Using intonation to disambiguate meaning: The role of empathy and proficiency in L2 perceptual development

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Abstract

The present study investigates the interplay between proficiency and individual pragmatic skills in the process of learning a new language. Notably, we focus on the role of empathy in the development of second language (L2) prosody by analyzing the perception and processing of intonation in questions and statements in L2 Spanish. It is common for L2 learners to struggle with L2 intonation, often resulting in comprehension and communication difficulties (Trofimovich & Baker, 2006). Previous research attests that learners gradually acquire target-language prosody as they gain proficiency in the language. Concretely, the perception and processing of L2 intonation has been shown to improve in conjunction with proficiency conditional on intonation type (Brandl, González, & Bustin, 2020), with polar (‘yes/no’) interrogatives being more difficult to process and acquire when compared with simple statements. 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). Importantly, 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. We extend this research to L2 acquisition in order to determine if individual differences in pragmatic skills affect the development of intonation in L2 processing and sentence comprehension. A total of N adult L2 Spanish learners (L1 English) from the Northeastern United States completed a two-alternative forced choice (2AFC) task in which they listened to four utterance types and categorized them as either questions or statements. The stimuli were randomly drawn tokens of declarative (broad, narrow focus) and interrogative (polar, wh-) sentences, spoken by native speakers of eight distinct varieties of Spanish (Andalusian, Argentine, Castilian, Chilean, Cuban, Mexican, Peruvian, Puerto Rican). The stimuli were presented aurally to the participants and subsequently identified as questions or statements using a keyboard. Additionally, participants completed the LexTALE vocabulary task in Spanish (Izura, Cuetos, & Brysbaert, 2014), which served as a proxy for L2 proficiency, as well as the Empathy Quotient questionnaire in English (Baron-Cohen & Wheelwright, 2004), which provided an individual assessment of the construct empathy. We used Bayesian multilevel regression and Drift Diffusion models to analyze the 2AFC data as a function of proficiency and empathy scores. Proficiency and empathy were used as continuous predictors to assess their relationship with pragmatic skill. The results replicated findings from Brandl et al. (2020) showing that learner response accuracy improved as a function of proficiency for all utterance types. Importantly, higher empathy scores were positively correlated with higher accuracy in identifying polar interrogatives. As is the case with L1 research, the present project underscores the importance of considering individual pragmatic differences when examining intonational meaning processing and sentence comprehension in an L2. More notably, the results also motivate the inclusion of measures of pragmatic skill, such as empathy, as predictors for L2 acquisition outcomes. Furthermore, these findings highlight an area in which models of L2 development can improve in order to better account for individual differences in L2 learning.

*Keywords:* Second language acquisition, Intonation, Empathy, Prosody

*Word count:* X

Using intonation to disambiguate meaning: The role of empathy and proficiency in L2 perceptual development

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 the 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 polite discourse (Astruc et al., 2016), bias or presupposition (Henriksen et al., 2016). One essential aspect of speech 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).

Unsurprisingly, interpreting and decoding the numerous functions of intonational contours in an L2 makes this aspect of speech comprehension particularly challenging for the learner. 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 (Rao, 2019). When target language pronunciation is addressed, it often focuses on segmental elements (de-la-Mota, 2019). As a result, intonation is one of the last aspects of L2 phonology that learners acquire (Kvavik & Olsen, 1974).

Research on L2 intonation has been concerned primarily with production. Learner difficulties tend to be ascribed to L1 transfer, and models of L2 phonology focus on the speech segment, as in the Speech Learning Model revised (Flege & Bohn, 2021), or contrasts between segments, i.e., PAM-L2, L2LP (Best & Tyler, 2007; Van Leussen & Escudero, 2015, respectively). Though some researchers have considered how these models account for suprasegmental phenomenon (See Trofimovich & Baker, 2006), a dearth of knowledge remains 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. Phonetic variation, however, is abundant. INTONATION EXAMPLES HERE FROM DE LA MOTA.

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 et al. (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 mismatched audio and visual stimuli. Participants’ task was to decide whether the sentence presented aurally was the same as the sentence presented visually. Brandl et al. (2020) 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. The authors concluded that perception of L2 intonation develops gradually as acquisition progresses.

To summarize, the extant literature suggests that mastery of L2 perception of intonation seems feasible for adult learners, as processing speed and accuracy and both improve as L2 proficiency increases. That being said, some utterances present more difficulties than others. Furthermore, familiarity with the L2 variety has a positive impact on learner outcomes, which is particularly relevant given the rich phonetic variability attested in Spanish prosody. Much less is known regarding how perceptual development is modulated by individual differences related to pragmatic skill. Studies on monolinguals suggest 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 tend to rely on different phonetic cues to parse syntactically ambiguous sentences with regard to less pragmatically skilled individuals (Bishop & Kuo, 2016). Thus, one possibility is that variability in intonation processing is also linked to individual differences in pragmatic skills.

**Empathy and pragmatic skill**. The construct empathy refers to one’s ability to infer the intentions of others. It is associated with understanding the feelings and emotions of those with whom one interacts (Baron-Cohen & Wheelwright, 2004). Research on empathy has associated the construct with Theory of Mind and perspective-taking (Baron-Cohen, 2011; Carruthers, 2009; Frith & Frith, 2003). Importantly, in recent years empathy has served a proxy for investigating individual pragmatic skill.

A series of studies has investigated how empathy influences language processing in monolingual populations (Esteve-Gibert et al., 2016, 2020; Orrico & D’Imperio, 2020). This work operationalizes the construct empathy as a pragmatic skill and has focused on it as a source of individual differences. For instance, Esteve-Gibert et al. (2020) examined how listeners with different levels of empathy interpreted intonation and meaning in contexts in which a temporary lexical ambiguity could only be resolved through intonation. 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 the context of this study 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. Target objects were homophones in French (e.g., cane - “female duck”; canne - “walking stick”). Esteve-Gibert et al. (2020) found that the processing of the lexical ambiguity (the homophones *cane*/*canne*) was modulated by empathy level when intonation was the only cue available. That is, highly empathic individuals varied their looking behavior as a function of intonational cues while less empathic individuals did not.

In short, individuals with more pragmatic skill (higher empathy) appear to be 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. To the best of our knowledge, no studies have explored the construct empathy and its relationship with L2 perceptual development. Thus, we extend this research to the SLA context in order to determine if individual differences in pragmatic skill, concretely empathy, affect the development of intonation in L2 processing and sentence comprehension.

## The present study

We investigate how proficiency and empathy are related to the development of L2 prosody by analyzing the perception of intonation in questions and statements in L2 Spanish. This study was pre-registered on the Open Science Framework[[1]](#footnote-22) and designed to address the following research questions:

1. Is perceptional development in L2 Spanish modulated by proficiency and intonation type (i.e., Brandl et al., 2020)?
2. Do pragmatic skills—specifically, empathy—modulate the rate of development in L2 prosody?
3. Does speaker variety affect perception accuracy and processing speed?

Regarding RQ1, we hypothesize that accuracy will increase and processing time will decrease as a function of proficiency and intonation type. As shown in previous studies, 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. 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 (RQ2). 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. Finally, with regard to RQ3, based on tentative findings from native speaker pilot data, we hypothesize that, overall, L2 learners will have most difficulty (lower accuracy, slower response time) with the Cuban variety.

This project presents a conceptual replication of Brandl et al. (2020) in that we employ a similar experimental paradigm using similar stimuli in order to analyze the relationship between proficiency and L2 perception of intonation. We extend this research by taking into account pragmatic skill, specifically empathy, in L2 sentence processing. Importantly, this research builds on recent studies looking at the role of individual pragmatic skills in language processing and extends them to the field of SLA.

# Method

## Participants

Participants were adult native speakers of English with varied levels of proficiency in Spanish (determined by the LexTALE task). Participants were be recruited via Prolific and were be compensated at a rate of $9.52 per hour for their time. We estimated the task would take approximately 15 minutes to complete, thus each participant was compensated with $2.70 for completing all three tasks.

Participants were L1 speakers of American English who ranged from functionally monolingual to highly proficient in Spanish (bilinguals). All participants with knowledge of Spanish were adult L2 learners, operationally defined as having begun the endeavor of learning Spanish after the age of 13.

We planed to collect data from 300 individuals (100 monolingual Spanish speakers and 200 L2 learners). Following Brandl et al. (2020), we assumed the effect size for perceptual learning was moderate in terms of the criteria set forth for L2 research by Plonsky and Oswald (2014) (Cohen’s D = 0.600, Pearson’s r = 0.287). Based on this assumption, we estimated that we would need 94 participants to have an 80% chance of capturing the proficiency effect with a type II error rate of 5%. Our hypothesis related to empathy as a possible mediator of perceptual learning is exploratory in nature and thus we did not base our sample size estimate on any parameter estimates related to this effect. That said, we believed the aforementioned exploratory effect was likely to be small, and, considering the resources necessary and available to us, we planned to recruit 100 additional participants.

The pool of online-recruited participants was filtered using criteria set in Prolific.ac to insure participants self-reported as being L1 English speakers born, raised, and currently living in the US with no knowledge of any languages other than English and/or Spanish. They reported no hearing difficulties and were required to use headphones on a desktop computer. Upon beginning the experiment, all participants responded to the following screening questions: 1) What part of the US are you from? 2) At what age did you begin learning Spanish? 3) Are you proficient in any languages other than English/Spanish?. Additionally, participants responded to the prompt “I am most familiar with Spanish from…” and using a pull-down window they selected a variety of Spanish or “I am not familiar with any variety of Spanish”.

We excluded data from any participant that responded that they were not from the US Northeast, that they began learning Spanish before the age of 13, or that they were proficient in a language other than English/Spanish. Participants responding categorically across all trials were also excluded.

## Tasks

The study consists of three tasks, given in the following order: a two-alternative forced choice task (2AFC), followed by the LexTALE, and, finally, the Empathy quotient (EQ).

**2afc**. In the 2AFC task participants will be presented with an audio file containing a statement (declarative: broad focus or narrow focus) or a question (yes-no or wh-). Their task is to determine, as quickly and as accurately as possible, if the utterance they hear is a question or a statement. Specifically, they will respond to the question “Is this a question” using the keyboard. They will type ‘1’ for “yes” (meaning “yes, this is a question”) and ‘0’ for ‘no’ (meaning “no, this is not a question”). The stimuli consist of 64 critical items, 16 of each sentence type. To generate the stimuli, we recorded native Spanish speakers of 8 different varieties (Cuban, Castilian, Andalusian, Puerto Rican, Chilean, Argentinean, Mexican, and Peruvian). The 8 native speakers all produced the same 64 critical items. We segmented all utterances using Praat and normalized them for peak intensity. The 2AFC task consists of 64 trials in which the stimuli presented are randomized across speaker variety. Each variety has the same probability of being selected on a given trial, such that, on average, a given participant will hear each variety approximately 8 times. The 2AFC task will be administered online using PsychoPy (Peirce et al., 2019) and participants will be recruited using the Prolific.ac online experimental platform. The task takes approximately 5 minutes to complete.

The experimental items consisted of sentences in Spanish…

We piloted the 2AFC experiment on 100 native Spanish speakers to assure critical item quality and assess the difficulty of the task. Crucially, our existing data does not include our population of interest, L2 learners.

**LexTALE**. The LexTALE task (Lemhöfer & Broersma, 2012) is a lexical decision experiment in which the participants are presented real and nonsense words. We will administer the Spanish version, LexTALE-ESP (Izura, Cuetos, & Brysbaert, 2014). Participants have to decide if the word they are presented is real or not using the keyboard (‘1’ for real, ‘0’ for fake). The purpose of the LexTALE task is to get an assessment of the participants’ vocabulary size in Spanish, which is assumed to be a proxy for Spanish proficiency. The LexTALE task takes approximately 5 minutes to complete.

We administered the Lexical Test for Advanced Learners of Spanish (Izura et al., 2014; LexTALE-ESP, Lemhöfer & Broersma, 2012) in order to provide a standardized assessment of the participants’ proficiency/vocabulary size in Spanish. On this measure, scores can range from −20 to 60, with native speaker values generally above 50. Individuals with little or no knowledge of Spanish typically score from −20 to 0. For the purposes of the present study, proficiency is treated as a continuous variable, thus we consider a monolingual English speaker to have little to no proficiency in Spanish.

**Empathy Questionnaire**. Finally, participants will complete the Empathy Quotient (EQ, Baron-Cohen & Wheelwright, 2004), a 60-item questionnaire that presents likert-type items ranging from ‘strongly agree’ to ‘strongly disagree’. The EQ is scored to produce a single value indicating an individual’s level of empathy. The EQ takes approximately 5 minutes to complete.

## Procedure

We excluded data according to the following criteria: error during data collection; clear lack of understanding or engagement during the task, i.e., all ‘1’ responses, failed three attention checks, etc.; participants reporting having learned Spanish before the age of 13; participants with knowledge of language other and English and Spanish. Data from a total of 78 participants was discarded because the session timed our and/or data was incomplete. An additional 8 participants were discarded due to low accuracy (n = 5), incomplete data (n = 2), and failed attention checks (n = 1). A total of 224 participants met the criteria for inclusion.

Participants were recruited via Prolific.ac. They completed the all three tasks in a single session. The 2AFC task was first, followed by the LexTALE task, and, finally, the empathy quotient questionnaire. Participants spent an average of 12.93 minutes (SD: 8.71) to finish the complete experiment.

## Statistical analyses

We report two primary statistical analyses that were pre-registered prior to collecting the learner data. First, we analyzed response accuracy using Bayesian hierarchical logistic regression. The model considered response accuracy for the population effects *utterance type* (declarative broad focus, declarative narrow focus, interrogative yes/no, interrogative -wh), proficiency (i.e., LexTALE score), empathy quotient, and the proficiency by empathy quotient interaction. The likelihood of the model was Bernoulli distributed with a logit link function. The criterion, *response*, was coded as “1” for correct responses and “0” for incorrect responses. Thus, the first analysis modeled the probability of responding correctly to the prompt “Is this a question”. We specified group-level effects for participants, speaker variety, and items.  
The slope for *utterance type* varied for the participant effect, as did the proficiency by empathy quotient interaction for the speaker variety effect. All continuous variables were standardized and ‘interrogative yes/no’ was set as the baseline for *utterance type*, thus the model intercept represents the probability of a learner with average proficiency and average empathy responding correctly to a yes/no question.

This is Figure 1

![Figure 1.   Need a caption.](data:application/pdf;base64,)

*Figure* *1.*  Need a caption.

The model included regularizing, weakly informative priors (Gelman, Simpson, & Betancourt, 2017).

We established a region of practical equivalence (ROPE) of ± 0.05 around a point null value of 0 (see Kruschke, 2018). We will sample the posterior distribution of the model for statistical inferences. A region of practical equivalence (ROPE) will be established around a point null value of 0 (Kruschke, 2018) using the following formula:

For all models, median posterior point estimates are reported for each parameter of interest, along with the 95% highest density interval (HDI), the percent of the region of the HDI contained within the ROPE, and the maximum probability of effect (MPE). For statistical inferences, a posterior distribution for a parameter β in which 95% of the HDI falls outside the ROPE and a high MPE (i.e., values close to 1) were taken as compelling evidence for a given effect. All exploratory analyses, explicitly described as such, include posterior point estimates, the 95% HDI and the MPE. The analyses were conducted in R and models fit using the probabilistic programming language stan via the R package brms (Bürkner, 2017, 2018).

# Results

This is Figure 2

![Figure 2.   Response accuracy: Probability of a correct response for each utterance type in the logistic space.](data:application/pdf;base64,)

*Figure* *2.*  Response accuracy: Probability of a correct response for each utterance type in the logistic space.

This is Figure 3

![Figure 3.   Response accuracy: Partially pooled estimates for each speaker variety.](data:application/pdf;base64,)

*Figure* *3.*  Response accuracy: Partially pooled estimates for each speaker variety.

This is Figure 4

![Figure 4.   Response accuracy: Probability of a correct response in the logistic space as a function of LexTALE score (A) and LexTALE score for each utterance type (B). Colored lines represent 300 draws from the posterior distribution.](data:application/pdf;base64,)

*Figure* *4.*  Response accuracy: Probability of a correct response in the logistic space as a function of LexTALE score (A) and LexTALE score for each utterance type (B). Colored lines represent 300 draws from the posterior distribution.

This is Figure 5

![Figure 5.   Response accuracy: Probability of a correct response in the logistic space as a function of empathy quotient (A) and empathy quotient for each utterance type (B). Colored lines represent 300 draws from the posterior distribution.](data:application/pdf;base64,)

*Figure* *5.*  Response accuracy: Probability of a correct response in the logistic space as a function of empathy quotient (A) and empathy quotient for each utterance type (B). Colored lines represent 300 draws from the posterior distribution.

This is Figure 6

![Figure 6.   Response accuracy: Probability of a correct response as a function of empathy quotient and LexTALE score for each question type.](data:application/pdf;base64,)

*Figure* *6.*  Response accuracy: Probability of a correct response as a function of empathy quotient and LexTALE score for each question type.

This is Figure 7

![Figure 7.   Need a caption.](data:application/pdf;base64,)

*Figure* *7.*  Need a caption.

This is Figure 8

![Figure 8.   Two-thousand simulations of the drift diffusion model for interrogative utterances as a function of empathy quotient (low/high) and LexTALE score (low/high). Low and high levels represent ±2 standard deviations above/below the mean. Dark red lines represent the average decision time course.](data:application/pdf;base64,)

*Figure* *8.*  Two-thousand simulations of the drift diffusion model for interrogative utterances as a function of empathy quotient (low/high) and LexTALE score (low/high). Low and high levels represent ±2 standard deviations above/below the mean. Dark red lines represent the average decision time course.

# Discussion

# Conclusion

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Appendix

# On-line supplementary material

## Drift diffusion models

## Supplementary analyses

This is Figure 9

![Figure 9.   Make sure each variety represented equally over course of experiment.](data:application/pdf;base64,)

*Figure* *9.*  Make sure each variety represented equally over course of experiment.

This is Figure 10

![Figure 10.   Make sure each variety represented equally over course of experiment.](data:application/pdf;base64,)

*Figure* *10.*  Make sure each variety represented equally over course of experiment.

## Reproducibility information

**About this document**

This document was written in RMarkdown using papaja (**R-papaja?**).

**Session info**

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1. See <https://osf.io/dh4zp/?view_only=162d6d13e5814417bcb9de349f18cb62> [↑](#footnote-ref-22)