech in ASD

Explorando a prosódia de perguntas: um estudo piloto da fala no tea

Leandro Lisboa 

Universidade Federal do Rio de Janeiro, Rio de Janeiro, RJ, Brasil.
E-mail: leandrolisboa@letras.ufrj.br

Abstract

This paper aims at exploring prosody in partial and disjunctive questions, focusing on speech produced by adults with Autism Spectrum Disorder (ASD). Using an exploratory approach, the study emphasizes the significant interindividual variability within this population rather than seeking confirmatory results. The methodology is based on a Discourse Completion Task (DCT) of the project Interactive Atlas of the Prosody of Portuguese (InAPoP, Frota *et al.*, 2015) designed to elicit diverse speech acts and speech directive acts in different pragmatic contexts. The corpus consists of recordings of 2 ASD and 2 control participants (non-ASD), collected in the Laboratory of Acoustic Phonetics of the Federal University of Rio de Janeiro (UFRJ), and the data were analyzed through detailed acoustic and prosodic annotation using the P-ToBI system (Frota *et al.*, 2015) on Praat. The study addresses how prosodic features such as pitch contours and syllabic duration vary in the production of partial (wh-) and disjunctive questions, as well as with total questions (yes/no) in a previous analysis, with particular attention to deviations or distinctive patterns observed in ASD speech. The findings highlight that prosody in ASD is characterized by a wide range of patterns, reinforcing the notion that speech production in this group cannot be generalized easily due to high intra-group variability. The exploratory nature of the research acknowledges this complexity and refrains from making broad claims, instead providing evidence that supports future confirmatory studies. Furthermore, this work situates

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its contribution within the context of Brazilian Portuguese prosody, investigating the gap in the literature concerning intonation in the ASD population. Future studies with more participants are necessary to describe and confirm the prosodic variability in this population. Overall, this paper offers a foundational step toward better understanding prosodic variation in ASD and its possible impact on communicative competence.

Keywords:

Prosody; ASD; Intonation; Phonetics; DCT.

Resumo

Este artigo tem como objetivo explorar a prosódia em questões parciais e disjuntivas, com foco na fala produzida por adultos com Transtorno do Espectro Autista (TEA). Utilizando uma abordagem exploratória, o estudo enfatiza a variabilidade interindividual dentro dessa população, ao invés de buscar resultados confirmatórios. A metodologia baseia-se na *Discourse Completion Task* (DCT), adaptado do Projeto *Interactive Atlas of Prosody of the Portuguese* (InAPoP, Frota *et al*, 2015), projetado para elicitare diversos atos de fala e atos diretivos em diferentes contextos pragmáticos. O corpus consiste em gravações de 2 participantes com TEA e 2 participantes neurotípicos, coletadas no Laboratório de Fonética Acústica da Universidade Federal do Rio de Janeiro (UFRJ), e os dados foram analisados por meio de anotações utilizando o sistema P-ToBI (Frota *et al*, 2015) no Praat. O estudo aborda como características prosódicas, como a frequência fundamental e a duração silábica, variam na produção de perguntas totais (sim/não), parciais (WH-/QU-) e disjuntivas, com atenção especial para padrões distintivos observados na fala dos indivíduos com TEA. Os achados destacam que a prosódia no TEA é caracterizada por uma ampla variedade de padrões, reforçando a ideia de que a produção da fala nesse grupo não pode ser facilmente generalizada devido à alta variabilidade intra-grupo. A natureza exploratória da pesquisa reconhece essa complexidade e evita fazer generalizações amplas, fornecendo evidências que apoiam estudos confirmatórios futuros. Além disso, este trabalho situa sua contribuição no contexto da prosódia do português brasileiro, preenchendo uma lacuna na literatura sobre prosódia e entoação nessa população. Estudos futuros com mais participantes são necessários para melhor descrever a variabilidade da prosódia dessa população. De modo geral, este artigo oferece um passo fundamental para uma melhor compreensão da variação prosódica no TEA e seu possível impacto na competência comunicativa.

Palavras-chave:

Prosódia; TEA; Entoação; Fonética; DCT.

Introduction

This pilot study aims at exploring the prosodic behavior in the speech of adults with Autism Spectrum Disorder (ASD), focusing on the production of partial and disjunctive questions, recorded in the *Laboratório de Fonética Acústica da Universidade Federal do Rio de Janeiro (UFRJ)* (Laboratory of Acoustic Phonetics of the Federal University of Rio de Janeiro). While our previous analyses focused on declaratives, total questions, commands, and vocatives, the current work is specifically dedicated to the examination of partial and disjunctive interrogatives, thereby addressing a gap in the existing prosodic descriptions of ASD speech. Rather than adopting a confirmatory approach, which tests pre-established hypotheses, the present study assumes an exploratory perspective. This choice is grounded in the recognition of the complexity and heterogeneity of prosodic expression in this population. Confirmatory models, often based on expectations of normative speech behavior, may fall short when applied to ASD, where the variability of linguistic, cognitive, and social traits is not an exception but a defining feature (McAlister, 2021; Shriberg et al., 2001). As such, it is more productive to consider prosody in ASD as a field in which patterns emerge through close observation, rather than through hypothesis-driven verification.

Recent studies highlight the intrinsic interindividual variability in prosodic expression among people with ASD, including differences in intonation contours, pitch range, speech rate, and rhythm (Paul *et al.*, 2005). These prosodic differences may reflect a wide spectrum of communicative strategies shaped by each individual's experiences, neurodevelopmental profile, and interactional context. Investigating questions, which require fine-tuned prosodic modulation to signal speaker intention, offers a concrete entry point into how this variability manifests. Given that question types (yes/no, wh-questions, disjunctive structures) are associated with distinct intonational patterns in typical language use, observing their realization in ASD speech provides insights that go beyond descriptive pathology.

Adopting an exploratory framework in this context is not a methodological compromise but rather a theoretical necessity. As Lepros and Féron (2019) argue, exploratory research plays a central role in fields where the phenomenon under investigation is non-uniform and highly context-dependent. It allows the data to inform theoretical understanding, rather than constraining analysis to pre-existing models. In the context of ASD, such an approach acknowledges not only the richness of individual variation but also the importance of resisting reductive generalizations. This study, therefore, contributes to the field by emphasizing prosodic diversity as an object of inquiry in its own right, and by advocating for analytical models that are sensitive to the nuances of variable prosodic behavior.

Autosegmental-Metric Phonology and P-ToBI

The study of prosody, particularly intonation, has undergone significant development through the integration of experimental and phonological models, notably Laboratory Phonology (Connell and Arvaniti, 1995; Docherty and Ladd, 1992; Keating, 1994; Kingston and Beckman, 1990; Local, Ogden and Temple, 2004). This interdisciplinary framework blends instrumental measurements (such as fundamental frequency tracking and acoustic analysis) with traditional phonological theory, offering valuable insights into how prosodic elements structure speech. Laboratory Phonology emphasizes precision in measuring speech parameters, such as pitch, duration, and intensity, providing a robust platform for analyzing intonation patterns across different linguistic contexts. By using controlled experimental settings, it is possible to explore how intonational contours contribute to meaning-making in communication, especially in atypical speech, such as that of autistic speakers. Within this experimental framework, Autosegmental-Metric Phonology (AM) (Pierrehumbert, 1980) remains a cornerstone of intonational analysis. The AM model posits that the intonational melody of an utterance consists of discrete contrastive tonal events, typically categorized as high (H) or low (L) tones. These tones are realized as modulations in F0 (fundamental frequency) and work to demarcate prosodic boundaries within an utterance. Crucially, the phonetic realization of these tones is not random; rather, it adheres to specific phonological rules regarding alignment (the position of a tone relative to a syllable or boundary) and scaling (the relative height of tones across different contexts). The F0 patterns resulting from these tonal events are essential for conveying linguistic structure and discourse meaning.

Phonetic details of intonational contours are essential for understanding how listeners interpret speech. In this context, the timing of a tonal peak, its height, and its relative positioning within a phrase or sentence significantly affect the perceived intended meaning. For instance, a late peak may signal focus, while an early peak can convey a sense of continuity or uninterrupted flow. Furthermore, pitch range, the difference between the highest and lowest points in an utterance, can reflect emotional tone or speaker intent. These nuanced phonetic cues allow speakers to manipulate F0 to express a wide range of meanings beyond the literal content of words.

In Brazilian Portuguese, for example, the pitch contour in declarative *versus* interrogative sentences plays a vital role in signaling question types, such as yes/no questions *versus* wh-questions. Rise-fall contours typically occur at the end of yes/no questions, while falling or level contours are more common in declaratives (Moraes, 2008). These F0 variations are central to both grammar and pragmatics, as they guide listeners in interpreting the speaker's intended focus, emotion, and discourse function. As such, F0 modulations are not merely linguistic but deeply

connected to pragmatic aspects of communication, allowing speakers to convey attitudes, certainty, surprise, and other subtle discourse signals.

However, beyond the structural properties of prosody, there is a growing interest in how these intonational patterns influence pragmatic interpretation, especially in atypical speech communities. Research in pragmatics suggests that prosodic markers such as F0 patterns, pause placement, and intonational boundaries are closely linked to interactional meaning (Couper-Kuhlen and Selting, 2001, 2018). In this aspect, intonation can signal not only grammatical distinctions (*e.g.*, statement *versus* question) but also speakers' social intentions, commitments, or engagement with their interlocutors. For instance, in the context of autistic speech, deviations in F0 realization might signal differences in how autistic speakers encode and express pragmatic cues, such as turn-taking or focus shifts. It is important to note that these deviations are not necessarily deficits but may reflect an alternative strategy for pragmatic communication. Research examining the prosody of autistic speech (*e.g.* Fillipe *et al.*, 2015) suggests that pitch range and intonation contour shape can be altered in ways that affect interpretation of emotional or social cues, leading to distinct pragmatic functions in discourse.

In line with this, Laboratory Phonology approach allows researchers to explore these intonational variances systematically, linking intonation patterns to both linguistic function and social cognition. This integration of phonetic and pragmatic perspectives highlights the potential of intonational research in providing a deeper understanding of how F0 modulation contributes to meaning-making, especially in atypical communicative contexts.

Why Questions Matter: A prosodic overview

Questions are central to human interaction. They do more than elicit information: they structure conversations, reveal speaker intentions, and shape the dynamics of turn-taking and turn-timing, for instance (Couper-Kuhlen and Selting, 2001, 2018). From a pragmatic standpoint, interrogatives are key tools for managing social interaction, making them especially relevant when studying populations whose communication patterns differ from neurotypical norms, such as ASD individuals (DSM-5-TR, 2013). In the context of ASD, questions hold a special diagnostic and functional status. Clinical observations often note differences in how autistic individuals understand, produce, or respond to questions (Baron-Cohen, 1989). These patterns are commonly framed in terms of language comprehension or social cognition (Paul *et al.*, 2005; Tager-Flusberg, 2000), but prosody, an equally critical dimension, has received less attention. Since prosody conveys cues about speaker attitude, emotion, and intention (Fónagy, 1983), investigating the intonation of questions offers a powerful lens for understanding how autistic speakers navigate interactional norms (Peppé *et al.*, 2007).

Beyond their linguistic form, questions are interactional moves that invite alignment, positioning speakers and listeners within a shared communicative space. As Du Bois (2007) argues, interrogatives play a key role in the dialogic negotiation of stance, functioning not just to solicit information but to co-construct meaning and interactional footing. In this sense, studying how questions are delivered prosodically in speech, especially in ASD, even in elicited tasks, is crucial for understanding how social alignment is enacted or disrupted in real time. Interrogatives are prosodically marked across languages, including Brazilian Portuguese (BP), where pitch contours, boundary tones, and stress placement signal question type (Moraes, 2008). In BP, total, partial, and disjunctive questions are distinguished not only syntactically but also through intonational patterns. As Moraes (2008) describes, these contours are systematic and play a central role in signaling the illocutionary force of an utterance. In total questions, for instance, as mentioned earlier, a rise-falling melody often marks the end of the utterance, contrasting with the falling contours found in declaratives.

When these prosodic cues are altered or absent, communication breakdowns may occur, something especially relevant in ASD populations, where atypical prosody is a well-documented feature (Baron-Cohen, 1989). Studying questions from a prosodic perspective is therefore not only a linguistic endeavor but also a path toward understanding broader patterns of communicative variation in autism. This approach aligns with recent calls for more exploratory, nuanced perspectives on ASD language use, ones that embrace interindividual variability rather than treating difference as deficit (Bolte e Diehl, 2013; Dubet, 2021; Wehrle, 2023).

Observations on prosody of WH-/QU- questions

In spoken language, prosody plays a crucial role in signaling the speaker's intentions, structuring information, and guiding the listener's interpretation. Intonation patterns, in particular, are central to how different types of questions are produced and understood. By analyzing prosodic cues, such as pitch contour, stress, and boundary tones, it becomes possible to distinguish not only between statements and questions, but also among various subtypes of interrogatives. Within this perspective, partial and disjunctive questions offer fertile ground for investigation, as they often rely on subtle prosodic markings to highlight contrast, indicate focus, or cue the expected type of response. In sentences such as "What happened yesterday?", the speaker specifies the information they are seeking. In this way, the speaker presupposes that *something happened yesterday* but does not know *what happened*. In other words, this type of question carries cues that part of the expected answer is already known to the speaker, who, in the example above, knows that *something* occurred, but not *what* exactly. Therefore, this type of utterance reveals that part of the context is known to the speaker, while the unknown part is precisely the

expected answer. Because of this feature, where part of the context is already given, this sentence type is called a partial question, in contrast to a total question, where the speaker lacks knowledge of the entire possible answer.

In addition to the pragmatic character of the partial question described above, this type of interrogative also presents a syntactic feature: the presence of a WH- (or QU-, in BP) element. Briefly, partial questions are “characterized by the presence of interrogative constituents, which traditional grammar labels as ‘interrogative pronouns,’ ‘interrogative adjectives,’ or ‘interrogative adverbs.’ The presence of such constituents precisely marks the focus of the question” (Mateus *et al.*, 2003, p.463). In examples 1a and 1b below, we can observe the presence of the interrogative element QU-, functioning as the focal point of the question.

1a) *O que* a Lorena te contava? (*What* did Lorena tell you?)

1b) *Quando* você vai voltar? (*When* are you coming back?)

In the examples above, the interrogative particle QU- is located in the leftmost portion of the sentence. However, in Portuguese, it is also possible to place the QU-element at the end of the utterance¹.

2a) A Lorena te contava *o quê?* (*Did Lorena tell you *what?*)

2b) Você vai voltar *quando?* (*You are coming back *when?*)

Thus, partial questions may present the interrogative particle QU-*in situ* (canonically at the end of the sentence) or *ex situ*, when the particle is displaced to the left edge, characterizing the phenomenon known as Q-Movement (Mateus *et al.*, 2003).

On the other hand, drawing on Moraes (2008), the author analyzes the prosodic features of partial questions with an *ex situ* WH- particle located at the left edge of the utterance. The author argues that this type of sentence shows a high F0 register at the beginning, falling on the WH- particle, followed by a gradual F0 declination throughout the utterance until the final accented syllable and any post-tonic syllable, which is produced at a low level. The low F0 at the end of the sentence is also found in declaratives, as mentioned earlier, but in the case of partial questions, “the melodic contrast between the pretonic syllable and the following tonic syllable is smaller than in assertions” (Moraes, 2008, p. 3-4, our translation). Figure 1 from the same study illustrates this explanation.

¹ *In situ* WH- elements, which remain in their original position within a sentence (on the right-end of the utterance, for BP) rather than moving to the front, often attract intonational focus. This prosodic emphasis highlights the WH- word and can change the function of a partial question by making it behave like an echo question. Instead of simply requesting new information, the echo question repeats or confirms previously mentioned information, reflecting a reaction or seeking clarification rather than initiating a new inquiry.

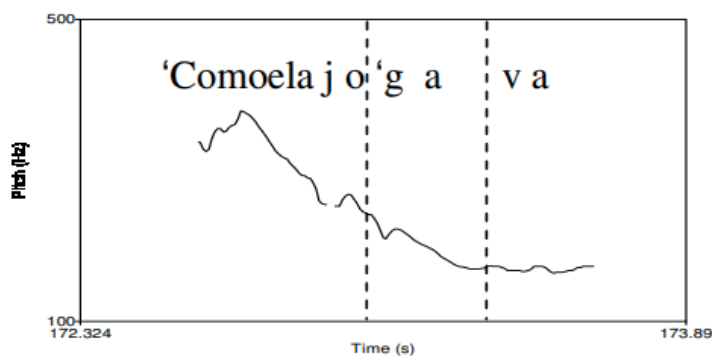


Figure 1. “Como ela jogava?” (How did she play?), example of partial question with *ex situ* WH-particle.

Source: Taken from Moraes (2008).

In the same study, Moraes (2008) conducts a perception test based on resynthesized speech data in which the nuclear accent from a declarative sentence is transplanted into a total question sentence. He concludes that it is not possible to perceptually differentiate these two sentence types based solely on nuclear accent. On the other hand, the two sentence types differ primarily in the prenuclear portion: the assertion displays a ascending L+H* tone, as previously described, while the partial question displays a high tone, described as H+H*.

Observations on prosody of disjunctive questions

In addition to total and partial questions, disjunctive questions also form part of the set of interrogative constructions in Brazilian Portuguese. In his study, Machado (2020) outlines the trajectory of different theoretical perspectives regarding the nature of disjunctive questions. Fónagy (1983) argues that, semantically, disjunctive questions are similar to polar questions, since both can offer alternatives and require a binary decision (yes or no, this or that), as illustrated in the examples 3a and 3b below:

3a) Did it rain?

3b) Do you want orange or jelly?

Building on this view, and following the suggestion that the notion of disjunctive questions be introduced more directly, it is possible to define disjunctive questions as structures that offer the interlocutor two alternatives within a binary paradigm, typically marked by the disjunctive element *ou* (or). These focal elements may appear either in the canonical sequence X *ou* Y or, alternatively, in configurations where the focal alternatives are distributed *between* ____ *and* ____, depending on the syntactic environment and the informational structure of the utterance. Seeking a more accurate definition of this question type, Machado (2020) revisits Bolinger (1978), arguing that the interpretation of disjunctive questions as involving a binary decision is mistaken. In the example above — “Do you want orange or jelly?” — the utterance can function as a disjunctive question when prosodic

prominence falls on both focal elements (“orange” and “jelly”), with the disjunctive element *or* in between. In this case, the speaker expects the addressee to choose between the two options. However, the same sentence may also be produced as a polar question (yes/no), with prosodic emphasis on only one focal element (“jelly”), suggesting the question refers to the entire disjunctive phrase as a unit and prompts a yes/no answer. Thus, what distinguishes a disjunctive question from a polar one is not solely syntactic structure but also prosodic factors in its realization.

Nevertheless, in a perception study on English by Pruitt and Roelofsen (2013), the authors show that placing prosodic prominence on both disjuncts is not sufficient to distinguish disjunctive questions from polar ones. In addition to binary pitch accent placement, a final falling melodic contour is necessary to mark the utterance as disjunctive.

The syntactic structure of disjunctive questions is also not fixed. As shown by Machado (2020), in their analysis of BP disjunctive constructions based on Construction Grammar, the presence of the element *or* is not strictly required for an utterance to be interpreted as offering alternatives. To support this claim, the authors cite examples such as *Entre Haddad e Bolsonaro, quem você prefere que ganhe as eleições de 2018?* (Between Haddad and Bolsonaro, who do you prefer to win the 2018 elections?) This illustrates that the absence of *or* does not prevent the question from requiring a choice between two alternatives.

According to Rosignoli (2017), disjunctive interrogatives involve two informational focus, triggering two distinct intonational contours. Lira (2009), in turn, argues that certain parts of the utterance are essential for identifying it as a disjunctive question: (i) the stressed syllable preceding the first alternative; (ii) the stressed syllable before the disjunctive element; and (iii) the final stressed syllable of the utterance, as exemplified in Machado (2020):

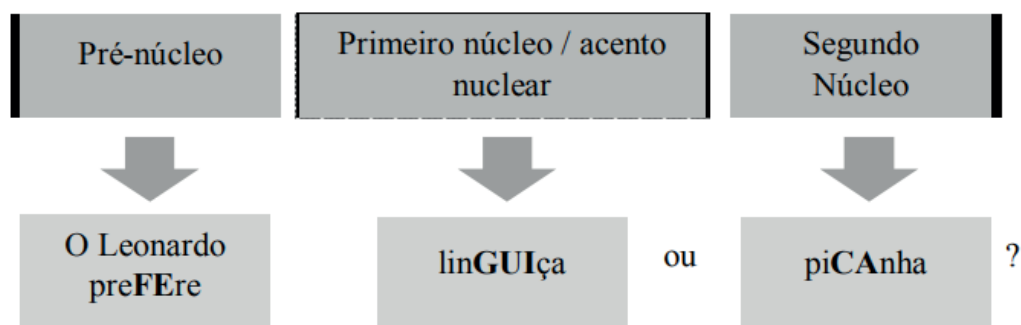


Figure 2. Example of the distribution of informational *foci* in a disjunctive interrogative. **Source:** Adapted from Machado (2020).

In the same study, the authors compare the prosodic cues of disjunctive questions formed with the element *entre* (“between”) and with the particle *ou* (“or”). Both constructions show similarities, especially regarding the prosodic treatment of the second disjunction. In our study, the disjunctive questions used in the DCT

are constructed exclusively with *ou*, but we consider it relevant to briefly reflect on both types of disjunction analyzed by the aforementioned authors.

On one hand, disjunctive questions containing the term *entre* typically also includes a WH-word, either at the beginning of the sentence or embedded within, along with the additive element *e* (“and”):

4a) *Entre Haddad e Bolsonaro, quem você prefere que vença as eleições de 2018?* (Between Haddad and Bolsonaro, *who* do you prefer to win the 2018 elections?)

4b) *O que Leonardo prefere entre palmito e cogumelo?* (*What* does Leonardo prefer between hearts of palm *and* mushrooms?)

On the other hand, disjunctive questions with *ou* do not require the presence of a WH-word or the additive *e*:

4c) Does Leonardo prefer pancakes or lasagna?

In figures 3 and 4 below, we present examples from Machado (2020), with melodic contours of both disjunctive constructions:

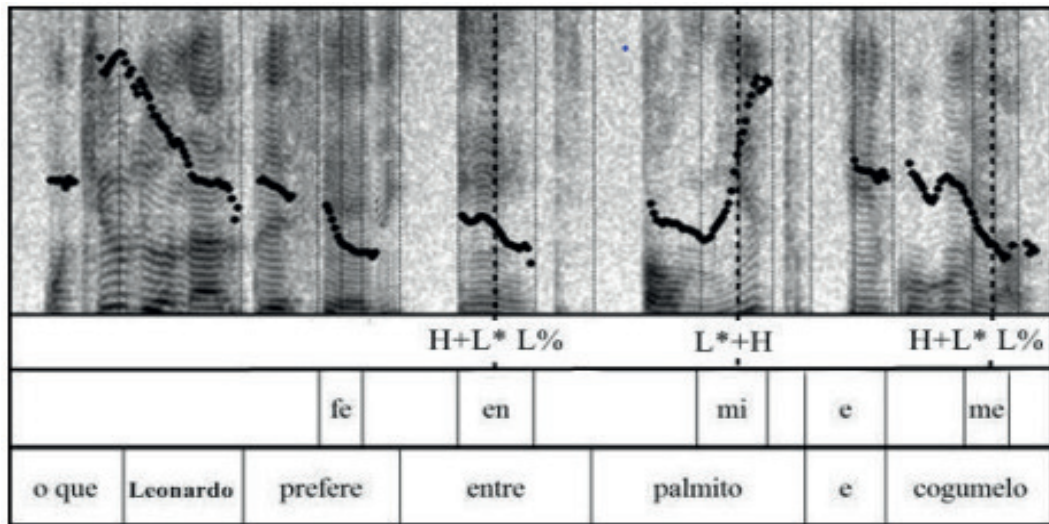


Figure 3. Disjunction with the word “entre” (between) and a WH-word.

Source: Taken from Machado (2020).

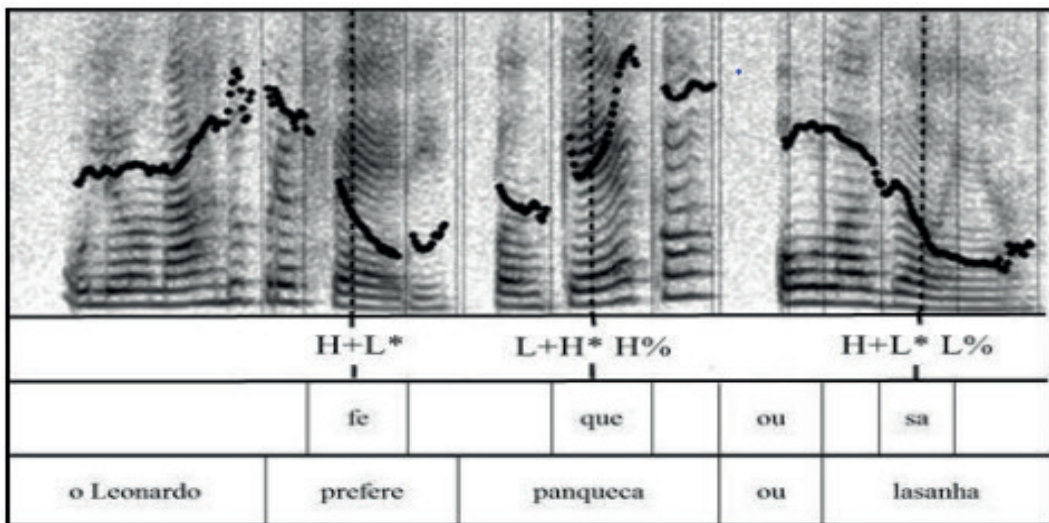


Figure 4. Disjunction with the word “ou” (or).

Source: Taken from Machado (2020).

In both constructions, a final falling contour H+L* L% is associated with the second disjunct. Regarding the first disjunct, both constructions display variations of the L+H pitch accent. In the example with *entre*, we observe L*+H, whereas in the *ou* construction, we find L+H*. Furthermore, both constructions exhibit a high boundary tone (H%) at the end of the first disjunct (e.g., “hearts of palm” and “pancakes”), which supports Rosignoli’s (2017) claim that this prosodic feature signals the speaker’s intention to pose a question. Machado (2020) also argue that “the high boundary emerges as a prosodic cue suggesting to listeners that the list of alternatives has not yet concluded” (p.139).

Finally, Machado (2020) propose the phonological notation H+L*(L%)_____L+H H%_____H+L* L% for disjunctive questions. They claim that disjunctive questions are characterized primarily by two F0 falls (associated with the pre-nuclear portion and the second disjunct), interspersed with an F0 rise (associated with the first disjunct, whose stressed syllable may bear either a low (L) or high (H) tone, depending on whether the disjunction is realized with *entre* or *ou*, respectively).

Methods

The present study adopts the same methodological framework as described in Lisboa and Serra (2024), given that the data collection was carried out as part of a broader investigation into the prosody of different sentence types in Brazilian Portuguese. As mentioned before, our previous analysis focused on declaratives, total questions, commands and vocatives, the current work is specifically dedicated to the examination of partial and disjunctive interrogatives. The continuity of the experimental design allows for a consistent comparative approach, and further details regarding participant recruitment, experimental procedures, and transcription protocols can be found in the aforementioned dissertation.

As in previous study (Lisboa, 2024; Lisboa and Serra, 2024), the data were elicited through a Discourse Completion Task (DCT), originally adapted from the Interactive Atlas of the Prosody of Portuguese (InAPoP). This questionnaire comprises 36 contextually and pragmatically oriented situations, each designed to elicit a specific prosodic realization of a target sentence type. The DCT was chosen for its ability to generate speech data that approximate naturalistic interactions while still providing experimental control over the elicited structures. In the present analysis, we focused exclusively on the contexts designed to elicit disjunctive and partial interrogatives, enabling a detailed prosodic and intonational characterization of these two interrogative types. In the present study, the elicited contexts of partial and disjunctive questions available in the questionnaire are presented below:

5a) Partial question context: *Pergunta que horas são.* (Ask what time is it.)

Answer: *Que horas são?* (What time is it?)

5b) Disjunctive question context: *Pergunta a sua amiga se ela prefere laranja ou gelatina para sobremesa.* (Ask your friend if she would rather have orange or jello for dessert.)

Answer: *Você prefere laranja ou gelatina?* (Would you rather have orange or jello?)

Recordings were carried out in the Laboratory of Acoustic Phonetics of the Federal University of Rio de Janeiro (UFRJ), following approval by the university's Ethics Committee for Research with Human Subjects. Four male participants, aged between 24 and 28, were selected for the study: two individuals with a formal diagnosis of Autism Spectrum Disorder (ASD)² and two non-ASD controls, all speakers of Brazilian Portuguese born and residing in the state of Rio de Janeiro. Each participant was given the contextual prompts orally from the researcher that was also in the room and then produced an oral utterance as if addressing an interlocutor. Each target structure was repeated three times, in three different sessions, with a one-week interval between sessions, resulting in a total corpus of 117 utterances (considering all the produced sentence types), from which the disjunctive and partial interrogatives were extracted for analysis in this study, totalizing 36 utterances³.

Acoustic and intonational analyses were performed using the software Praat (Boersma and Weenink, 2007). Segmentation was done manually at the syllabic level, and the acoustic parameters analyzed included syllabic duration and fundamental frequency (F0) contours. Intonational patterns were annotated according to the P-ToBI framework, an adaptation of the ToBI (Tones and Break Indices) system for Brazilian Portuguese, based on the Autosegmental-Metrical model (Pierrehumbert, 1980; Ladd, 1996; Frota *et al.*, 2015). Special attention was given to the nuclear (partial and disjunctive questions) and pre-nuclear (partial questions) regions of the intonational phrase, with the goal of identifying pitch accent types and boundary tones characteristic of each interrogative form. The methodology adopted here allows for a fine-grained analysis of both the phonetic and phonological dimensions of intonation, while also enabling a comparative approach between control and ASD participants. The inclusion of pragmatically grounded contexts supports the investigation of how prosody interacts with discourse structure, contributing to broader discussions in prosodic phonology and clinical pragmatics.

² One of the limitations of this study is the non-mandatory attachment of the medical report on ASD by the participants. To ensure a satisfactory methodological accuracy, participants were asked to fill a certificate describing, by themselves, that they were diagnosed with ASD.

³ The participants repeated certain sentences more than three times spontaneously, without any request from the researcher. Detailed information on the excluded data and other phenomena, such as hesitations and false starts, are available in the author's dissertation (Lisboa, 2024, chapter 6).

For comprehensive methodological details, including recruitment criteria, ethical considerations, the full DCT script, and the prosodic labeling procedures, readers are referred to Lisboa (2024).⁴

Results

The acoustic analysis of the utterances produced by the Experimental Group (EG) and the Control Group (CG) revealed marked differences in prosodic behavior, particularly regarding syllabic duration and pitch variation. One of the most consistent findings was a possible tendency toward increased syllabic duration in the speech of participants in the EG across all question types analyzed—total, partial, and disjunctive questions⁵. More specifically, the data showed that stressed and post-stressed syllables were significantly lengthened in the EG when compared to the CG.

In total questions, which the research was conducted beforehand and are available in Lisboa and Serra (2024), post-stressed syllables exhibited a higher degree of lengthening in the EG, while the same syllables in the CG were comparatively shorter. This behavior suggests that the EG may be employing a compensatory prosodic strategy to signal sentence modality or to maintain communicative clarity, especially in contexts where linguistic processing may be more demanding (Crystal, 1987; Shriberg et al., 2001), although we support the hypothesis that the longer duration could, in fact, be a characteristic of this population.⁶

In partial questions, a similar tendency was observed: the stressed syllable of the interrogative nucleus, typically the informational focus of the utterance, was noticeably longer in the EG, as shown in Figure 4 below.

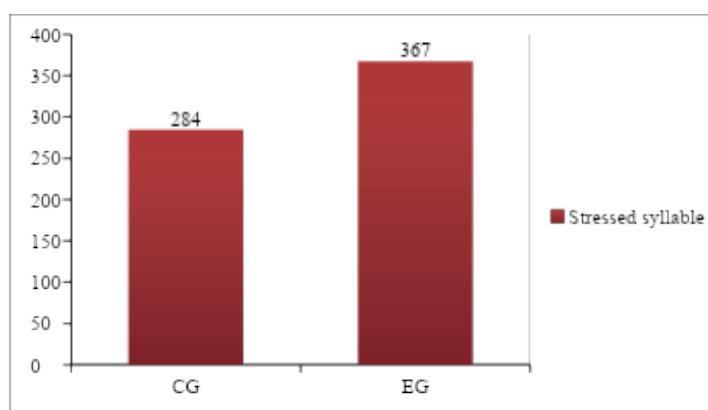


Figure 4. Duration, in milliseconds, of the stressed syllable in the nucleus of the partial question “*Que horassão?*” (What time is it?).

Source: Elaborated by the author.

⁴ Additionally, readers are referred to Lisboa and Serra (2024) to a more summarized version of the same study, focusing on declarative and total question sentences, as well as commands and vocatives.

⁵ This tendency is also observed on the abovementioned sentence types (cf. Lisboa, 2024, chapter 6).

⁶ We find important to highlight that a “slower” speech could be related to the effects of antidepressants or other psychiatric medicines, as it is signaled on the remedy leaflet of some medications. In our pilot study, this variable was not controlled. More refined experiments are being conducted by our research group controlling this and other variables, such as psychotherapy and speech therapy attendance, and medication intake frequency.

This finding aligns with studies that suggest that focal stress is not only realized through pitch prominence but also through temporal expansion (Ladd, 2008; Truckenbrodt, 2004). Such expansion may serve a dual function in the EG: highlighting focal information and managing planning demands in real-time production. Further investigation is necessary to confirm this assumption.

Disjunctive questions further supported this tendency. The first disjunctive nucleus in EG productions (*laranja*-orange) showed increased duration across all syllabic positions—pre-stressed, stressed, and post-stressed—relative to the CG (Figure 5). Moreover, in the second disjunctive nucleus (*gelatina*-jello), which corresponds to the final word of the utterance, the post-stressed syllable was markedly longer in the EG than in the CG (Figure 6). These results reinforce the idea that speakers in the EG may rely more heavily on temporal cues to structure discourse and to signal sentence-finality or contrastive elements (Barbosa, 2006; Prieto e Torreira, 2007).

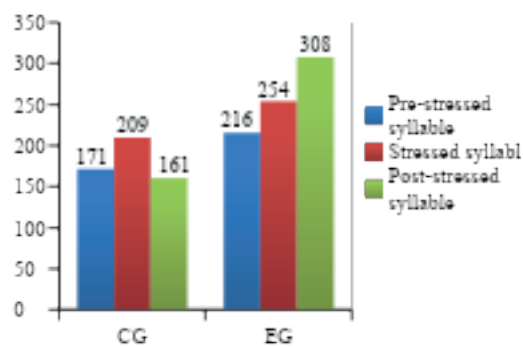


Figure 5. Duration, in milliseconds, of the syllables in the first disjunctive nucleus of the disjunctive question “*Você prefere laranja ou gelatina?*” (Would you rather have orange or jello?).

Source: Elaborated by the author.

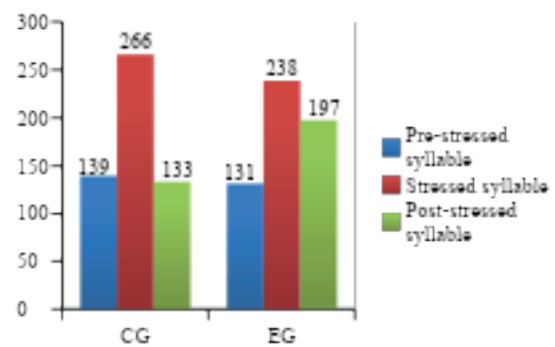


Figure 6. Duration, in milliseconds, of the syllables in the second disjunctive nucleus of the disjunctive question “*Você prefere laranja ou gelatina?*” (Would you rather have orange or jello?).

Source: Elaborated by the author.

Overall, when examining syllabic duration irrespective of sentence type, a general pattern emerges: the EG consistently exhibited longer syllabic duration when compared to the CG. This global tendency points to a broader prosodic profile, potentially associated with slower articulation rate, heightened segmental planning demands, or distinct rhythmic structuring (Dellwo et al., 2004; Ferreira, 1991). It is also consistent with findings in populations characterized by atypical prosodic profiles, though further investigation would be required to confirm any diagnostic association.

In addition to differences in duration, the two groups also diverged in terms of pitch variation. The EG showed a lower variation of F0 rise and fall in the nucleus when compared to the CG across all question types, which is observable below in Figures 7 and 8, for the pre-nucleus and nucleus of partial questions, respectively;

and on Figures 9 and 10 for first and second disjunctive nucleus of disjunctive questions, respectively.

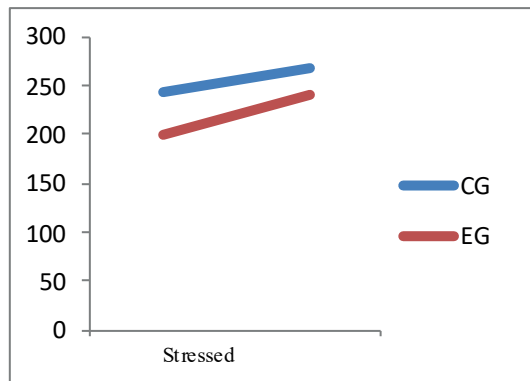


Figure 7. F0 variation of “*que*” on the pre-nucleus of the partial question “*Que horas são?*” (What time is it?)

Source: Elaborated by the author.

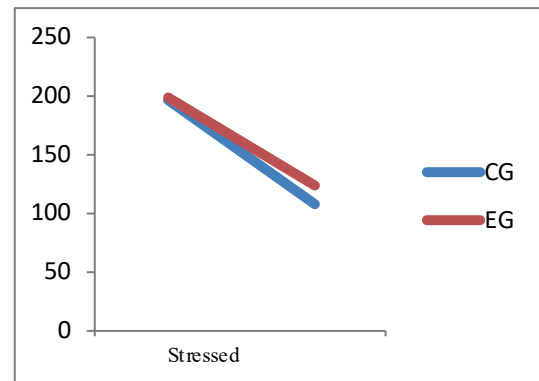


Figure 8. F0 variation of “*são*” on the nucleus of the partial question “*Que horas são?*” (What time is it?)

Source: Elaborated by the author.

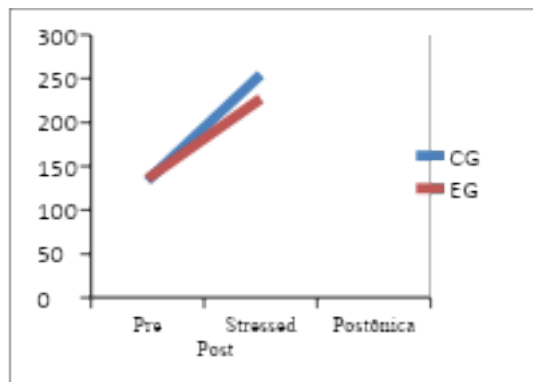


Figure 9. F0 variation on the first disjunctive nucleus “*laranja*” of the disjunctive question “*Você prefere laranja ou gelatina?*” (Would you rather have orange or jello?).

Source: Elaborated by the author.

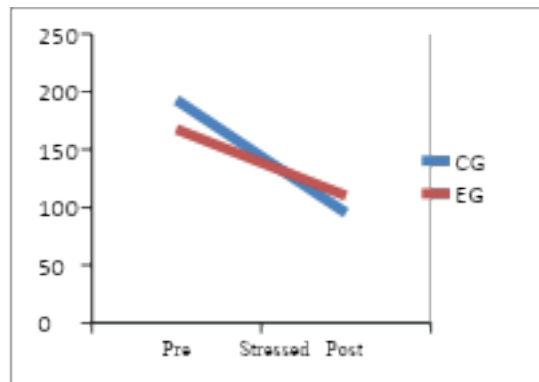


Figure 10. F0 variation on the second disjunctive nucleus “*gelatina*” of the disjunctive question “*Você prefere laranja ou gelatina?*” (-Would you rather have orange or jello?).

Source: Elaborated by the author.

Figures 7 and 8 illustrate the F0 variation in the partial question “*Que horas são?*” (“What time is it?”), with Figure 7 focusing on the pre-nuclear region and Figure 8 on the nuclear region of the utterance. These figures reveal a pattern of reduced pitch movement in the speech of the EG compared to the CG. In the pre-nuclear region, CG participants exhibit a wider F0 range, signaling dynamic pitch variation that contributes to the interrogative contour of the sentence. By contrast, EG productions display a profile with an inferior F0 excursion if compared to the CG. This pattern persists into the nuclear region, where the CG shows clear pitch modulation aligned with the stressed syllable, which is the prosodic nucleus of the question. The EG, however, maintains a less dynamic contour, suggesting reduced melodic prominence. Taken together, these figures indicate that while the structural placement of pitch accents may be preserved, their phonetic realization, parti-

cularly in terms of pitch dynamism, is attenuated in the EG. Figures 9 and 10 present F0 variation in the disjunctive question “*Você prefere laranja ougelatina?*” (“Would you rather have orange or jello?”), examining the first and second disjunctive nuclei, respectively. In Figure 9, the CG shows a rising contour associated with the first disjunct (“*laranja*”), consistent with the expected prosodic marking of contrast and continuation. The EG, however, exhibits a much narrower F0 rise in the same segment, reflecting a less variable F0 dynamic pattern. Figure 10 shows the F0 behavior in the second disjunct (“*gelatina*”), typically characterized by a falling contour marking the end of the utterance. In the CG, this fall is steep, indicating finality and closure. In contrast, the EG’s contour is again less dynamic, with a more gradual and limited fall. Together, these figures demonstrate that although EG participants may maintain the overall contour direction (rising in the first disjunct, falling in the second), the extent of pitch movement is reduced. This diminished melodic variation may influence the perception of contrast and sentence modality, supporting the interpretation that ASD speakers rely on a narrower intonational range while preserving the broader prosodic structure. Further studies on perception of these question types would be necessary to confirm this argument.

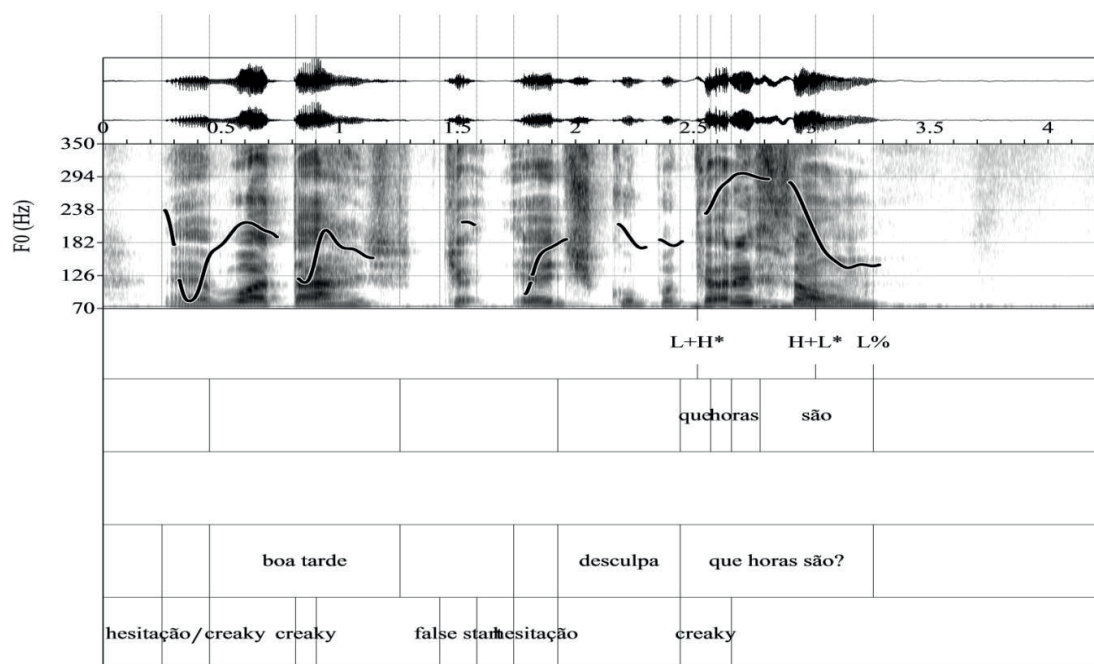


Figure 11. F0 and intonation notation of the partial question “Que horas são?” (What time is it?) produced by one participant of the EG.

Source: Generated by the author in the software Praat.

This reduction in melodic movement may reflect a flattened intonational contour⁷, which has been described in the literature as a marker of prosodic atypicality (McCann and Peppé, 2003). In particular, the reduced F0 range observed in the EG could suggest less dynamic intonation patterns, potentially impacting the pragmatic interpretation of sentence modality and speaker intention (Grice *et al.*, 2005). Interestingly, as shown in Figure 11, despite these acoustic differences in duration and pitch movement, the intonational notation, analyzed through prosodic labeling, did not differ significantly between groups. Both groups employed the same tonal categories, suggesting that while the phonological structure of intonation was preserved, the phonetic implementation of these contours could be altered in the EG. This distinction between phonological constancy and phonetic variability is well-documented in the prosody literature (Ladd, 2008), and it highlights the importance of examining both levels of analysis. In the Figure 12 below, we can observe the F0 movement on the utterance as a whole, and on the disjunctive nucleus.

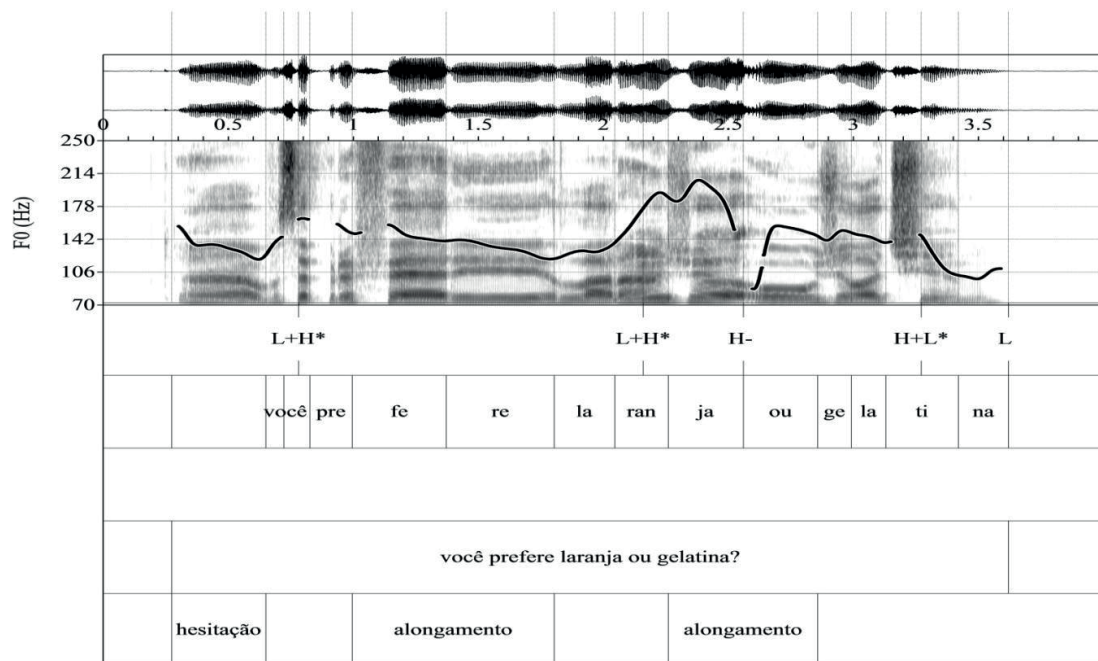


Figure 12. F0 and intonation notation of the disjunctive question “*Você prefere laranja ou gelatina?*” (Would you rather have orange or jello?) produced by one participant of the EG.

Source: Generated by the author in the software Praat

Figure 12 shows the F0 contour and the intonational notation for the disjunctive sentence examples produced by the EG, showing a rise in the first disjunctive nucleus, starting in the stressed syllable *ran*, and a high boundary tone right after

⁷ As pointed out in Lisboa (2024, chapter 4), a more refined review based on Lisboa and Roberto (2023), there is no consensus in the literature whether this “atypical” intonation of ASD individuals is monotonous (robotic) or exaggerated (singsongy). For a more detailed and descriptive review of prosody in ASD, readers are referred to Grice *et al* (2023).

the post-stressed syllable *ja*, and the falling contour over the second disjunctive nucleus, which is also the end portion of the utterance.

Moreover, a qualitative examination of the recordings revealed production discontinuities in the EG that were not observed in the CG. These included false starts, lengthening of segments, filled pauses, and hesitations. Such features may indicate increased cognitive load or difficulties with linguistic planning and execution, which often manifest through disruptions in fluency (Levelt, 1989; Shriberg et al., 2001). The presence of these discontinuities may further corroborate the hypothesis that the EG presents a more complex speech planning strategy to maintain communicative effectiveness despite underlying production challenges.

In summary, the results demonstrate a distinct prosodic pattern in the speech of the Experimental Group, characterized by longer syllabic durations, reduced pitch variation, and the presence of discontinuity markers. These differences are not attributable to changes in intonational structure *per se* but rather to their phonetic realization. Such findings underscore the importance of integrating both phonological and phonetic analyses in prosodic studies, especially when investigating populations that may deviate from typical speech patterns. Future studies should explore the cognitive and neurological underpinnings of these prosodic strategies, as well as the and consider how they interact with discourse-level planning, pragmatic interpretation, and listener perception.

Conclusion

This exploratory study explored the prosodic behavior of individuals with Autism Spectrum Disorder (ASD) in the production of interrogative utterances, with a particular focus on partial and disjunctive questions. Grounded in the principles of Laboratory Phonology and framed within an Autosegmental-Metrical (AM) model, the analysis combined phonological labeling and detailed phonetic measurements in order to understand the nature of intonational variation in ASD speech. By adopting an exploratory approach rather than a confirmatory one, this research emphasized the intrinsic variability of prosodic expression within ASD populations and resisted framing deviations from neurotypical norms as deficits.

One of the most prominent findings of this study was the consistent lengthening of syllabic duration across question types in the speech of ASD participants. Whether in total, partial, or disjunctive interrogatives, the experimental group displayed longer durations in stressed, pre-stressed, and post-stressed syllables than their control counterparts. This tendency could suggest a speech production strategy that relies more heavily on temporal cues to structure discourse. While this could be interpreted as a compensatory mechanism for communicative clarity, the data also support the possibility that this lengthening reflects a characteristic prosodic feature of this population. The data also revealed differences in melodic variation. Compared to the control

group, ASD participants exhibited reduced F0 excursions in both the pre-nuclear and nuclear regions of their utterances. This flatter intonational contour, while not affecting the overall phonological structure of the utterance as labeled through P-ToBI notation, marked a divergence in phonetic realization. These findings could reinforce a crucial distinction in prosodic studies: phonological categories may be shared across populations, while phonetic implementation can differ significantly. This distinction is especially relevant in clinical pragmatics, where such phonetic variations may affect how intentions are perceived and interpreted by listeners, although perception studies with this population should be performed in the future.

Importantly, the production of prosodic markers, such as boundary tones, pitch accents, and contour shapes, followed typical patterns from a structural standpoint (cf. Lisboa, 2024). Both experimental and control groups employed the same prosodic labels in their utterances, demonstrating an adherence to the grammatical underpinnings of question intonation in Brazilian Portuguese. However, the phonetic realization of these structures differed in significant ways. For example, post-stressed syllables in sentence-final positions were markedly longer in the speech of ASD participants, particularly in disjunctive questions.

The presence of speech planning markers, such as hesitations, false starts, and filled pauses, was another notable characteristic of the ASD participants' speech. These phenomena could suggest increased cognitive load during production and point toward a more complex relationship between prosody and speech planning in this group. While these features are often treated as signs of disfluency, this study interprets them as evidence of an adaptive and individualized approach to linguistic formulation. In this light, prosodic variation in ASD is not a symptom to be pathologized but a communicative style worthy of description and understanding on its own terms. Taken together, the results of this study challenge deficit-based models of prosody in ASD. They demonstrate that while acoustic and phonetic properties may diverge from neurotypical norms, the fundamental prosodic architecture remains intact. This supports a view of ASD prosody as a domain of interindividual variation rather than impairment. Furthermore, these findings lend support to recent calls in the literature for greater emphasis on exploratory research designs, which are better suited to capturing the complexity and nuance of communicative behavior in non-normative populations.

By focusing on the production of interrogatives, this study was able to illuminate the ways in which ASD speakers manage pragmatic meaning and interactional stance through prosodic modulation. As questions play a key role in organizing discourse, turn-taking, and speaker intention, their prosodic realization offers a powerful lens through which to understand communication beyond grammatical form. This study, therefore, contributes to a more inclusive view of linguistic competence, one that recognizes the legitimacy of diverse prosodic expressions and advocates for analytical models capable of accommodating such variability.

Future research should aim to expand the dataset, incorporate perceptual evaluations, and further investigate the interaction between prosody, cognition, and discourse management in ASD. The integration of phonological, phonetic, and pragmatic perspectives, as pursued here, has the potential to reshape our understanding of prosodic variation and to promote more nuanced approaches in both linguistic theory and clinical practice. Currently, our research group is working on the analysis of intonation phrasing based on reading *corpora* of ASD population, and we are also developing a project to analyze the integration of prosody on interaction between ASD dyads.

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