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Spanish–English Cross-Linguistic Influence on Heritage Bilinguals' Production of Uptalk

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Abstract: The present study examines the production of uptalk in Spanish and in English by Spanish heritage speakers in Southern California. Following the L2 Intonation Learning Theory, we propose that cross-linguistic influence in heritage bilinguals' uptalk may occur along multiple dimensions of intonation. In this study, we examined the systemic dimension (i.e., presence of uptalk and presence of uptalk with IP-final deaccenting), the frequency dimension (i.e., frequency of uptalk and frequency of uptalk with IP-final deaccenting), and the realizational dimension (i.e., pitch excursion and rise duration) of heritage bilinguals' uptalk. Our data showed that the three dimensions of intonation demonstrate varying degrees of cross-linguistic influence. The heritage bilinguals produced uptalk with IP-final deaccenting in both languages (i.e., systemic dimension), but produced it more in English than in Spanish (i.e., frequency dimension). That is, IP-final deaccenting emerges in heritage bilinguals' uptalk in Spanish, but heritage bilinguals seem to recognize that this is an English feature that is not allowed in Spanish and try to suppress it as much as possible when producing uptalk in Spanish. However, in the realizational dimension, the heritage bilinguals demonstrated either phonetic assimilation to English (i.e., pitch excursion) or individual variability conditioned by language learning experience (i.e., rise duration). The asymmetry found across the dimensions suggests that, when bilinguals' two languages are in competition for finite online resources, such as in the case of spontaneous speech production, phonological distinctions between L1 and L2 prosodic structures are kept, whereas phonetic differences that do not lead to any change in meaning are more prone to undergo cross-linguistic influence in order to reduce online processing cost. This study attempts to fill a gap in the literature on the cross-linguistic influence of intonation by bringing attention to heritage bilinguals. Heritage bilingualism introduces bilingual contexts that are often left unnoticed in traditional L2 acquisition scenarios (e.g., transfer from L2 to L1 intonation, asymmetry between order of acquisition and language dominance). Given that many aspects of cross-linguistic influence are shared across bilinguals, the investigation of heritage bilinguals' intonation will contribute to building robust models of bilingual intonation.

Keywords: cross-linguistic influence; heritage speakers; heritage language intonation; uptalk; L2 Intonation Learning Theory

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1. Introduction

Bilingual speakers are not two monolinguals in one person (Grosjean 1989). They sometimes exhibit speech sounds that differ from the monolingual norm in one or both of their languages and, if noticeable enough to listeners' ears, these differences could mark their speech as sounding non-native like. Thus, identifying areas of convergence and divergence between bilinguals' L1 and L2 speech sounds sheds light on issues regarding the mechanism of cross-linguistic phonetic and phonological influence and the relative difficulty or ease when acquiring L2 phonetics and phonology. Based on comparisons of L1 and L2 segments, current models in L2 speech learning, such as the (Revised) Speech Learning Model (Flege 1995; Flege and Bohn 2021) and the Perceptual Assimilation Model (-L2) (Best 1995; Best and Tyler 2007), posit that L1 and L2 sound categories exist in a

common phonological space, leading to bidirectional cross-linguistic influence that can surface in various forms; depending on the perceptual similarity between L1 and L2 sound categories, a category in one language may approach a similar-sounding category in the other language or drift away from that category to maintain phonetic contrast (Flege and Bohn 2021; Flege et al. 2003). In some cases, variability is found in the presence, form, and direction of influence under the same linguistic contexts, conditioned by multiple factors associated with bilinguals' language learning experience (e.g., age of acquisition of the target language, speech community size, language proficiency, language use, and language attitude).

While bilinguals may differ from monolinguals in their production and perception of both segments and prosody, the majority of research on bilingual phonetics and phonology has focused on segments, whereas there is comparatively little work on prosody (Mennen 2015; Queen 2006). Studies in L2 prosody have shown that L2 learners demonstrate non-target-like patterns in various prosodic features that are conjectured as L1 transfer. Examples of such include the prosodic marking of information structure (Gut and Pillai 2014; Kim 2019; Nagano-Madsen 2015a; Nguyen et al. 2008; O'Brien and Gut 2010; Ortega-Llebaria and Colantoni 2014; Rasier and Hiligsmann 2007; Saito 2006; Swerts and Zerbian 2010; Turco et al. 2015; Ueyama and Jun 1998), prosodic phrasing (Horgues 2013; Nagano-Madsen 2015b; Nibert 2006; Santiago-Vargas and Delais-Roussarie 2012), and the types and phonetic implementation of pitch accents (Grabe 2004; Jilka 2000; Kim 2020; Mennen 2004; Mennen et al. 2014; Nagano-Madsen 2015a; O'Brien and Gut 2010; Trofimovich and Baker 2006) and boundary tones (Jilka 2000; Mennen et al. 2010). As in the case of L2 segments, depending on various linguistic and extralinguistic factors, deviations can appear in multiple forms, such as substitution (Jilka 2000; Mennen et al. 2010; O'Brien and Gut 2010), hybridization (de Leeuw et al. 2012; Mennen et al. 2014; Queen 2001; Rao 2016), phonetic assimilation (Colantoni et al. 2016; Kim 2020; Zuban et al. 2020), and phonetic dissimilation (de Leeuw et al. 2012).

Built on the types of intonational variability identified by Ladd (1996), the L2 Intonation Learning Theory (LILt) (Mennen 2015) recognizes four dimensions along which deviation from native norms may occur in L2 intonation. The systemic dimension refers to the inventory of structural phonological elements (e.g., tonal sequences and tune–text association). The realizational dimension refers to the phonetic implementation of the structural phonological elements (e.g., pitch scale, slope, and tonal alignment), while the semantic dimension is concerned with how such elements are used to convey meaning (e.g., information structure and question vs. statement). Lastly, the frequency dimension involves the frequency of use of the structural phonological elements. Consistent with the models in the acquisition of L2 segments (Best 1995; Best and Tyler 2007; Flege 1995; Flege and Bohn 2021), the LILt posits that L1 and L2 intonation categories exist in a common phonological space, leading to a cross-linguistic influence along any of the above-mentioned dimensions (Mennen 2015). Given the complexity and multidimensionality of intonation, the LILt's method of viewing L2 intonation through a multilayered lens allows us to answer questions, such as whether different dimensions of intonation are equally susceptible to native language influence and whether certain dimensions develop at a faster pace than others with more experience in the L2 (Mennen 2015). For instance, Mennen et al. (2010) found that, after 30 months of living in the UK, Punjabi and Italian L2 learners of English produced fewer rising pitch contours than when they first arrived to the UK and predominantly used the falling pitch contour, which is the most prevalent contour in British English (Grabe 2004) (i.e., frequency dimension). However, they did not use any complex contours (e.g., rise–fall and fall–rise) observed in British English, showing no improvement in the inventory of the tonal sequences of the target language (i.e., systemic dimension). Jun and Oh (2000) examined various aspects of the surface tone production in Korean accentual phrases (APs) by English L2 learners of Korean. They found that the learners were in general successful in using the high (H) tone in AP-final position (i.e., systemic dimension), but they failed to demonstrate f0 differences between AP-initial tones which are realized as

the H tone when the AP begins with an aspirated or tense obstruent and as the low (L) tone in other contexts (i.e., realizational dimension). While surface AP tones in Korean do not change the meaning of an utterance, phrase boundaries do (Jun 2000). Unlike the AP-initial tones which are segmentally triggered, the AP-final H tone is a strong perceptual cue that marks the right edge of an AP. Thus, the better success observed in learners' production of the AP-final H tone suggests that L2 learners of Korean acquire the phonological properties earlier than the phonetic properties of intonation (Jun and Oh 2000).

Most evidence of deviation in L2 intonation has been found in the realizational dimension (Mennen 2015), particularly in tonal alignment (Atterer and Ladd 2004; Chen and Fon 2008; Graham and Post 2018; Kim 2019, 2020; Nagano-Madsen 2015a; Mennen 2004), pitch range (Aoyama and Guion 2007; Huang and Jun 2011; Jilka 2000; Kim 2019; Mennen et al. 2014; Willems 1982), and pitch scaling (Henriksen et al. 2010; Kelm 1987; McGory 1997). However, it is unclear whether the realizational dimension is the most susceptible among the four dimensions of intonation to cross-linguistic influence. Studies have demonstrated both improvement and deviation within the same dimension (Chen and Fon 2008; Huang and Jun 2011), as well as interactions between dimensions (Jun and Oh 2000; Kim 2019; Mennen 1999; Nagano-Madsen 2015a). That is, cross-linguistic influence of intonation is a complex process and it is sometimes difficult to identify the dimension of influence. More empirical studies should be carried out on a variety of L1-L2 pairings, prosodic aspects, and bilingual situations to better understand the interaction between bilinguals' two intonation systems.

While the LILt centers around L2 intonation, this model can be applied to the intonation of any bilinguals, including heritage speakers. Heritage speakers are a type of bilinguals who grew up speaking a home language (i.e., the heritage language) that is different from the majority language of the society. Heritage languages are minority languages acquired naturalistically in a bilingual or multilingual environment, such as diasporic languages spoken by immigrants and their children, aboriginal or indigenous languages whose linguistic status has been jeopardized by colonizing languages, and historical minority languages that have coexisted with other standard languages (Montrul and Polinsky 2021; Rothman 2009). Unlike L2 intonation, heritage language intonation is relatively underexplored. Given the minority status of heritage languages, many heritage speakers grow up becoming more dominant in the societally dominant language (Benmamoun et al. 2013; Polinsky and Kagan 2007). Thus, heritage language research has focused primarily on the cross-linguistic influence from the dominant language to the heritage language. Several studies have shown that heritage bilinguals exhibit intonational patterns that are present in both of their languages (Bullock 2009; Colantoni et al. 2016; Kim 2019; Queen 2006; Robles-Puente 2019; Zárate-Sández 2015). For instance, in the prenuclear position of declarative sentences, Spanish heritage speakers in the US demonstrate both the high-level tone, which is the most common tone in English (Jun 2014), and the rising tone with displaced f0 peak, which is the most common tone in Spanish (Colantoni et al. 2016; Jun 2014; Robles-Puente 2019; Zárate-Sández 2015). Similarly, heritage speakers of French (Bullock 2009) and Spanish (Kim 2019) in the US prosodically mark focus by adopting the strategies used in both English (e.g., prominence in situ) and their heritage language (e.g., prosodic boundary after the focused constituent). Heritage bilinguals may also demonstrate mixed patterns in the phonetic implementation (Harris et al. 2014; Kim 2020; Mennen and Chousi 2018; Rao et al. 2022; Zárate-Sández 2015), the frequency of use (Dehé 2018; Rao 2016; Zuban et al. 2020), or the discourse functions of the prosodic categories of their heritage language (Alvord 2010; Queen 2001; Rao 2016). That is, deviation in heritage language intonation occurs along various dimensions of intonation, consistent with the LILt's claims on L2 intonation.

For many heritage bilinguals, although the heritage language is acquired earlier or simultaneously with the societally dominant language, it oftentimes becomes their less dominant language. Heritage language outcomes exhibit high interspeaker variability depending on the amount of heritage language use, proficiency, literacy, speech community

size, access to formal education, etc. (Amengual 2016, 2018, 2019; Chang et al. 2010, 2011; Kan 2021; Kissling 2018; Oh et al. 2003; Rao 2014, 2015; Repiso-Puigdelliura 2021; Robles-Puente 2014; Rodríguez 2021; Ronquest 2012; Saddah 2011; Yeni-Komshian et al. 2000). As heritage bilingualism introduces bilingual situations that are usually overlooked in traditional L2 acquisition scenarios (e.g., transfer from L2 to L1 intonation, asymmetry between order of acquisition and language dominance), the inclusion of heritage bilinguals in the discussion of the cross-linguistic influence of intonation will contribute to building robust models of bilingual intonation.

The present study examines the production of uptalk in Spanish and in English by Spanish heritage speakers in Southern California. In Section 2, we present an overview of previous work on uptalk in English and in Spanish, as well as studies on Spanish–English bilinguals' uptalk, which motivated this study. Section 3 presents the research questions of this study and Section 4 provides details on the participants and the methods used to answer the research questions. Section 5 presents the statistical results and Section 6 discusses the findings in connection with the research questions, as well as directions for future research. Lastly, Section 6 concludes this paper.

2. Uptalk

According to Warren (2016, p. 2), uptalk is "a marked rising intonation pattern found at the ends of intonation units realized on declarative utterances, and which serves primarily to check comprehension or to seek feedback." Here, the term "marked" is used to distinguish uptalk from other sentence types where rises are more expected, such as in declarative questions, which function as questions, but have the syntactic form of a declarative sentence (e.g., echo questions) (Warren 2016, p. 23), and continuation rises, which occur at the end of a set of listed items, except for the last one, or at the end of incomplete statements (e.g., subordinate clauses) (Warren 2016, p. 25). Uptalk is also distinguished from statements with the rise–plateau–slump contours often found in the Urban Northern British (UNB) varieties (Cruttenden 1995, 2007; Ladd 1996, pp. 125–26; Warren 2016, pp. 88–92) and from the circumflex contours in Chicano English (Fought 2003, p. 72; Santa Ana and Bayley 2008), originated from Mexican Spanish intonation (Kvavik 1979; Matluck 1952; Martín Butragueño 2004). Such rise–fall patterns differ from uptalk, not only systemically, but also functionally. The UNB pattern is usually found in affirmative statements and signals finality (Warren 2016, p. 88) and the Chicano English pattern has emphatic and assertive discourse functions (in Kvavik 1979, as cited in Martín Butragueño 2004). The commonality of the functions of the rise–fall patterns in these varieties is that they have "closed" meanings (e.g., finality and reinforcing), which, according to Cruttenden (1981), are generally associated with falling tones.

Uptalk, on the other hand, signals openness (Warren 2016, pp. 68, 169), which is commonly linked to rising tones (Cruttenden 1981). Some of the meanings of uptalk that frequently appear in the literature are uncertainty, politeness, deference, friendliness, open-ended, and checking (House 2006; Shokeir 2008; Warren 2016, pp. 47–68). While uptalk is stereotypically associated with uncertainty or lack of confidence, this interpretation is contentious, given that uptalk has multiple layers of meaning (e.g., indexical, linguistic, discourse, and attitudinal), which often simultaneously emerge in a single contour (House 2006; Warren 2016, p. 14). Moreover, uptalk may even signal conflicting meanings within the same layer (e.g., subjugation vs. socially ambitious), depending on the context and on the shared communicative conventions and norms (McLemore 1991; Warren 2016, p. 68). According to Warren (2016), despite the vast range of meanings, the main significance of uptalk is interactional; uptalk is primarily used to invite listeners to check for comprehension, to elicit feedback, and to signal information structure (Warren 2016, pp. 47–68).

2.1. Uptalk in English

Uptalk is widely used across English varieties and the forms of uptalk may vary from one variety of English to another, similar to how sound change in certain segments (e.g., back vowel merger) is present in some varieties, but not in others (Warren 2016, pp. 31, 42). In a review of the phonological description of uptalk across English varieties, Grice et al. (2020) stated that, in Autosegmental-Metrical (AM) terms, "uptalk has been labelled as L* H-H% and H* L-H% for Canadian English (Di Gioacchino and Jessop 2010; Shokeir 2008), L* L-H%, L* H-H%, and H* H-H% for American English (Hirschberg and Ward 1995; McLemore 1991; Ritchart and Arvaniti 2014), L* H-H%, H* H-H% and the longer sequence H* L* H-H% for Australian and New Zealand English (Fletcher 2005; Fletcher et al. 2005; Fletcher and Harrington 2001; McGregor and Palethorpe 2008), H* L-H% or H*+L H-H% for British English (Bradford 1997)."

The phonetic realization of uptalk in English also shows variability in whether and how uptalk differs from question rises (see Warren 2016, pp. 36–40 for a comprehensive review). For instance, uptalk in North American English (Di Gioacchino and Jessop 2010; Ritchart and Arvaniti 2014) demonstrates smaller pitch excursion, compared to question rises, while in Australian English the pitch level at rise onset appears to play a more important role in the distinction between uptalk and question rises (i.e., lower onset in uptalk) (Asano et al. 2020; Fletcher and Harrington 2001). With regard to the temporal aspect of the rise, uptalk is found to be produced with later rises than questions in Southern California English (Ritchart and Arvaniti 2014), in New Zealand English (Warren 2005), and in South African English (Dorrington 2010). This pattern may be found because question rises typically include the last stressed vowel, whereas rises in uptalk is generally aligned with "metrically strong post-nuclear syllables (MSPNS)" or with the final unstressed syllable at the periphery of the phrase (Dorrington 2010; Ritchart and Arvaniti 2014; Warren 2005). However, it is important to note that there is a wide range of areas that uptalk can cover in English; uptalk rises may occur in the final syllable of the intonational phrase (IP), over more than one syllable within the last word, or across multiple words (Britain and Newman 1992; Warren 2005; Warren 2016, p. 32). These findings suggest that, while there is some commonality in the forms of uptalk in English, considerable variation exists within and across varieties (Warren 2016, p. 45).

While the use of uptalk is not limited to a specific variety of English, in the context of the US, it is stereotypically associated with young female speakers from Southern California (Armstrong et al. 2015; Ritchart and Arvaniti 2014; Tyler 2015). It is deemed a typical trait of *Valley Girl* speech, which triggers images of "rich, white young females from the San Fernando Valley" in Los Angeles County (in Ritchart 2014, as cited in Tyler 2015). Such misconception of uptalk, which may have been popularized due to media exposure, has been overturned by empirical evidence. For instance, Armstrong et al. (2015) compared uptalk in Southern California English and Massachusetts English and found that the two varieties did not have any systematic gender or regional differences in the frequency of uptalk. Ritchart and Arvaniti (2014) also found that female and male speakers in Southern California used uptalk with similar frequency in non-floor-holding statements (17% and 16%, respectively), although the female speakers used uptalk more than twice as much as the male speakers for floor holding purposes (59% and 28%, respectively). With regard to the phonetic implementation of uptalk, Ritchart and Arvaniti (2014) found that the female speakers had greater pitch excursions and later rise onsets (i.e., steeper rises) than male speakers. Similarly, the female speakers in Armstrong et al. (2015) produced steeper rises than the male speakers, but they also had longer rises than the male speakers. That is, female speakers are likely to use greater "intonational gesture space" between short/steep and long/shallow rises (Armstrong et al. 2015, p. 5). According to Armstrong et al. (2015), the popular stereotype regarding the prevalence of uptalk in *Valley Girl* speech may have been formed because young female speakers in Southern California exploit the phonetic aspects of rises and/or use uptalk for more forward-looking purposes (e.g., directing attention to the upcoming utterance), which is associated with prolonged rising pitch

(Tomlinson and Tree 2011). In other words, rather than the use of uptalk per se, young female speakers' phonetic implementation of uptalk and/or the different pragmatic choices that they make may have led to the impression that their uptalk is more salient than others.

2.2. Uptalk in Spanish

Uptalk in Spanish has not been investigated as extensively as in English, but studies have reported that Spanish speakers commonly use uptalk (Henriksen 2017; Holguín Mendoza 2011; Kim and Repiso-Puigdelliura 2021; Martínez-Gómez 2018; Vergara 2015; Willis 2010). For instance, Willis (2010) reported that, similar to uptalk in English, statements in the Cibaeño variety of Dominican Spanish were consistently produced with a final rise, which often involved a high boundary tone (H%), preceded by a falling nuclear pitch accent (H+L*). While these contours are mainly found in yes–no questions in this variety, the magnitude of rise was typically higher in statements than in questions (Willis 2010). Henriksen (2017), based on oral narratives collected from an on-going project with Armstrong-Abrami and García-Amaya, showed that non-question rises were much more common in Peninsular Spanish (57.8%) than in American English (20.4%). They found that male speakers produced more rises and that their rises were realized with greater pitch excursion and with longer duration than those of female speakers, contrary to the findings in English (Armstrong et al. 2015; Ritchart and Arvaniti 2014). According to Vergara (2015), Peninsular Spanish speakers mainly use the L* LH% melody when producing uptalk. According to the Spanish Tones and Break Indices (Sp_ToBI) annotation system (Beckman et al. 2002; Prieto and Roseano 2010), this contour is realized as a low plateau throughout the last accented syllable and a part of the subsequent syllable, followed by a rise to a high pitch level. Although less frequent than L* LH%, there were some instances of L+H* HH%. The L+H* HH% melody is the same contour used for counter-expectational questions in Peninsular Spanish, which is realized as a rise during the last accented syllable that continues into the following syllable(s), attaining a high pitch level (Estebas-Vilaplana and Prieto 2010).

In Mexican Spanish, uptalk is associated with *fresa* (Spanish word for "strawberry"), a word that is used in Mexico to call "a person, especially, women, who are or try to appear from the upper class by behaving, dressing, and speaking in a manner perceived as snobbish towards other people" (Holguín Mendoza 2011, p. 36). Holguín Mendoza (2011) showed that young women in Ciudad Juárez, Mexico, who demonstrate typical traits of *fresa* speech, produced many of their uptalk contours using the L* LH% melody, as in Peninsular Spanish (Vergara 2015). According to Holguín Mendoza (2011), this melody resembled the contours of information-seeking yes–no questions, echo yes–no questions, and imperative yes–no questions in Mexico City Spanish (De la Mota et al. 2010). Uptalk is also used among non-*fresas*. Martínez-Gómez (2018) argued that young speakers in the Guadalajara Metropolitan Area, frequently use uptalk, regardless of whether they are *fresas* or not. She found that the main difference between *fresa*-sounding and non-*fresa*-sounding speech derived from the phonetic realization of uptalk; *fresa*-sounding participants produced uptalk with greater pitch excursions and steeper rise slopes than non-*fresa*-sounding participants. In other words, uptalk in itself does not index a *fresa* persona, but rather the way it is realized (e.g., steep rises accompanied by other linguistic features) (Martínez-Gómez 2018, p. 92). The distinction between the uptalk in *fresa*- and non-*fresa* speech may also be characterized by their intonation contours. As in Holguín Mendoza (2011) and Vergara (2015), Kim and Repiso-Puigdelliura (2021) found that non-*fresa* speakers in Central Mexico used L* LH% when producing uptalk (11.4%), but the two most common melodies in their data were L+H* (H)H% (33%) and L* (H)H% (20.4%). Recall that the former contour was also found in Peninsular Spanish uptalk, but it was used with very low frequency (Vergara 2015). The L* H(H)% contour is generally used for invitation and confirmation yes–no questions in Mexico City Spanish and it is realized as a low plateau during the last accented syllable, followed by a rise to a (very) high pitch level (De la Mota et al. 2010). While there were very few instances of questions (3.4% of the entire data) to make any generalizations, the uptalk

rises in Kim and Repiso-Puigdelliura (2021) had greater pitch excursions and steeper rises (8.4 semitones, 32.3 semitones per second) than the questions (7.2 semitones, 23.3 semitones per second), which are consistent with the uptalk rises in Dominican Spanish (Willis 2010).

The findings of the above-mentioned studies demonstrate that the use of uptalk is widespread in Spanish, showing not only similarities, but also considerable differences within and across varieties in its intonation contour and phonetic implementation, which may index different linguistic and social meanings. Moreover, uptalk in Spanish seems to share the same intonation contours with yes–no question rises, with uptalk rises having a greater pitch excursion than yes–no question rises. Nonetheless, more research should be conducted to confirm that the distinction between the two sentence types in Spanish is truly phonetically based. The meanings and functions of uptalk have been even less investigated in Spanish. To the best of our knowledge, Vergara (2015) is the only study that examined various discourse functions of uptalk in Spanish. He found that Peninsular Spanish speakers use uptalk to hold the floor, to show camaraderie, to soften a command, and in the case of female speakers, to flirt (*coqueteo*). However, it is uncertain whether these functions are transferable to other Spanish varieties and whether they surface in different uptalk contours.

2.3. Uptalk of Spanish–English Bilingual Speakers

Due to the strong link between uptalk and English, uptalk observed in Spanish–English bilinguals' Spanish is often considered an indication of influence from English intonation (Buck 2016; Henriksen et al. 2010; Méndez Seijas 2019; Trimble 2013; Zárate-Sández 2018). Zárate-Sández (2018) examined the pitch values at the end of declarative sentences produced by six groups of speakers with varying degrees of language dominance, from Spanish dominant to English dominant: Spanish monolinguals, Spanish heritage speakers that are balanced bilinguals, three groups of English L2 learners of Spanish with different Spanish proficiency levels (i.e., very high, high, and intermediate), and English monolinguals. Results showed that speakers who are more dominant in English had higher final pitch values. Given the final rising intonation in uptalk, Zárate-Sández (2018) conjectured that the higher final pitch found in more English-dominant speakers suggests a more frequent use of uptalk by these speakers. However, given that high pitch at the end of an utterance alone does not signify a final rise, it is possible that uptalk does not explain the positive relationship found between English dominance and final pitch height.

While it is well accepted that uptalk is a widespread phenomenon in English, it is important to take into account that Spanish speakers frequently use uptalk as well (Henriksen 2017; Holguín Mendoza 2011; Kim and Repiso-Puigdelliura 2021; Martínez-Gómez 2018; Vergara 2015; Willis 2010). Thus, the presence of uptalk in bilinguals' Spanish in itself does not attest that uptalk has been transferred from English to Spanish. Kim and Repiso-Puigdelliura (2021) found that Mexican Spanish speakers did not differ in their uptalk frequencies, regardless of whether they are monolingual in Spanish or heritage bilinguals. Rather, the two groups differed in the forms of uptalk. Compared to the Spanish monolinguals in Mexico, the heritage bilinguals in Southern California produced uptalk with flatter, and to some extent, larger rises and with less dynamic intonation contours, similar to the low-rise pattern found in Southern California English uptalk (Ritchart and Arvaniti 2014). Moreover, in some cases, the heritage bilinguals produced uptalk over multiple words, which has been attested in English (Britain and Newman 1992; Warren 2005; Warren 2016, p. 32), whereas none of the Spanish monolinguals demonstrated rises beginning in a non-IP-final word.

According to Jun (2014), both Spanish and English are head-prominence languages, but the domain of the head (i.e., pitch accent) is approximately one content word in Spanish, whereas it is larger than one content word in English. Therefore, uptalk in English can begin in a non-IP-final word if the following words are deaccented, while rise onsets in Spanish should occur within IP-final words because, in Spanish, content words almost always carry a pitch accent. While deaccenting is also possible in Spanish, particularly in semantically

light words (e.g., high lexical frequency, given information, syntactic determiners, and copulas) in spontaneous speech (Face 2003; Rao 2009), it is not as common as in English (Face 2003); if it does occur, it is usually located in non-final phrase positions (Rao 2009). Thus, uptalk beginning in a non-IP-final word is an English feature associated with IP-final deaccenting. To the best of our knowledge, no study has reported such uptalk patterns in non-heritage Spanish varieties. Fought (2003, pp. 73, 76) reported that some of the heritage bilinguals she interviewed seemed to superimpose the uptalk contours of California English onto their Spanish. These findings suggest a potential influence from English to Spanish on how bilinguals produce uptalk in Spanish.

With regard to uptalk productions in English by Spanish–English bilinguals, studies have shown that heritage bilinguals demonstrate similar uptalk patterns as Anglo English speakers who grew up monolingually in English (Asch and Brogan 2022; Fought 2003; Santa Ana and Bayley 2008). Asch and Brogan (2022) found that heritage bilinguals in Southern California were very similar to Anglo English speakers in both the frequency and the phonetic implementation of uptalk (i.e., starting pitch, pitch scaling, rise alignment, and peak delay). These findings suggest that Spanish (i.e., a minority language) may not have a noticeable influence on heritage bilinguals' production of uptalk in English (i.e., the societally dominant language). However, in order to corroborate cross-linguistic influence of uptalk in heritage bilinguals, it is necessary to examine both languages because bilingual speakers are highly heterogenous and transfer cannot occur if the target features are absent in one's grammar. To the best of our knowledge, no study has made a direct comparison between the uptalk in bilinguals' two languages.

3. Research Questions

The present study examines heritage bilinguals' uptalk in Spanish and in English to better understand the role of cross-linguistic influence in their uptalk production. We explore heritage bilinguals' uptalk patterns, focusing on those that have been found to differ from Spanish monolinguals (Kim and Repiso-Puigdelliura 2021): uptalk with IP-final deaccenting and uptalk realized with smaller and flatter rise. In Kim and Repiso-Puigdelliura (2021), the phonetic analysis of uptalk was conducted based on two interrelated properties, namely, pitch excursion and rise slope (i.e., the extent of pitch excursion per second). Thus, in this study, instead of rise slope, we analyzed the duration of uptalk rises.

Following the L2 Intonation Learning Theory (LILt) (Mennen 2015), we propose that cross-linguistic influence in heritage bilinguals' uptalk can occur along multiple dimensions of intonation. Here, we focus on the systemic, the frequency, and the realizational dimensions of heritage bilinguals' uptalk. The semantic dimension of uptalk was not considered in this study because, without a clear understanding of the meanings and functions of various uptalk contours in Spanish, it is premature to investigate the cross-linguistic influence in the semantic dimension. Moreover, the meanings of uptalk can be best understood through a perception task that tests how uptalk is interpreted by listeners of the target variety (e.g., Tomlinson and Tree 2011), which is outside the scope of the present study. Apart from the above-mentioned three dimensions of uptalk, we also examine how heritage bilinguals' uptalk is influenced by their language learning experience.

We aim to answer the following research questions.

(1) Do heritage bilinguals produce uptalk in both Spanish and English (systemic dimension)? If so, do they produce it with similar frequency between the two languages (frequency dimension)?
(2) Do heritage bilinguals produce uptalk with IP-final deaccenting in both Spanish and English (systemic dimension)? If so, do they produce it with similar frequency between the two languages (frequency dimension)?
(3) Do heritage bilinguals produce uptalk with similar pitch excursion and rise duration between Spanish and English (realizational dimension)?
(4) Do extralinguistic factors associated with heritage bilinguals' language learning experience have an effect on their production of uptalk?

4. Methods

4.1. Participants

Twenty-four Spanish–English bilingual Mexican Americans (18F, 6M) participated in the present study. Due to technical issues, the speech of one participant (HS3) was not recorded. In this paper, we report information regarding the remaining 23 participants. 16 of them (12F, 4M) were born and raised in Los Angeles County and their parents immigrated to the US from Mexico as adults. The other 7 speakers (5F, 2M) spent their childhood in Mexico and moved to Southern California during late childhood or adolescence (age range: 7–15 years). All of the 7 speakers were born in Mexico, except for one speaker (HS11), who was born in Los Angeles, moved to Mexico with her family soon afterwards, and lived there until 8 years of age.

Among the 23 participants, only 2 speakers learned Spanish and English at the same time (i.e., simultaneous bilinguals). The other 21 speakers learned Spanish first and English after that (i.e., sequential bilinguals); 14 of them learned English before entering elementary school (age range: 1–5 years), while 7 speakers reported that they learned English at school (age range: 7–15 years). All the participants acquired Spanish at home since birth and were fluent enough in both Spanish and English to carry on a conversation in the two languages. Table 1 summarizes participants' language profile.

Table 1. Descriptive statistics of participants' language profile.

	Mean	Standard Deviation	Min	25%	Median	75%	Max
Age (years)	21.87	3.02	18	19.5	21	24	28
Age of arrival (years)	3.43	5.57	0	0	0	7.5	15
English AOA [1] (years)	5.61	3.95	0	4	4	8	15
Language dominance [2] (−218–218)	6.54	50.76	−118.78	−11.26	15.98	43.23	77.64
Language use [3] (0–50)							
Spanish	20.7	8.29	9	13	20	26	37
English	29.3	8.29	13	24	30	37	41
Proficiency [3] (0–24)							
Spanish	19.87	3.93	12	17.5	21	23.5	24
English	21.61	2.76	14	20	22	24	24
Education [3] (years)							
Spanish	4.04	2.88	0	2	4	6	10
English	14.35	3.81	4	13	15	16.5	20
Picture naming (0–60)	54.3	3.38	48	52	55	57	59

[1] Age of acquisition, [2] Bilingual Language Profile score, and [3] Sub-Component of the Bilingual Language Profile.

The age of the participants ranged between 18 to late 20s. All of the participants were either college students or recently graduated from college. Information regarding participants' language dominance was obtained from their responses in Birdsong et al.'s (2012) Bilingual Language Profile (BLP). The BLP is a questionnaire that evaluates the overall language dominance of bilingual speakers based on self-reports on language history, language use, language proficiency, and language attitude in their two languages. It generates a continuous score from −218 to 218. A positive score indicates English dominant and a negative score indicates Spanish dominant. A score of or close to zero indicates balanced bilingualism. The BLP scores in our data ranged between −118.78 (Spanish dominant) and 77.64 (English dominant); 6 speakers were Spanish dominant (M = −51.51, SD = 47.95), 4 speakers were balanced bilinguals (M = −6.27, SD = 2.34), and 13 speakers were English dominant (M = 40.68, SD = 19.98).

One of the advantages of using the BLP in bilingualism research is that it not only evaluates the overall language dominance through a composite score, but also allows separate analysis of the amount of use and the proficiency of bilinguals' two languages. Language dominance is a multidimensional construct that is relativistic in nature (i.e., Language A compared to Language B) (Birdsong 2016; Montrul 2016; Silva-Corvalán and Treffers-Daller

2016). In other words, language use and language proficiency are sub-constructs of language dominance (Birdsong 2016; Montrul 2016). Among the 23 participants, 6 speakers use Spanish more frequently than English and 17 speakers use English more frequently than Spanish. Regarding language proficiency, 4 speakers rated their Spanish higher than their English, 7 speakers rated the two languages equally, and 12 speakers rated their English higher than their Spanish. The BLP also provides information regarding bilingual's classroom experience in their two languages, which is an important factor of heritage bilinguals' language learning experience because exposure to formal speech has shown to influence heritage bilinguals' sound system (Rao et al. 2020). Since our participants spent all or many of their school years in the US, they had classes in English for a longer period of time than classes in Spanish; only one speaker who moved to the US at age 15 reported that she spent more time taking classes in Spanish than in English.

In this study, we also conducted a picture-naming task in Spanish (Kim 2016) to measure participants' lexical proficiency. According to Polinsky and Kagan (2007), lexical proficiency is a powerful diagnostic of heritage language proficiency. The picture-naming task includes black-and-white images of 60 Spanish object nouns across five frequency levels based on Davies' (2006) Spanish frequency dictionary. The images were selected from the International Picture-Naming Project (IPNP) database (Szekely et al. 2004) and were individually presented in PowerPoint slides. The participants were asked to say the word out loud in Spanish as quickly as possible. For a detailed explanation of the task design and the complete list of items used in the picture-naming task, refer to Kim (2016, pp. 54–55, 162). Out of 60, the participants scored between 48 (80%) and 59 (98.33%), suggesting that they had good lexical knowledge in Spanish.

4.2. Procedures

The participants were assigned to pairs that had similar backgrounds (e.g., country of birth, age, and gender) and based on their time availability. All pairs matched in their age of arrival to the US, except for one pair (HS11 and HS12); both participants were born in Los Angeles, but HS12 spent all her life in the US, whereas HS11 moved to Mexico soon after she was born and lived there until she came back to Los Angeles when she was 8 years old (see Section 4.1). After reading and signing a written informed consent form, the participants completed two production tasks (one in each language), the picture-naming task, and the Bilingual Language Profile (Birdsong et al. 2012). Recall that uptalk most likely occurs in interactional contexts (see Section 2), which indicates that it is unlikely to emerge in tasks where "the listener can be assumed to already know the general content of what the speaker is saying" (Warren 2016, p. 176). Thus, we conducted production tasks that involve conversations between two people.

For the Spanish conversation task, a dyadic interaction task was conducted in a sound-attenuated room, where the participants discussed topics related to Los Angeles in pairs. A list of topics was provided at the onset of the task (e.g., racism, undocumented immigrants, safety of women, maintenance of Spanish language, and housing) and each pair chose between two and four topics of interest to discuss. The instructions were provided in Spanish by a Spanish–English bilingual Mexican American research assistant. With regard to the English conversation task, the investigator, a second language (L2) speaker of Spanish and non-Latinx, asked questions regarding participants' experience interacting with their partners during the dyadic interaction task (e.g., Does your partner share similar backgrounds with you? Did you agree on the topics you discussed? If you were to choose a different topic, would you have similar perspectives as your partner?). While the English conversation task took place in the form of an interview, the investigator encouraged the participants to elaborate their responses and talk about any other topics of their interest. The conversations oftentimes diverged from the interview topics, which the investigator did not deter, given that the purpose of this study was to elicit spontaneous conversational speech.

After the Spanish conversation task, the participants took a short break of 5–10 min. After the break, one of the partners moved to a quiet furnished office room to complete the English conversation task. In the meantime, the other partner stayed in the lab to complete the picture-naming task and the BLP questionnaire described in Section 4.1. Then, the partners switched turns[1]. Participants' spontaneous speech during the conversation tasks and their responses during the picture-naming task were recorded using an AKG C520 head-mounted microphone and a Zoom H4n digital recorder with a sampling rate of 44.1 kHz and a sample size of 16 bits.

4.3. Coding and Analysis

Uptalk was identified as rising contours at the end of non-question intonational phrases (IPs). In this study, we used pauses as the main cue to IP-final boundary, which surface as silence, glottalization, or final lengthening in the speech signal. Instances of pausing due to disfluency, such as stutters, self-repairs, fillers (e.g., like, you know, so, and uh), backchannel responses (e.g., yeah and uh-huh), and utterances interrupted by the interlocutor, were excluded from the analysis. We also excluded IP-final boundaries overlapped with laughter or background noises, in which the intonation patterns are unclear. Moreover, any English expressions at IP-final boundaries in the Spanish data or Spanish expressions at IP-final boundaries in the English data were excluded from the analysis, given that it is uncertain whether the language of the uptalk in such cases should be categorized as Spanish or English. We also did not consider the circumflex contours attested in Chicano English (Asch and Brogan 2022; Fought 2003; Santa Ana and Bayley 2008) and in Mexican Spanish (Kvavik 1979; Matluck 1952; Martín Butragueño 2004), which are clearly distinct from uptalk (Fought 2003; Santa Ana and Bayley 2008).

A trained Spanish–English bilingual research assistant identified non-question IPs in the Spanish and the English data and annotated whether they were produced as uptalk based on both auditory and visual inspections of the pitch contours (i.e., rising contours). The annotation and the visualization of the pitch contours were carried out in Praat (Boersma and Weenink 2021). By default, the pitch settings were set to 75–300 Hz for male speakers and 100–600 Hz for female speakers, but adjustments were made if an individual speaker's pitch ranged outside the default settings. For non-question IPs produced as uptalk, the investigator further annotated whether the last accented syllable occurred in a non-IP-final word (i.e., uptalk with IP-final deaccenting), based on auditory inspection and visual inspection of the pitch contour (i.e., no prominent f0 movement between rise onset and offset) and the spectrogram (i.e., no clear distinction in the darkness of syllables between rise onset and offset). After extracting the labels of all non-question IPs using a Praat script (adapted from a custom script by Christopher Carignan), the investigator re-coded them in Excel spreadsheet based on the presence of uptalk (1 = uptalk, 0 = not uptalk). For instances of uptalk, further coding was carried out based on the presence of uptalk with IP-final deaccenting (1 = IP-final deaccenting, 0 = no IP-final deaccenting). The relative frequency of uptalk was calculated as the number of uptalk divided by the total number of non-question IPs. The relative frequency of uptalk with IP-final deaccenting was calculated as the number of uptalk with IP-final deaccenting divided by the total number of uptalk instances.

With regard to the phonetic realization of uptalk, the investigator extracted the pitch excursion and the rise duration using Praat (Boersma and Weenink 2021). For each rise, we first selected the regions in which the highest (i.e., f0 maximum) and the lowest points (i.e., f0 minimum) of the rise were identified and automatically extracted the f0 (Hz) and time (seconds) of these points using a Praat script (adapted from a custom script by Christopher Carignan). To calculate pitch excursion, we converted the f0 difference between these two points into semitones (st) (=12 * log2[f0 maximum/f0 minimum]), which is a logarithmic scale that best reflects listeners' intuitions about intonational equivalence (Nolan 2003; Pépiot 2014; Simpson 2009). Tokens in which the f0 maxima and minima could not be measured (e.g., within voiceless segments and creak) were excluded from the analysis.

Rise duration was calculated as the distance between the time of the f0 maxima and the time of the f0 minima (seconds). Rise duration of uptalk with IP-final deaccenting was excluded from the analysis, given that uptalk realized across multiple words inevitably leads to longer rise duration than those realized at IP-final words. Statistical analyses and data visualization were performed using R (R Core Team 2021). More information of the packages and the statistical models used in this study is presented in Section 5.

With regard to the effect of extralinguistic factors associated with language learning experience, we did not include language dominance in the analysis, given that language dominance is a multidimensional construct that embraces most of the other variables. Moreover, since none of the participants spoke languages other than Spanish and English, their Spanish use was inversely related to their English use. Thus, we only included participants' Spanish use and not their English use in the analysis. This resulted in a total of 8 extralinguistic variables (i.e., age of arrival to US, age of acquisition of English, Spanish use, Spanish self-rated proficiency, English self-rated proficiency, education in Spanish, education in English, and picture-naming task score). The correlation matrix of theses variables[2] revealed that, among the 28 pairs of variables analyzed, 10 pairs exhibited absolute correlation coefficients higher than 0.5, suggesting that many of these variables are correlated with each other (e.g., age of arrival to the US and age of acquisition of English: $r = 0.89$, Spanish use and Spanish self-rated proficiency: $r = 0.7$, and age of arrival to the US and education in English: $r = -0.66$). Therefore, we decided to conduct principal component analysis to reduce dimensionality.

Prior to performing the principal component analysis, we ran the Kaiser-Meyer-Olkin (KMO) test (Kaiser 1970) and Bartlett's Test of Sphericity for data screening. The KMO test gauges sampling adequacy. While values higher than 0.7 are considered adequate (Kaiser 1974), given the small number of participants in the present study ($n = 23$), we considered 0.5 as the acceptable lower limit, following Field's (2009) recommendation. Bartlett's test checks whether the correlations among the variables are large enough to be analyzed. A significant Bartlett's test indicates interrelationship among the variables. The KMO test and Bartlett's test were performed using the *KMO*() function and the *cortest.bartlett*() function, respectively, in the *psych* package (Revelle 2022).

The principal component analysis was performed using the *principal*() function in the *psych* package (Revelle 2022). We determined the number of components to extract based on the components' eigenvalues (Kaiser 1960) and their cumulative percentage of total variation (Jolliffe 2002). Following Kaiser's (1960) criterion, eigenvalues above 1 were extracted, given that an eigenvalue lower than 1 indicates that the component accounts for less variance than the original variable. However, if the combination of the extracted components based on this criterion does not sufficiently explain the total variation of the dataset, we extracted additional components. Jolliffe (2002, p. 113) suggested the cut-off point to be somewhere between 70% and 90%. In this study, we set 70% as the cut-off point.

5. Results

5.1. Principal Component Analysis of Extralinguistic Factors Associated with Language Learning Experience

We conducted principal component analysis on the eight extralinguistic factors associated with language learning experience (i.e., age of arrival to US, age of acquisition of English, Spanish use, Spanish self-rated proficiency, English self-rated proficiency, education in Spanish, education in English, and picture-naming task score) to reduce dimensionality. In our dataset, the KMO value was 0.66 and Bartlett's test was significant ($\chi^2(28) = 105.47$, $p < 0.001$), indicating acceptable sampling adequacy and interrelationship among variables. Based on these results, we concluded that the variables are suitable for principal component analysis. We initially extracted two principal components (PCs) based on their eigenvalues (PC1: 4.12, PC2: 1.33). However, given that their cumulative percentage of total variation was lower than the 70% cut-off point, we additionally extracted PC3 whose eigenvalue was 0.95. The three components in combination accounted for 80% of the variance (PC1: 38%,

PC2: 28%, PC3: 14%). Since the components were not correlated with each other (i.e., correlation coefficients close to zero), we chose varimax rotation, which is an orthogonal rotation. Table 2 contains the component loadings of the eight variables after rotation. Only variables with absolute loadings greater than 0.4 are shown.

Table 2. Component loadings.

Variables	PC1 (English Experience)	PC2 (Spanish Proficiency and Use)	PC3 (Education in Spanish)
Age of arrival	0.9		
English AOA	0.9		
Proficiency in English	−0.9		
Education in English	−0.7		
Spanish use		0.8	
Proficiency in Spanish		0.9	
Picture naming		0.6	
Education in Spanish			0.9

As demonstrated in Table 2, the rotated solution yielded three interpretable components. PC1 is strongly correlated with age of arrival to the US, age of acquisition of English, English self-rated proficiency, and education in English. We will interpret this component as "English experience." PC2 is strongly correlated with Spanish use, Spanish self-rated proficiency, and the picture-naming task score (i.e., lexical proficiency) and PC3 is constructed mostly from education in Spanish. Thus, we will interpret PC2 and PC3 as "Spanish proficiency and use" and "education in Spanish", respectively.

5.2. Systemic and Frequency Dimensions of Uptalk

In our data, uptalk was observed in heritage bilinguals' Spanish and English. In total, 7431 instances of non-question intonational phrases (IPs) were produced. Among them, 2232 were IPs with uptalk contours (30.04%) and 5199 were non-uptalk IPs (69.96%). Average uptalk rates in English and in Spanish were 30.27% and 29.23%, respectively. Individual uptalk rates varied between 14.15% and 63.92% in English and between 14.29% and 58.06% in Spanish.

With regard to uptalk with IP-final deaccenting, we found that heritage bilinguals produce this pattern in both languages. Out of the 2232 instances of uptalk, 595 tokens (26.66%) were produced with IP-final deaccenting. Such rises occurred 31.66% of the time in English with individual rates ranging from 17.02% to 50.91%. In Spanish, they occurred 8.51% of the time and individual rates ranged from 0% to 30.77%. Figure 1 demonstrates an example of uptalk with IP-final deaccenting, in which the rise onset falls on the penultimate content word.

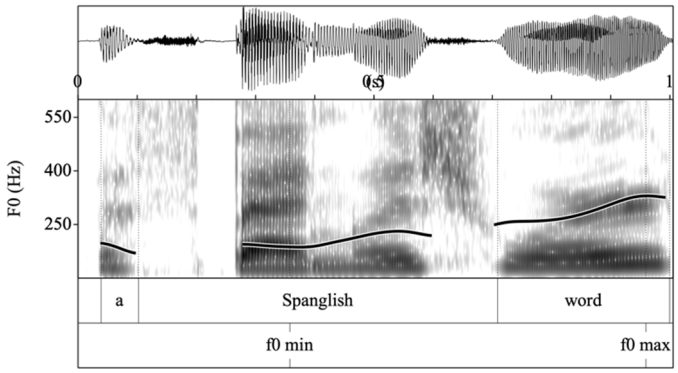


Figure 1. Example of uptalk with IP-final deaccenting in English produced by a female heritage bilingual (HS2). "*A Spanglish word*".

We performed a mixed-effects logistic regression analysis using the *glmer*() function in the *lme4* package (Bates et al. 2015) to examine whether language and participants' language learning experience influence the presence of uptalk (1 = yes/0 = no). Moreover, we further analyzed the effects of the same factors on the presence of uptalk with IP-final deaccenting (1 = yes/0 = no). As fixed effects, we entered language (English/Spanish) and the three principal components (PCs) presented above (see Section 5.1). Recall that half of the participants completed the language survey first and the English conversation task after that, whereas the other half completed the English conversation task first and the language survey after that (see Section 4.2). Since the order of the language survey and the follow-up interview may have an impact on participants' performance, we included task order (language survey first/English conversation task first) as a covariate. We also included gender as a covariate, due to potential relationship between gender and uptalk use (Armstrong et al. 2015; Henriksen 2017; Ritchart and Arvaniti 2014; Tyler 2015). The categorical fixed effects were contrast-coded using simple coding, in which each level is compared to the reference level (language: English, task order: language survey first, gender: female) and the intercept is the grand mean. We entered participant as a random effect. For both the presence of uptalk and the presence of uptalk with IP-final deaccenting, the best fitting model selected through backward elimination included an intercept for participant with by-participant random slope for language. Statistical significance of the fixed effects was analyzed through likelihood ratio tests of the full model with all the predictor effects (i.e., language and the three PCs) against the model without the effect in question. Likelihood ratio tests were performed using the *anova*() function in the *car* package (Fox and Weisberg 2019) and visualization of the predictor effects was carried out using the *predictorEffect*() function in the *effects* package (Fox and Weisberg 2019).

With regard to the presence of uptalk, adding gender to the model significantly strengthened the model fit ($\chi^2(1) = 8.38$, $p < 0.01$), while task order did not show any improvement. Thus, we added gender to the full model. Results showed that none of the four predictor effects influenced the presence of uptalk (ps > 0.05). As in the case of the presence of uptalk, adding gender to the model significantly strengthened the model fit for the presence of uptalk with IP-final deaccenting ($\chi^2(1) = 6.26$, $p < 0.05$), while task order did not show any improvement. Thus, we added gender to the full model. Results showed that language ($\chi^2(1) = 31.5$, $p < 0.001$) affected the presence of uptalk with IP-final deaccenting, which indicates that heritage bilinguals produced this uptalk pattern more frequently in English than in Spanish (see Figure 2). None of the PCs had an effect on participants' production of uptalk with IP-final deaccenting.

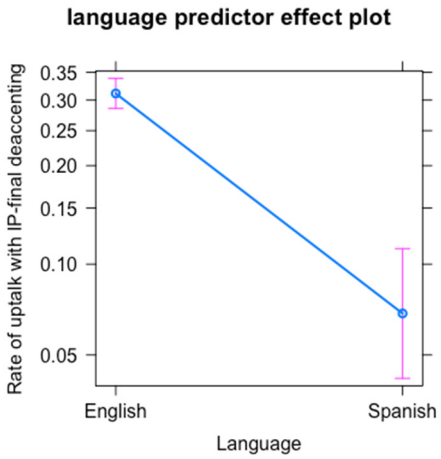


Figure 2. Rate of uptalk with IP-final deaccenting by language.

These findings suggest that heritage bilinguals use uptalk to varying degrees, regardless of language and their language learning experience. However, they make a distinction between the uptalk pattern of their two languages. In English, they sometimes produce

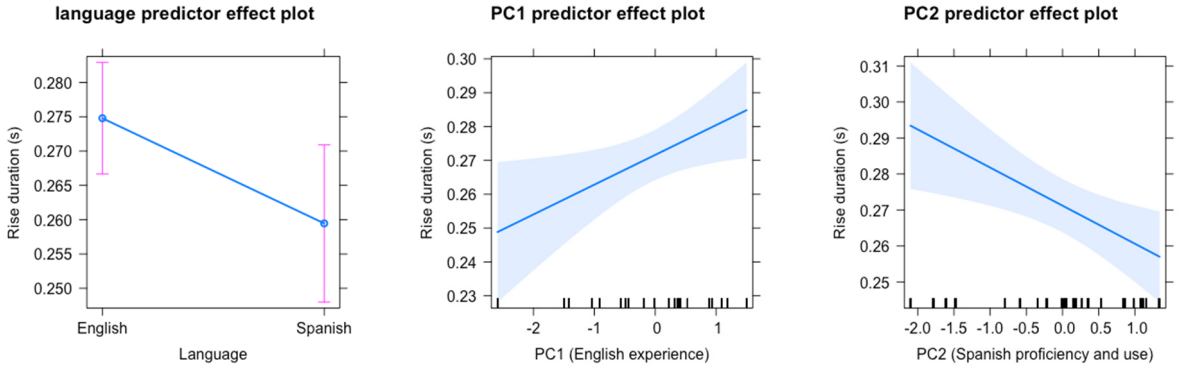
their uptalk with IP-final deaccenting, while such pattern was rarely found in their uptalk in Spanish.

5.3. Realizational Dimension of Uptalk

In this study, we examined two aspects of the phonetic realization of uptalk: pitch excursion (st) and rise duration (s). 488 tokens were excluded from the analysis of pitch excursion due to missing f0 maxima and minima (see Section 4.3). For the analysis of rise duration, 464 tokens with IP-final deaccenting were additionally removed because uptalk realized across multiple words inevitably leads to longer rise duration than those realized at IP-final words (see Section 4.3). Furthermore, 22 proproparoxytones tokens were removed, since this stress pattern was only found in the English data. Thus, the remaining data reflect a total number of 1744 tokens for the pitch excursion analysis and 1258 tokens in the case of the rise duration analysis.

We performed a mixed-effects linear regression analysis using the *lmer*() function in the *lme4* package (Bates et al. 2015) to examine whether language and participants' language learning experience affect the two phonetic properties of uptalk. As fixed effects, we entered language (English/Spanish) and the three principal components (PCs). Task order and gender were included as covariates due to the reasons mentioned above (see Section 5.2). For the analysis of rise duration, we additionally added stress pattern (oxytone/paroxytone/proparoxytone) as a covariate, since rise onset is expected to be influenced by stressed syllable location; rise onset is likely to occur earlier for words in which the stressed syllable is farther away from the right edge of the IP boundary. The categorical fixed effects were contrast-coded using simple coding, in which each level is compared to the reference level (language: English, task order: survey first, gender: female, and stress pattern: oxytone) and the intercept is the grand mean. We entered participant as a random effect. For the analysis of pitch excursion, the best fitting model selected through backward elimination included an intercept for participant with by-participant random slope for language. In the case of the analysis of rise duration, the best fitting model included an intercept for participant with no slope terms. Statistical significance of the fixed effects was analyzed through likelihood ratio tests of the full model with all the predictor effects (i.e., language and the three PCs) against the model without the effect in question. Likelihood ratio tests were performed using the *anova*() function in the *car* package (Fox and Weisberg 2019) and visualization of the predictor effects was carried out using the *predictorEffect*() function in the *effects* package (Fox and Weisberg 2019).

Regarding the analysis of pitch excursion, adding task order or gender to the full model did not have any effect on the model fit. Thus, we did not include these factors in the full model. Results showed that none of the four predictor effects influenced participants' pitch excursion ($ps > 0.06$). In the case of rise duration, the model fit improved by adding gender ($\chi^2(1) = 9.8$, $p < 0.01$) or stress pattern ($\chi^2(2) = 338.67$, $p < 0.001$) to the model, and adding both gender and stress pattern demonstrated a better fit than the models with one of the effects ($ps < 0.001$). Thus, we included both covariates in the full model. Results showed that language ($\chi^2(1) = 6.27$, $p < 0.05$), English experience (PC1) ($\chi^2(1) = 4.51$, $p < 0.05$), and Spanish proficiency and use (PC2) ($\chi^2(1) = 6.11$, $p < 0.05$) had an effect on participants' rise duration. In other words, the participants produced the uptalk with shorter rise duration in Spanish than in English (see Figure 3a). Moreover, participants with more English experience had longer rise duration (see Figure 3b), whereas those that had higher Spanish proficiency and use demonstrated shorter rise duration (see Figure 3c). Education in Spanish (PC3) did not have an effect on participants' rise duration.



(**a**) (**b**) (**c**)

Figure 3. Rise duration (s) by (**a**) language; (**b**) English experience (PC1); (**c**) Spanish proficiency and use (PC2).

Overall, the findings of the phonetic properties of uptalk suggest that heritage bilinguals do not systematically distinguish the pitch excursion of uptalk in their two languages. Rather, the difference between their two languages is based on rise duration (i.e., longer rise in English uptalk than in Spanish uptalk). The rise duration of heritage bilinguals' uptalk was conditioned by their language learning experience; heritage bilinguals with more English experience and those with lower Spanish proficiency and use tend to produce uptalk with longer duration.

6. Discussion

The present study explores cross-linguistic influence of intonation, focusing on the production of uptalk by Spanish–English bilingual Mexican Americans in Southern California (i.e., heritage bilinguals). While uptalk is typically regarded as an intonational pattern of *Valley Girl* speech of Southern California English (Armstrong et al. 2015; Ritchart and Arvaniti 2014; Tyler 2015), there is a good deal of empirical evidence that uptalk is commonly used across English varieties (Asano et al. 2020; Bradford 1997; Di Gioacchino and Jessop 2010; Dorrington 2010; Fletcher 2005; Fletcher et al. 2005; Fletcher and Harrington 2001; Hirschberg and Ward 1995; McGregor and Palethorpe 2008; McLemore 1991; Shokeir 2008; Warren 2005), as well as in Spanish (Henriksen 2017; Holguín Mendoza 2011; Kim and Repiso-Puigdelliura 2021; Martínez-Gómez 2018; Vergara 2015; Willis 2010).

Given that uptalk occurs in both English and Spanish, the presence of uptalk in heritage bilinguals' Spanish does not provide enough support for transfer from English intonation. Rather, it would be informative to examine in what ways heritage bilinguals' uptalk differs from the uptalk of non-heritage Spanish varieties and whether the divergent patterns trace back to their own English. Previous studies have shown that heritage bilinguals use uptalk both in Spanish (Fought 2003; Kim and Repiso-Puigdelliura 2021; Zárate-Sández 2018) and in English (Asch and Brogan 2022; Fought 2003; Santa Ana and Bayley 2008). Moreover, while heritage bilinguals produce uptalk in Spanish with similar relative frequency as Spanish monolinguals, they exhibit English-like patterns that differ from those of Spanish monolinguals (Kim and Repiso-Puigdelliura 2021). On the other hand, uptalk in heritage bilinguals' English is comparable to that of Anglo English speakers in both frequency and phonetic implementation (Asch and Brogan 2022), suggesting that English-to-Spanish influence may be stronger than Spanish-to-English influence for heritage bilinguals.

This study attempts to fill a gap in the literature on cross-linguistic influence of intonation by investigating the uptalk patterns in the two languages of heritage bilinguals and by taking into account language learning experience to explain interspeaker variability. Following the L2 Intonation Learning Theory (LILt) (Mennen 2015), we propose that cross-linguistic influence in heritage bilinguals' uptalk can occur along multiple dimensions of intonation. Among the four dimensions recognized by the LILt (i.e., systemic,

frequency, realizational, and semantic), we focused on the systemic, the frequency, and the realizational dimensions of heritage bilinguals' uptalk. Below we summarize our findings (Section 6.1) and discuss cross-linguistic influence in heritage bilinguals' uptalk along the three dimensions (Section 6.2).

6.1. Summary of Findings

Our data showed that heritage bilinguals produced uptalk in both Spanish and English. The frequency of heritage bilinguals' uptalk did not systematically differ between their two languages. While individual uptalk rates varied across speakers (14.15–63.92% in English and 14.29–58.06% in Spanish), they were not conditioned by heritage bilinguals' language learning experience. That is, heritage bilinguals with more experience with English (i.e., earlier age of arrival to the US, earlier age of acquisition of English, higher self-rated English proficiency, and more education in English) were not the ones that produced more uptalk rises. These findings, in addition to the fact that heritage bilinguals use uptalk as frequently as monolingual speakers of Spanish (Kim and Repiso-Puigdelliura 2021) and English (Asch and Brogan 2022), confirm that uptalk is not an English-specific phenomenon. In other words, the presence and frequency of uptalk per se do not inform us about cross-linguistic influence of intonation between heritage bilinguals' Spanish and English.

We now turn to our findings regarding uptalk rises beginning in a non-final word (i.e., uptalk with IP-final deaccenting). Recall that, unlike Spanish monolinguals whose rise initiate within the last word of the intonational phrase (IP), heritage bilinguals' uptalk in some cases span multiple words (Kim and Repiso-Puigdelliura 2021), similar to what has been found in English (Britain and Newman 1992; Warren 2005; 2016, p. 32). To test whether this divergent pattern is transferred from English, we compared heritage bilinguals' production of uptalk with IP-final deaccenting in Spanish and in English. Our findings showed that the heritage bilinguals produced uptalk with IP-final deaccenting significantly more frequently in English (31.66%) than in Spanish (8.51%). This implies that heritage bilinguals are able to maintain the typological differences between Spanish and English prosodic structures. Language learning experience did not influence their use of uptalk with IP-final deaccenting; the interspeaker variability found in our data may be explained by factors not examined in the present study or it is simply idiosyncratic.

As for the phonetic realization of uptalk, we examined two acoustic properties of the rise: pitch excursion and rise duration. Our data showed that heritage bilinguals distinguished uptalk in their two languages based on rise duration, but not based on pitch excursion; their uptalk in English was produced with longer rise duration than their uptalk in Spanish. The individual variability in rise duration was conditioned by heritage bilinguals' experience with English (PC1) and by their Spanish proficiency and use (PC2). Education in Spanish (PC3) did not affect their rise duration. These findings suggest that heritage bilinguals make cross-linguistic distinction mainly in the duration of the rise, which is influenced by their experience with English and the local Spanish variety, not by their experience with standard Spanish.

6.2. Varying Degrees of Cross-Linguistic Influence along the Dimensions of Intonation

Our findings support the LILt's argument that cross-linguistic influence of intonation occurs along multiple dimensions (Mennen 2015). The heritage bilinguals in this study produced uptalk with IP-final deaccenting in both languages, but produced it more in English than in Spanish. That is, at least for this uptalk pattern, cross-linguistic influence from English to Spanish is likely to occur in the systemic dimension of heritage bilinguals' uptalk, but not so much in the frequency dimension. While IP-final deaccenting emerges in heritage bilinguals' uptalk in Spanish, heritage bilinguals seem to recognize that this is an English feature that is not allowed in Spanish and try to suppress it when producing uptalk in Spanish.

With respect to the realizational dimension of uptalk, the heritage bilinguals mainly used rise duration to distinguish the uptalk of their two languages (i.e., longer rise duration

in English than in Spanish), whereas they did not make any cross-linguistic distinction in pitch excursion. Long rise duration, especially in female speech, and small pitch excursion have been attested in Southern California English uptalk (Armstrong et al. 2015; Ritchart and Arvaniti 2014). While the phonetic properties of uptalk have not been investigated in Spanish as much as in English, what we can infer from our data is that heritage bilinguals do not associate the extent of pitch excursion (small or large) with any language. Studies have shown that heritage bilinguals produce a somewhat smaller pitch excursion in Spanish than Spanish monolinguals (Kim and Repiso-Puigdelliura 2021), whereas the pitch excursion of uptalk in heritage bilinguals' English does not systematically differ from that of Anglo English (Asch and Brogan 2022). This, together with the findings of our study, suggests that heritage bilinguals phonetically assimilate the pitch excursion of the uptalk in Spanish to the uptalk in English to the point that they no longer distinguish the two languages in this regard.

As for the rise duration of uptalk, our findings indicate that heritage bilinguals associate long rise duration with English uptalk and, importantly, long rise duration is more prone to emerge for individuals with more experience with English and less experience with the local Spanish variety. According to Putnam (2020), non-balanced bilinguals, similar to many heritage speakers, may fail to properly inhibit their more dominant language, especially in situations where the two languages are in competition for finite online resources, such as in the case of spontaneous speech production. In such situations, they would be pressured to select between representations that have similar and contrastive properties. Over time, properties that are shared between both languages can lead to restructuring in the grammar of the less dominant language to free up processing cost, whereas properties that contrast from the more dominant language has a better chance at survival (Putnam 2020). This line of reasoning is in accordance with current models of L2 speech learning (Best 1995; Best and Tyler 2007; Flege 1995; Flege and Bohn 2021; Mennen 2015), as presented in Section 1.

The asymmetry found between the frequency (i.e., uptalk with IP-final deaccenting) and the realizational dimensions (i.e., pitch excursion and rise duration) is noteworthy. While cross-linguistic distinction was observed in both the frequency of uptalk with IP-final deaccenting and the rise duration of uptalk, only in the latter, interspeaker variation was conditioned by individuals' language learning experience. In the case of pitch excursion, the heritage bilinguals did not make any cross-linguistic distinction; the uptalk in both languages resembled the English low rises characteristic of their region (i.e., Southern California). These findings imply that phonetic aspects are more prone to cross-linguistic influence at the individual level than the phonological aspects of intonation, consistent with the argument of Jun and Oh (2000). Perhaps for this reason, most support for cross-linguistic influence of intonation has been found in the realizational dimension (Mennen 2015). Bilinguals have only one vocal tract to produce an extensive set of speech sounds in their two languages (de Bot 1992) and, as a consequence, may experience difficulties in articulating sub-phonemic differences between the two languages. The separation of cross-linguistic differences is especially taxing for bilinguals when the same articulator(s) are used in the two languages. For instance, the distinction in pitch excursion is achieved primarily through fine adjustments of pitch, which involve laryngeal muscle activation that controls the stiffness and the tension of the vocal folds (Zhang 2016). Thus, for the sake of economy of online resources (Polinsky and Scontras 2020), it is likely that heritage bilinguals avoid making cross-linguistic phonetic differences as much as possible during spontaneous speech production if these differences do not lead to any change in meaning. Future research should conduct cross-linguistic analysis on the link between phonetic properties and meanings of uptalk in Spanish and in English. If the same meaning is realized differently between the two languages, it would be important to investigate whether phonetic assimilation is more prone to occur in such cases than in cases where cross-linguistic phonetic distinction leads to change in meaning.

Even if heritage bilinguals are found to be better at making cross-linguistic phonetic distinction that leads to different meanings, the phonetic properties of one language may still surface in the other. For instance, Queen (2006, 2012) demonstrated that Turkish heritage speakers in Germany produce a mix of Turkish and German phrase-final rises in both of their languages; apart from the normative low rise of German, the heritage bilinguals also employed rising pitch to indicate pragmatic prominence (e.g., emphasis and focus), which is generally used in Turkish. Queen (2006) interpreted this as a fusion of two intonational grammars into a single intonational grammar, within which the two rise patterns are contrasted. According to Queen (2012, p. 794), heritage bilinguals capitalize on the differences in their two intonational grammars, which "serve as conventionalized, strategic linguistic resources that speakers (and listeners) may use as cues to discourse structures and inference." Although the heritage bilinguals in this study were able to distinguish the rise duration of uptalk in the two languages, they may employ a mix of Spanish-like short rises and English-like long rises for different purposes, which is shared across members of their speech community, similar to the case of Turkish heritage speakers in Germany (Queen 2006, 2012). To attest this, apart from understanding the form-function association of uptalk in Spanish and in English, it is important to demonstrate whether heritage bilinguals utilize the resources from both of their languages and whether such practice is recognizable to other heritage bilinguals with similar backgrounds.

7. Conclusions

Bilinguals' two languages interact at multiple levels and intonation is no exception. Given the complexity and multidimensionality of intonation, cross-linguistic influence is expected to occur along different dimensions of intonation that interact with each other (Mennen 2015). While a good amount of work has been performed on L2 intonation, the intonation of heritage bilinguals has received relatively little attention. Heritage bilingualism offers bilingual contexts that are often left unnoticed in traditional L2 acquisition scenarios (e.g., transfer from L2 to L1 intonation, asymmetry between order of acquisition and language dominance). Given that many aspects of cross-linguistic influence are shared across bilinguals, the investigation of heritage bilinguals' intonation will contribute to building robust models of bilingual intonation.

The present study attempts to fill a gap in the literature by comparing uptalk produced in Spanish and in English by Spanish heritage speakers in Southern California and by exploring whether individuals' uptalk varies depending on their language learning experience. Our findings showed that heritage bilinguals produced uptalk with similar frequency between Spanish and English, confirming that uptalk is not English-specific. Consistent with the L2 Intonation Learning Theory (LILt) (Mennen 2015), the cross-linguistic influence of uptalk occurred along multiple dimensions of intonation. In the systemic dimension, the heritage bilinguals produced uptalk in Spanish with IP-final deaccenting, which is an English feature that has not been attested in non-heritage Spanish varieties. However, in the frequency dimension, they demonstrated significantly lower rates of uptalk with IP-final deaccenting in Spanish than in English. Heritage bilinguals' overall success in separating their two languages in the frequency dimension implies that cross-linguistic influence occurs only to a small degree from English to Spanish in this dimension. With regard to the realizational dimension, the heritage bilinguals demonstrated either assimilation to English (i.e., pitch excursion) or individual variability conditioned by language learning experience (i.e., rise duration). In other words, English-to-Spanish influence appears to occur to a larger extent in the realizational dimension than in the frequency dimension of uptalk. The findings of this study suggest that different dimensions of intonation demonstrate varying degrees of cross-linguistic influence. Specifically, the phonetic aspects are more prone to change than the phonological aspects of intonation.

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Data Availability Statement: No new data were created or analyzed in this study. Data sharing is not applicable to this article.

Conflicts of Interest: The author declares no conflict of interest.

Notes

[1] As a reviewer noted, proximity to the Spanish conversation task and/or heightened language awareness after the language survey may have an effect on participants' performance. We included this potential effect as a covariate in the statistical analysis.

[2] We used the *corr.test*() function in the *psych* package (Revelle 2022) in R (R Core Team 2021).

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