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Abstract

One or two sentences providing a **basic introduction** to the field, comprehensible to a scientist in any discipline.

Two to three sentences of **more detailed background**, comprehensible to scientists in related disciplines.

One sentence clearly stating the **general problem** being addressed by this particular study.

One sentence summarizing the main result (with the words “**here we show**” or their equivalent).

Two or three sentences explaining what the **main result** reveals in direct comparison to what was thought to be the case previously, or how the main result adds to previous knowledge.

One or two sentences to put the results into a more **general context**.

Two or three sentences to provide a **broader perspective**, readily comprehensible to a scientist in any discipline.

*Keywords:* keywords

*Word count:* X

The title

# Introduction

A fundamental difficulty of speech comprehension is that listeners can come to understand different messages when presented with the same linguistic information (Cain, Oakhill, & Lemmon, 2004). This can be especially problematic when one begins the endeavor of learning a new language. In particular, it is common for second language (L2) learners to struggle with intonation—i.e., the melodic contour of an utterance—in the target language (Trofimovich & Baker, 2006). The difficulties associated with intonation can result in comprehension and communication mishaps because the tune is associated not only with linguistic information (e.g., utterance type, syntactic constituency), but also pragmatic information (e.g., polite discourse Astruc, Vanrell, & Prieto, 2016; bias, or presupposition Henriksen, Armstrong, & Garcı́a-Amaya, 2016). The present study investigates how the comprehension of intonation develops in adult L2 learners.

Recent research on monolingual populations suggests that individual differences in pragmatic skills, such as empathy, may play a role in meaning disambiguation (Bishop & Kuo, 2016; Esteve-Gibert, Portes, Schafer, Hemforth, & D’Imperio, 2016; Esteve-Gibert et al., 2020; Orrico & D’Imperio, 2020). Concretely, higher empathy individuals, in comparison with lower empathy individuals, appear to be more sensitive to the intonational cues of speech during the process of forming sound-meaning associations. Furthermore, increasing attention has been given to how individual differences in learner backgrounds play a role in the process of L2 acquisition. The present study contributes to these lines of research by examining how individual differences in pragmatic skills affect the development and processing of intonation during sentence comprehension. Specifically, we investigated the interplay between language proficiency and an individual pragmatic skill (empathy) when learning an L2. We focus on the role of empathy in the development of L2 prosody by analyzing the perception and processing of intonation in questions and statements in L2 Spanish.

## Background and motivation

### L2 acquisition of prosody.

The difficulties associated with learning an additional language in adulthood are numerous. More often than not our focus falls on individual sounds, or segments, though we know that adults who learn an L2 are faced with suprasegmental challenges as well. Concretely, L2 learners often struggle with intonation, i.e., melodic variation at the utterance level. In normal discourse, speakers use intonation to indicate syntactic structure, whether an utterance is a question or a statement, to focus constituents, as well as to convey affective meaning. Notably, the manner in which intonation is mapped to meaning is often language-specific. For these reasons, the development of L2 intonation represents a facet of L2 phonological learning that often results in comprehension and communication difficulties (Trofimovich & Baker, 2006).

As alluded to above, intonation has a semantic function, and through the adequate cognitive decoding of intonation a listener can interpret the function of a given utterance. For example, the intonational contour can indicate whether a speakers’ utterance is declarative or interrogative in nature. Additionally, through prosody a speaker can signal various additional pragmatic functions, such as when they present a polite discourse (Astruc et al., 2016), bias or presupposition (Henriksen et al., 2016). One essential aspect of second language acquisition and language comprehension is that in the presence of the same linguistic elements, listeners can arrive at different interpretations of the message (e.g. Cain et al., 2004). The difficulty in interpreting and decoding the multiple functionalities of intonational contours makes L2 learning a challenge.

Traditionally, intonation is not taught in the L2 classroom. Primary focus is generally on syntax and morphology, with target language phonology receiving much less, if any, attention (REFS). When target language pronunciation is addressed, it often focuses on segmental elements. As a result, intonation is one of the last aspects of L2 phonology that learners acquire (REFS)

Generally, research on L2 intonation has been concerned primarily with production. Learner difficulties are generally ascribed to L1 transfer, and models of L2 phonology focus on the speech segment (i.e., PAM-L2, SLMr, L2LP, though CF trofimovich paper extending SLM) There is a dearth of knowledge with regard to how perception of intonation develops in L2 learning, and even less is known about how individual pragmatic differences account for learner outcomes. The purpose of the present project is to address this gap in the literature by examining the perception and processing of intonation during adult L2 phonological acquisition.

### Acquisition of Spanish prosody.

Spanish is extensively spoken across the world, with relatively small geolectal differences between its varieties compared to other languages, such that speakers from distinct regions can still generally understand each other. This linguistic continuum allows, however, for variation to occur. Previous research on the acquisition of Spanish prosody attests that learners gradually acquire target-language intonation as they gain proficiency in the language. Research in this area has focused on speech production. For instance, Trimble (2013a) analyzed L2 Spanish learners’ production of intonational patterns for broad focus declaratives and absolute interrogatives after a semester-long study abroad program.

Research on perception of Spanish intonation also supports the notion that mastery is indeed possible for adult learners. Trimble (2013b) examined the perception of intonational cues … Trimble (2013b) found that intonational cues that were absent form participants’ L1 were difficult to perceive. Unsurprisingly, the study suggests the L2 intonation system develops in tandem with proficiency in Spanish, which was positively correlated with time spent studying abroad.

In a similar vein, Brandl, González, and Bustin (2020) investigated the perceptual development of intonation in questions and statements in L2 Spanish. Specifically, Brandl et al. (2020) examined the effect of L2 proficiency on the perception of statements (broad-focus and narrow-focus) and questions (wh-questions and yes/no questions). Adult English L1-Spanish L2 learners (beginner, intermediate, and advanced) and adult native speakers of Spanish completed an AX discrimination task in which they were presented with two stimuli sentences at a time, one aural and one visual. Participants had to decide whether the sentence presented aurally was the same as the sentence presented visually by pressing a button (‘yes’, ‘no’).

The study found that perception and processing of L2 intonation improved in conjunction with proficiency conditional on intonation type, with polar (‘yes/no’) interrogatives being more difficult to process and acquire when compared with simple statements. Accuracy was high in match conditions, but accuracy in mismatch conditions was below chance for all L2 learners. Regarding response times, intermediate learners were the fastest overall, and native speakers were the slowest. Learners with lower proficiency processed statements faster than questions. Brandl et al. (2020) concluded that L2 intonation perception differs from L1 intonation perception in Spanish, that L2 intonation perception undergoes a gradual development as L2 acquisition progresses, and that statements are more easily processed and acquired by L2 learners of Spanish, compared to yes/no questions.

### Empathy.

The construct empathy has been shown to influence native language processing in how listeners interpret intonation and meaning when words are ambiguous (Esteve-Gibert et al., 2020).

Recent research has also shown that empathy influences native language processing in how listeners interpret intonation and meaning when words are ambiguous (Esteve-Gibert et al., 2020). Specifically, higher empathy individuals, in comparison with lower empathy individuals, appear to be more sensitive to intonation cues in the process of forming sound-meaning associations. In short, individuals with more pragmatic skill (higher empathy) are able to use intonation to resolve temporary lexical ambiguity that can lead to confirmatory vs. contrasting interpretations. This research underscores the importance of considering individual pragmatic differences when examining intonational meaning processing and sentence comprehension. Thus, we extend this research to second language acquisition in order to determine if individual differences in pragmatic skills affect the development of intonation in L2 processing and sentence comprehension.

According to Esteve-Gibert et al. (2020), empathy can be understood as it is related to theory of mind and perspective taking (Baron-Cohen, 2011; Carruthers, 2009; Frith & Frith, 2003). In other words, those with higher empathy are expected to more effectively take the perspective of another, and past research has investigated whether better perspective taking is related to more effective meaning disambiguation. Evidence has been found for the use of intonational cues to disambiguate meaning by higher empathy individuals in monolingual speech (Esteve-Gibert et al., 2020). On the other hand, there is also evidence that higher proficiency Spanish speakers can effectively distinguish questions from statements (Brandl et al., 2020).

Speakers use intonational cues to express feelings, intentions, and pragmatic meaning (see Prieto, 2015), but listeners vary in how they interpret intonational cues to infer meaning (e.g., Bishop & Kuo, 2016, 2016; Portes, Beyssade, Michelas, Marandin, & Champagne-Lavau, 2014). This variability could be related to differences in individual pragmatic skills. Previous studies have shown that individual pragmatic skills correlate with variability in semantic/pragmatic interpretation of ambiguous linguistic items, with more pragmatic individuals preferring pragmatically enriched interpretations and less pragmatic individuals preferring literal/semantic interpretations (e.g., Degen & Tanenhaus, 2016; Nieuwland, Ditman, & Kuperberg, 2010). In addition, more pragmatically skilled individuals and less pragmatically skilled individuals tend to rely on different phonetic cues to parse syntactically ambiguous sentences (Bishop & Kuo, 2016). It is possible that variability in intonation processing is also linked to individual differences in pragmatic skills.

Recent studies have explored the possibility that individual pragmatic skills can modulate the sensitivity of listeners to intonational cues that convey pragmatic meaning. Esteve-Gibert et al. (2020) focused specifically on empathy, which is a pragmatic skill that helps listeners understand other peoples’ feelings, emotions, intentions, and behavior (Baron-Cohen & Wheelwright, 2004). Esteve-Gibert et al. (2020) investigated whether listeners’ empathy modulated variability in intonation processing. Empathy was measured using a self-reported Empathy Quotient (EQ) questionnaire (Baron-Cohen & Wheelwright, 2004). Esteve-Gibert et al. (2020) tested French monolinguals in a visual-world paradigm eye-tracking task that resembled a card guessing game. Participants listened to short dialogues in French between two players (Player A and Player B) playing a card guessing game as they saw a display of four objects on a screen. Participants had to identify the object that depicted the picture of the card of one of the players. Target objects were homophones in French (e.g., cane - “female duck”; canne - “walking stick”). The dialogues consisted of a suggestion by Player A (e.g., “I think you have a stick”) followed by Player B’s response, which could confirm (e.g., “I have a stick, indeed, to walk”) or contrast (e.g., “I have a female duck, instead, the animal”) Player A’s suggestion. The first portion of Player B’s responses varied in intonational contours (confirmation or contrast of beliefs) and had subsequent disambiguating lexical information (indeed/instead + additional information). Results indicated that empathy level affected the processing of an ambiguous word (a homophone) when intonation was the only cue available. Highly empathic individuals varied their looking behavior as a function of intonational cues while less empathic individuals did not. However, the direction of the looking behavior of the highly empathic individuals was not as expected and reverse intonation-meaning mapping was observed. Confirmation intonation did not trigger more looks to the suggested image and contrast intonation did not trigger more looks to objects other than the suggested image.

To explore this unexpected finding further, Esteve-Gibert et al. (2020) tested an additional group of French monolinguals in an offline matching task in which they listened only to the ambiguous portion of Player B’s response (e.g., “I have a stick.”, “I have a female duck.”) and matched the sentences to either a confirmatory or contrastive meaning. Intonation was the only disambiguating cue available. Results showed that the higher the listeners’ empathy, the more accurate they were matching intonation to meaning. Esteve-Gibert et al. (2020) concluded that listeners use empathy as a pragmatic ability to process linguistic information and that empathy influences how listeners use intonation to infer pragmatic meaning, especially when linguistic information is ambiguous or non literal. Pragmatic skills like empathy need to be considered when investigating intonation processing in typical and atypical individuals.

## The present study

We investigate the interplay between proficiency and individual pragmatic skills via empathy in the development of second language (L2) prosody by analyzing the perception of intonation in questions and statements in L2 Spanish.

It is unclear whether those with higher empathy also take advantage of intonational cues to infer another speaker’s communicative intent in a second language when proficiency is also taken into account.

The present study investigates whether L2 learners of Spanish with higher empathy are more effective in distinguishing statements from questions when proficiency is held constant.

the project intends to contribute to cumulative science by conceptually replicating the Brandl et al. (2020) finding, which demonstrates that perception and processing of L2 intonation improves in conjunction with L2 proficiency and as a function of intonation type. Second, this research will extend the current findings on perceptual development to include pragmatic skills, specifically empathy.

This research builds on recent studies looking at the role of individual pragmatic skills in language processing and extends them to the field of second language acquisition. Concretely, we examine the role of empathy in the development of L2 prosody by analyzing the perception of intonation in questions and statements in L2 Spanish. L2 learners gradually acquire Spanish prosody as they gain proficiency in the language. The extant literature shows that ‘yes/no’-type questions are harder to process and acquire, when compared with simple statements (Brandl et al., 2020).

Current study is a conceptual replication of Brandl et al. (2020) - Extend current findings on perceptual development to include pragmatic skills (empathy) - Build on studies that look at the role of individual pragmatic skills in language processing - And if individual differences in pragmatic skills affect the development of intonation in L2 processing and sentence comprehension - Examine the role of empathy in the development of L2 prosody by analyzing the perception of intonation in questions and statements in L2 Spanish

### Research questions.

Research question 1: Is perceptional development in L2 Spanish modulated by proficiency and intonation type (i.e., Brandl et al., 2020)?  
Hypothesis: Accuracy will increase and processing time will decrease as a function of proficiency and intonation type. Yes-no questions will present the most difficulty for L2 learners of Spanish, followed by wh-questions and declarative broad focus and narrow focus statements.

Research question 2: Do pragmatic skills—specifically, empathy—modulate the rate of development in L2 prosody? Hypothesis: Based on the findings of Esteve-Gibert et al. (2020), we posit that prosodic development will occur sooner and at a faster rate in higher empathy individuals. In this operationalization, ‘sooner’ refers to lower proficiency levels in a cross-sectional design, that is, at an earlier developmental stage than lower empathy individuals.

Research question 3: Does speaker variety affect perception accuracy and processing speed? Hypothesis: Based on tentative findings from native speaker pilot data, we hypothesize that overall L2 learners will have most difficulty (lower accuracy, slower RTs) with the Cuban variety.

# Method

## Participants

The participant pool included XX English L1 - Spanish L2 learners. Participants were recruited…

## Tasks

In the study, participants completed three tasks in the following order: LexTALE, Empathy questionnaire, and Two-alternative forced choice task…

### LexTALE.

The LexTALE is a vocabulary test that provides a proxy of proficiency based on vocabulary size…

### Empathy Questionnaire.

Participants completed a questionnaire that assessed their…

### 2afc.

Participants completed a two-alternative forced choice task in which they listened to sentences in Spanish and had to decide whether the sentences were questions or statements…

## Stimuli

The experimental items consisted of sentences in Spanish…

## Procedure

Data collection was carried out online. Participants were provided with…

## Statistical analyses

Data was analyzed using…

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