Studies of second language (L2) lexical tone learning have found that learners are better at perceiving and producing tones that are acoustically salient (Qiu & Mok, 2013; Wang, Jongman, & Sereno, 2002), highly frequent in the input (Yeung, Chen, & Werker, 2013) or both (Nguyen & Macken, 2008). In many tone languages, however, tone types with low acoustic salience (such as level low and mid tones) are the most frequent across the lexicon, while tone types with high acoustic salience (such as rising tones) are the least frequent. This begs the question of how learners make use of these competing factors during tone learning. The results of the current study show that acoustic salience and input frequency are both relevant for L2 lexical tone learning, but that they drive different aspects of development. More precisely, beginning learners employed a default tone strategy using the tone type from the target language inventory that was the most frequent in the input. At the same time, early accuracy in L2 lexical tone production was driven by high acoustic salience and lexical frequency, but not tone type frequency.

This poster presents the initial results of a longitudinal study investigating L2 lexical tone development using a classroom corpus and periodic tests of vocabulary knowledge and lexical tone production. The learners in the study are Spanish-speaking children learning Macuilixtianguis Zapotec (MacZ) through an after-school language revitalization program in Oaxaca, Mexico (ages 7-11; N=8). All learners are beginning L2 learners; none of the children in the study speak MacZ regularly at home. The input data come from the first six weeks of “teacher talk” in the corpus (4 hours 21 minutes of transcribed data). Learner production data come from a test of lexical tone production given at the end of the six-week period. Learners read a list of vocabulary words that had been taught in class during the preceding six weeks. To aid in comprehension, a picture accompanied each word. Before the tone production test learners completed a vocabulary test to assess their form-meaning association for the same words.

MacZ exhibits low, mid, high, falling, and dipping tones. The current study is restricted to analyzing the acquisition of these tones as realized on long, stressed vowels (i.e., in open syllables or before a lenis consonant). Figure 1 shows examples of each of the five tones along with duration, average pitch (blue), and pitch slope (red). Following previous work (e.g., Wang, Jongman, & Sereno, 2002) two measures were used to operationalize acoustic salience: duration and magnitude of pitch slope. Measures were taken using a random sample of monomorphemic words from the corpus (n=10 for each tone type). Two aspects of the phonetic analysis are important for the current study. First, dipping tones had the longest duration (M=631ms; SD=41.24), about twice the length of mid and high tones. A one-way ANOVA and Tukey HSD post-hoc tests revealed a significant difference in duration between dipping tones and all other tones (F(4,46) = 168.92, p < .01). Second, mid tones had the smallest magnitude of pitch slope (M=13.01Hz; SD=5.03) and the second shortest duration (M=245ms; SD=41.39), after high tones. A one-way ANOVA and Tukey HSD post-hoc tests revealed a significant difference in pitch slope between mid tones and all other tones (F(4,46) = 53.88, p < .01). An initial analysis of the classroom corpus data (N=248 words; 526 syllables) showed that syllables carrying mid tones were by far the most frequent (n=254, 48.3%) across the classroom “lexicon,” followed by low (n=116, 22.1%) and high (n=103, 19.6%), with falling (n=28, 5.3%) and dipping tones (n=25, 4.8%) being the most infrequent.

The results of the tone production test showed that all learners produced the majority of words tested with a level mid tone across the entire word. In other words, they overgeneralized the tone pattern of lexical items such as lāā ‘name’ and nīsī ‘milk’ to words like gāā ‘nine,’ sāā ‘day,’ and ītī ‘head’ producing instead gāā, sāā, and ītī. The second most commonly used tone pattern differed with each learner, but was either a level high tone or a level low tone. However, these high and low tones were never applied to lexical items correctly during testing and were seemingly random. Only two learners, those with the highest overall scores on the vocabulary tests, produced dipping tones in addition to level tones. When they did so, they were always applied correctly and always to the highest-frequency lexical items carrying this tone type.
The fact that all students produced a mid tone across the majority of the test words suggests that this is a default strategy likely related to the frequency of mid tones in the input, the ease of producing mid tones, or a combination of these factors. An L1 transfer effect can reasonably be ruled out as an explanation for the default strategy, because pitch accent in Mexican Spanish exhibits a L*H pattern (dipping on tonic syllable followed by a rise late on the tonic syllable or the following mora) (Face, 1999; Sosa, 1999 and confirmed for the local variety). The only tone types produced accurately by any learners (other than those matching the learners’ default type) were the dipping tones. This suggests that acoustic salience, in this case duration in particular, plays an important role in developing early tone contrasts. Incidentally, dipping tones are generally considered to be articulatorily complex (Ohala, 1978), so this result suggests that articulatory complexity is less of a barrier to accurate tone production for L2 learners than it is for L1 learners (see e.g., Li & Thompson, 1977). Learners who produced dipping tones correctly did so only for the highest frequency words in the input, offering a variety of incorrect strategies in place of dipping tones on lower frequency words. This study thus adds to evidence that early accurate production of L2 phonological segments is driven by high-frequency words (Trofimovich et al., 2012), showing a similar effect for L2 tone learning.

In sum, the results of this study demonstrate that in early L2 tone development, learners’ default tone strategy is related to tone type frequency in the input while accurate tone production is driven by the acoustic salience of the tone type in combination with word frequency in the input. Pending analyses of the entire six-month study will clarify this interpretation of the results. Overall, this research represents a first attempt at using learner corpus data to account for the role of input frequency alongside phonetic and phonological factors in L2 tone development.

Figure 1. Duration and pitch of sample tones