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SENSITIVITY TO SPANISH PHONOTACTIC CONSTRAINTS AMONG ENGLISH MONOLINGUALS

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Abstract

We investigated the implicit phonotactic constraints of adults who are incidentally exposed to a language in their ambient environment. People in south Texas have persistent exposure to Spanish due to strong historic, cultural, and economic ties to Mexico and Spanish speaking people. We show that people who self-identify as English monolinguals living in south Texas are able to judge the Spanish word-likeness of Spanish based nonwords just as well as self-identified Spanish-English bilinguals indicating that the English monolinguals living in south Texas have and utilize a non-negligible source of phonotactic knowledge of Spanish.

Keywords

Phonotactic Learning, Bilingual, Word-Likeness, Implicit Language Learning

Typically developing children acquire an amazing amount of linguistic information in a remarkably short amount of time. Without knowing much about the world around them and without fine motor skills, typically developing babies all over the world can distinguish between their language from others, divide up a mostly continuous stream of speech into meaningful chunks, and distinguish between strings of sounds that are acceptable in their language from those that are not acceptable. Infants learn these skills within a relatively short amount of time. Most people cannot remember learning their first language; it is more likely that people have memories of trying to learn a second language. For many, learning a second language is remembered as a challenging episode that is often linked to formal classrooms where instructors translated unfamiliar words from the second language into familiar words from a primary language. From a limited corpus of new words in the second language, students build up their knowledge and skills in their new language. However, this process of learning a second language is obviously different from what happens when we learn our first language. Infants lack a known language to translate new words into and rarely experience organized language instruction that explicitly explains the structure and rules of the language being learned. Infants learn by absorbing the linguistic information in their environment, recognizing common patterns in the information stream, then deducing rules and facts from those patterns. An adult situation that is more like learning our first language is being immersed in a community that speaks a completely unknown language without anyone around who speaks your first language. International travelers sometimes get a glimpse of this situation when they travel to countries where few others speak their language. The perception of these travelers is that the people they encounter speak incredibly fast and the possibility of identifying a single meaningful word in the deluge of speech is challenging.

One case study that illustrates how adults might experience the language acquisition process of infants was reported in an English-speaking woman, Julie, who was suddenly left in a non-English speaking, Egyptian Arabic speaking community (Ioup et al., 1994). Linguistically isolated, Julie utilized English to help decipher the Egyptian Arabic she was immersed in. She kept a journal, noting information learned through her attempts at communicating using gestures and context. The notes were a lexicon of new nouns, verbs, and adjectives as well as fixed linguistic routines and patterns. Within 45 days of complete immersion in the non-English speaking, Egyptian Arabic speaking community, Julie was communicating effectively using simple sentences and fixed expressions. Her production continued to improve such that by the end of two and a half years, her speech was at the level of a native speaker. A significant detail of this case study is that there was no formal instruction in Egyptian Arabic to assist in language learning. There is no doubt that Julie's remarkable level of competence in Egyptian Arabic benefited from the English she knew. Knowing English, Julie assumed that there were words in Egyptian Arabic that represented nouns, verbs, and adjective. She also began with the assumption that word meaning can be modified by case markers for gender, number, and person. The written notes she kept is another way Julie's knowledge of English assisted her to reach a remarkable level of proficiency in Egyptian Arabic. These examples of how knowing one language assisted in learning a new language highlight how Julie's experience is different from an infant's experience of language acquisition. However, Julie's ability to attain a native-like proficiency testifies to the ability of adults to learn new languages. In Julie's case, there was an explicit intention to master the ability to communicate in Egyptian Arabic, however, there is evidence that some of the language knowledge was acquired without conscious awareness. Julie's case report specifically notes that she had no conscious awareness of how she mastered the syntactic aspect of the Egyptian Arabic grammar but reported that it just came to her. In this way, Julie's experience resembles that of infant language acquisition. Infants might not always be aware of the knowledge that they are learning from their language environment despite the ability to utilize that knowledge to improve their ability to communicate.

One potential account for the difference between the inability to remember first language learning compared to remembering second language learning stems from the difference between explicit memory and implicit memory. Explicit memory refers to knowledge retrieved using the conscious process of remembering. People who attempt to learn a second language are likely to remember their language instructor, where they sat in that classroom, and the effort that was required to assemble a sentence by remembering the proper vocabulary, verb tense, gender markers etc. The early process of learning a second language includes the conscious attempt to remember the translation of words from the known language. Alternatively, implicit memory is a term used to describe how experiences shape our understanding, associations, and behaviors without the ability to consciously remember how we learned. Implicit memory can be understood as knowing without remembering. First language learning fits well with the notion of knowing without remembering. Infants who are simply exposed to language are influenced by the structure, rules, and patterns of that language without explicit instructions or explicit intent. A growing body of evidence suggests that infants are born with a learning mechanism that is sensitive to the regularities in their environment (Saffron, 2003; Cleeremans et al., 1998). The spoken language in an infant's environment is one source of statistical regularities because the sequence of speech sounds that occur are structured rather than random. Without trying, the infants pick up on these regularities in a process known as statistical learning (Frost et al., 2019). Statistical learning is a general implicit learning strategy for quickly making sense of repeated patterns that occur in several sensory domains (Creel et al., 2004, Glickson & Cohen, 2013, Schapiro et al., 2014).

One example of this implicit language learning comes from the knowledge that is acquired even before the infant is born. In a classic experiment, French speaking expecting mothers were asked to recite a children's rhyme three times a day, every day for four weeks starting at their thirty-fourth week of pregnancy (DeCasper et al., 1994, see also Lecanuet & Schall, 2002). This point in the gestation period is important because evidence suggests that the fetus can hear sounds however external sounds are muffled by the layers of muscle, fat, and skin that separate the fetus from the world (Busnel et al., 1983, Altmann, 1997). After the four weeks, the fetuses were tested to determine how their heart rate would respond to the familiar rhyme or an unfamiliar rhyme. The results showed that the fetuses' heart rate was lower (i.e., more relaxed) in response to hearing the familiar rhyme compared to the unfamiliar rhyme. The ability to discriminate familiar rhymes from unfamiliar rhymes within the same language is extended to an ability to discriminate between the rhythm of a familiar language and an unfamiliar language. Mahler et al. (1988) presented 4-day-old infants born to French speaking parents with a variety of utterances that were spoken in either French or Russian. The results from measurements of suck rate on a pressure-sensitive pacifier indicate that the infants were more aroused by the familiar French utterances than the unfamiliar Russian utterances. Because the samples of speech were varied, the infants were distinguishing their native language from another language based on a familiarity with the prosody (i.e., rhythmic profile) of their native language which were prenatally learned from exposure. Remarkably, infants born into a bilingual environment where two prosodically similar languages are spoken (e.g., Spanish and Catalan) can distinguish between the two language rhythms by 4-months of age (Borsch & Sabastián-Gallés, 2001). These results suggest that infants are implicitly drawn to and extract patterns from the speech samples that they passively experience.

One distinctive language pattern that is implicitly learned by infants is the cooccurrences of speech sounds (i.e., phonemes). Languages differ in terms of how likely phonemes occur together in a word and the position in which they can occur in a word. Although most speech utterances are a continuous stream of sound with no breaks to mark where one word begins or ends, it is estimated that ten percent of speech presented to infants involve single word utterances (Sedivy, 2014). Infants can infer that a repeated sequence of phonemes belong together as a unit (i.e., a word). Moreover, the infant learns that any sounds that come before that unit or after that unit belong to other words – this is known as word segmentation. As the infant learns more word units from that ten percent of single word utterances, the infant identifies the type of phonemes that are likely to be at the beginning and the ends of words as well as the type of sounds that are strung together in a word unit. Gradually, the infant builds a profile of the patterns of sounds that are likely to occur in their language. These patterns of sounds are known as phonotactic constraints which are different for different languages. Research suggests that by 9-months, infants can discriminate between their native language and another prosodically similar language based on the phonetic constraints of their native language (Jusczyk et al., 1993). Remarkably, infants from bilingual environments also show sensitivity to legal and illegal sounding words in both languages as early as 10 months of age (Sabastián-Gallés & Bosch, 2002). It is important to emphasize that infants learn this pattern of acceptable phonetic ordering constraints implicitly through exposure to the language.

The ability to learn the phonotactic constraints of one's language environment does not seem to fade with age (Palmer et al., 2018). Adults show an ability to extract enough linguistic information from the speech samples of an artificial language to be able to distinguish between legitimate words and nonwords even when listening to the speech was note their primary task (Saffran et al., 1997). Studies using artificial languages provide the controls necessary to isolate the specific information that is used to acquire linguistic information. The benefit of control that comes with using artificial languages suffers the expense of ecological validity. Because artificial languages lack the nuances and complexities of natural languages, results from studies using artificial languages have limited ecological validity. However, studies have also shown that adults can implicitly learn enough linguistic knowledge to distinguish between words and nonwords (a fake word designed for research purposes to either mimic or violate the phonotactic constraints of a language) from exposure to natural languages. Kittleson and colleagues (2010) showed that participants with no knowledge of Norwegian were able to learn enough from listening to Norwegian speech samples to distinguish between real Norwegian words and nonwords. An interesting feature of some of the studies with natural languages is that adults can learn the patterns in the unfamiliar language they hear in a remarkably short amount of time. For example, Gullberg et al. (2010) had native Dutch speakers, who were unfamiliar with Mandarin Chinese, watch a 7-minute video sample of a Mandarin Chinese weather forecast then listen to speech samples and determine whether the speech samples were real Chinese words or nonwords. The real Chinese words included words that had not been presented in the video sample. The nonwords were constructed with Chinese phonemes in combinations that violated the phonotactic rules of Chinese and were also not presented in the video sample. Surprisingly, the Dutch participants were able to extract enough phonotactic information about Mandarin Chinese from the 7-minute video to accurately distinguish between real and fake Chinese words. The ability to implicitly learn the phonotactic constraints of a language does not diminish with age and does not depend on explicit instruction or intention but rather requires exposure to the language.

One recent study looked explicitly at whether non-Māori speaking New Zealanders would show a sensitivity to the phonotactic constraints of Māori given the prevalence of Māori words in the ambient environment (Oh et al., 2020). New Zealand's linguistic environment is English dominate and most people identified as English monolinguals. However, New Zealand's indigenous people have the Māori language which the government has intentionally encouraged and revitalized. For example, public schools regularly teach children words in Māori and songs in Māori. Therefore, most people in New Zealand have some exposure to Māori words. Oh et al. (2020) tested whether the exposure to examples of Māori words would lead to an ability to distinguish between potentially good (e.g., phonotactic-conforming) Māori words and poor (e.g., phonotactic-violating) Māori words. Participants were shown written nonwords that were varied in terms of their Māori-based phonotactic conformity. Participants were asked to rate how good each would be as a real Māori word based on a scale from 1 ("non-Māori-like nonword") to 5 ("Highly Māori-like non-word"). Fluent Māori speaking participants rated non-words with low Māori phonotactic probability (PP) as less Māori-like and rated non-words with high Māori PP as more Māori-like. The surprising result was that the non-Māori speaking participants showed the same pattern of results. These results were interpreted as evidence that non-Māori speaking participants had implicitly acquired significant phonotactic knowledge of Māori from their environment. This study was possible because of New Zealand's linguistic environment where dominate-language monolinguals (i.e., English speakers) are surrounded by a ubiquitous non-dominate language (i.e., Māori).

South Texas provides an interesting linguistic environment to study implicit language acquisition through language exposure because of the prevalence of Spanish. In 2022, the population of Hispanics living in Texas surpassed the population of non-Hispanic whites (U.S. Census Bureau, n.d.). Hispanics now make up the largest ethnic group in Texas, comprising nearly 12-million people which is estimated to be about 40.2% of the population of Texas. Related to this rise in the number of Hispanics are the number of Spanish speaking individuals. According to the 2020 U.S. Census, Texas is estimated to include 7.7 million Spanish-speakers which comes to approximately 28.8% of the state's population. The proximity of South Texas to the border with Mexico also contributes to the cultural impact of Spanish in the area as does the history of Texas as once being a territory of Mexico. Moreover, Mexico was the largest economic trading partner with the U.S. at the start of 2023, representing 15.4 percent of all the goods exported and imported by the US (U.S. Census Bureau, 2023). One consequence of the historic, economic, and cultural ties between Mexico and Texas is English monolinguals' exposure to Spanish. Their exposure is difficult to precisely quantify, however, a reasonable assumption is that English monolinguals in Texas are regularly exposed to Spanish words based on reasons mentioned above. This study investigates the ability of self-identified English monolinguals in Texas to distinguish, judge, and rate nonwords based on the phonotactic constraints of Spanish. Given the exposure of individuals living in Texas to Spanish and the ability of adults to implicitly learn the phonotactic constraints of languages to which they are exposed, our prediction is that the judgments of Spanish word-likeness of nonwords will be explained by the Spanish PP of the nonword.

Specifically, we predict the Spanish nonwords' PPs should be positively correlated to the word-likeness ratings for self-identified English monolinguals living in Texas.

Method

Participants

One hundred eighty-six participants between the ages of 18 and 52 completed the survey. The participants were students at Hispanic Serving Institute in South Texas. All participants have lived in Texas for at least 1 year. All participants verified that they do not have hearing impairments.

Stimuli

The present study uses audio recordings of 20 Spanish nonword stimuli from Frisch and Brea-Spahn (2010). The nonwords were constructed from rimes and onsets from a database of spoken Spanish Latin American transcriptions (Brea-Spahn, 2009). None of the nonword stimuli included distinctive Spanish phonemes such as the trill /r/. None of the nonword violated phonotactic patterns such as sequences of identical consonants within or across the syllable boundary. All the stimuli were two-syllable nonwords. The probability of each rime and onset was determined by the number of real Spanish words with that specific rime or onset in that specific position divided by the total number of words in the lexicon with any rime or onset in that specific position. The probability of each rime and onset included in a nonword was then added together into a cumulative probability for each nonword stimuli. Similar to other scales of lexical frequency, the cumulative probability was then log-transformed so that nonwords with a large negative log probability are low in PP and nonwords with small negative log probabilities have higher PP. In other words, the higher the PP, the more that the nonword conforms to Spanish phonotactic constraints. Each nonword was read and digitally recorded using clear speech by a single male bilingual Spanish-English speaker.

Our nonword stimuli range from a PP of -4 to -8. The 20 selected nonword stimuli have high Spanish PPs considering that the whole set of nonwords from Frisch & Brea-Spahn (2010) ranged from -4 to -14. We limited the nonword stimuli to the upper half of the range of cumulative PP to avoid artificially exaggerating the sensitivity of ratings. We expect that non-Spanish speaking Texans will be able to discriminate high PP Spanish nonwords almost as well as Spanish speakers thus, we did not include lower PP Spanish nonwords. It is more difficult to accurately rate the Spanish word-likeness of a nonword when that nonword is designed to sound very Spanish-like.

In addition to the audio recordings, we developed orthographic representations of the 20 nonword stimuli and 3 alternative incorrect spellings. The alternatives were created by replacing one phoneme from the correct orthographic representations. The first phoneme was never replaced.

Procedure

Participants completed an online survey with two parts: the demographic section and the stimuli testing section. The demographic section was a series of questions to fulfill three purposes: 1) to distinguish SEB from EM group 2) to ensure all EM individuals have been residing in Texas – indicating their ongoing casual exposure to Spanish, and 3) to quantify EM groups' Spanish exposure. In the stimuli testing section, participants listened to an audio clip of a nonword stimulus then responded to two prompts: 1) rate how Spanish-like the nonword sounded on a scale of 1 (not Spanish-like) to 7 (very Spanish-like) and 2) select the most accurate spelling of the nonword stimuli. The first prompt used a slider bar to choose the word-likeness rating while the second prompt used a multiple-choice format. The spelling questions were used to verify that the participants were accurately perceiving the audio stimuli. The participants were shown four orthographic options in random order including the accurate orthographic representation of the nonword.

The word-likeness judgement questions were used to analyze participants' phonotactic knowledge of Spanish. The spelling questions were a quality measure to eliminate participants who were not actively listening or completing the survey to the best of their ability. Participants were asked to wear headphones or earbuds to ensure good sound quality.

Results

Fifty participants were eliminated from further analysis due to a high rate of unanswered questions, low spelling accuracy, or low variance in answer choices. Any participant who left more than four questions unanswered was eliminated. Participants who had an error rate greater than 25% on the spelling questions were eliminated from the analysis. Inspection of the data revealed that some participants responded with the same answer to every question suggesting that the stimuli were not carefully considered as instructed. To address this issue, participants with standard deviation of word-likeness ratings that was greater than two standard deviations from the mean nonword ratings variation were eliminated. All elimination criteria serve as quality controls to ensure the analyses use sufficient data from participants who were fully engaged. The 136 remaining participants included 30 self-identified as fluent in Spanish and English referred to as Spanish-English bilinguals (SEB) – while 106 self-identified as non-fluent Spanish – referred to as English monolinguals (EM).

In addition to evaluating the participants, an analysis based on items was also conducted to identify any problematic nonword stimuli. The item analysis focused on responses to the spelling questions where participants were asked to identify the most accurate orthographic representation of the auditory nonword. The high quality of a nonword audio stimulus is evidence by a consistent selection of the correct orthographic representation. A problematic nonword stimuli would be one in which the orthographic representation was ambiguous. One of the nonword stimuli stood out as ambiguous. The auditory nonword stimuli represented by the spelling "suril" was identified by half of the participants as "sudil". Upon closer inspection, it was determined that this auditory nonword stimuli was ambiguous and that both spellings ("suril" and "sudil") could be valid orthographic representations. Because of this ambiguity, this nonword stimulus was eliminated from further analysis. The remaining 19 nonword stimuli had a spelling accuracy rate of greater than 72%. Responses to the remaining 19 nonword stimuli were included in the analysis. The average word-likeness ratings per nonword stimulus was calculated within each group (SEB and EM) and entered into an ordinary least squares regression analysis along with the nonword's PP. If a participant did not give a word-likeness rating for a specific nonword, they were excluded from the average word-likeness calculation for that nonword but not from the others. There was a total of 570 word-likeness ratings for the SEB group used to determine the average word-likeness ratings for the 19 nonword stimuli. The average word-likeness ratings for the SEB group ranged from a high 5.8 to a low of 3.1. Because of the Spanish lexical knowledge of the SEB group, the word-likeness ratings were expected to correlate with the Spanish PP of the nonwords. The regression analysis indicated that the nonword PP predicted the word-likeness ratings among the SEB group, $R^2 = 0.286$, $F(1,17) = 6.805$, $p < .05$. It is important to remember that smaller negative log PP values correspond to more Spanish conforming nonwords, and larger negative log PP values correspond to less Spanish conforming nonwords. As shown in the scatterplot in Figure 1, the SEB group rated more Spanish conforming nonwords as more word-like than less Spanish conforming nonwords.

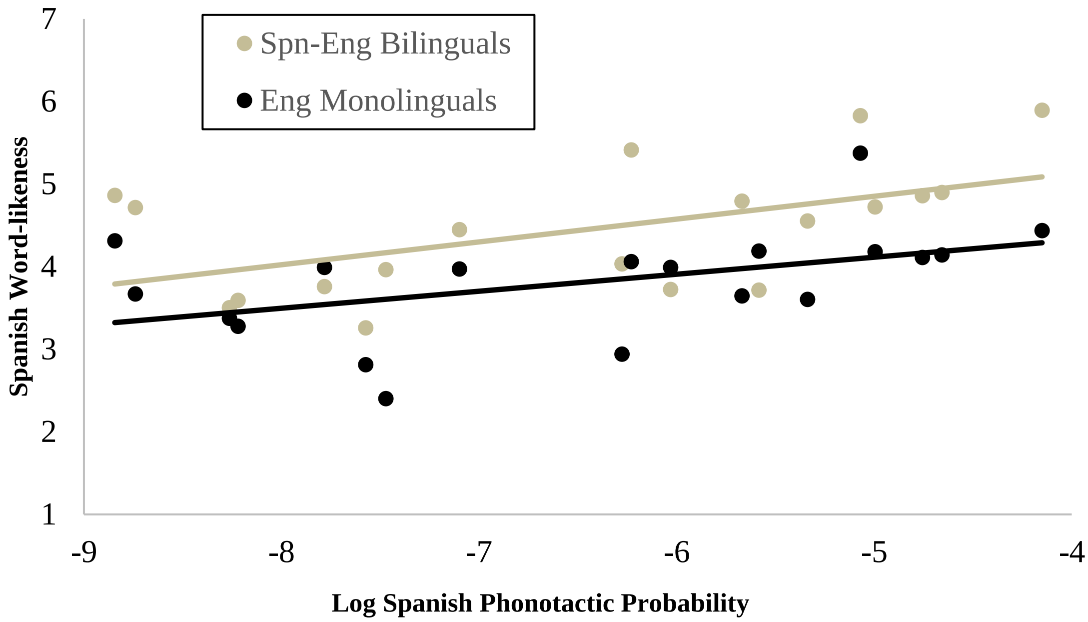

Figure 1 Change in Spanish Word-Likeness as a function of Spanish Phonotactic Probability

Note. This figure shows the relation between Spanish phonotactic probability of the nonword stimuli and how the Spanish word-likeness of those stimuli were rated by the Spanish-English bilinguals (in gray) and the English monolinguals (in black). The lines indicate the correlation between Spanish phonotactic probability and word-likeness ratings for each group.

A similar regression analysis was done for the EM group data that included 2,014 word-likeness ratings used to estimate the average ratings for the 19 Spanish nonwords. The average word-likeness ratings ranged from a maximum of 5.2 to a minimum of 2.4 for the EM group and a maximum of 5.89 and a minimum of 3.25 for the SEB group. One observation is that the range of word-likeness averages for the SEB group included both a higher maximum and a higher minimum compared to the EM group. Similar to the SEB group, the regression indicated that the Spanish nonword PP predicted the word-likeness ratings among the EM group, $R^2 = 0.212$, $F(1,17) = 4.583$, $p < .05$. As seen in the scatterplot in Figure 1, the EM group also rated more Spanish conforming nonwords as more word-like compared to less Spanish conforming nonwords. That analysis suggests that 21% of the variability in the word-likeness ratings can be accounted for by the nonword's Spanish PP which qualifies as a medium effect size and was not much different from the 28.6% of the variability in the word-likeness ratings of the SEB group that is explained by PP.

Discussion

The Spanish PP of the nonwords predicted the Spanish word-likeness ratings of the self-identified EM. The phonotactic probabilities were derived from the statistical likelihood of the sound components (e.g., onsets and rimes) of spoken words from a database of a variety of Latin American dialects (Garrett et al., 1996). The EM group reported having lived at least a year in Texas which is known to have a historical, cultural, and economic influence of Spanish speaking people. Compared to the self-identified SEB group, the amount of variance among the word-likeness ratings explained by the Spanish PP was similar in the EM group. In both groups, Spanish PP explained about 20% of the variability in word-likeness ratings. Both groups rated nonwords that are more conforming to Spanish PP as more Spanish word-like compared to nonwords that are less conforming to Spanish PP. The word-likeness responses of the EM group were clearly not random but rather based on some knowledge that allowed for a statistically significant correlation between word-likeness responses and Spanish PP.

Similar results of a monolingual group casually exposed to another language, who showed a sensitivity to the other language's PP, were used to support the argument that the monolingual group had implicitly developed a proto-lexicon (Oh et al., 2020). A proto-lexicon is a collection of word-type memory entries derived from speech input with little to no semantic meaning associated with the entries (Ngon et al., 2013). Ideally, the proto-lexicon would allow the learner to recognize familiar sounding word-like speech even if there was no recognition of the words' meaning. Importantly, the items in this proto-lexicon reflect the PP of the language. Non-Māori speaking New Zealander's, who were able to rate the orthographically presented nonwords' potential for being a Māori word as well as the Māori speaking participants, were said to use their extensive proto-lexicon. The notion of a proto-lexicon is well known in theories of infant language acquisition (Johnson, 2016). However, Oh et al. (2020) argued that the non-Māori speakers had also developed a proto-lexicon as a consequence of the casual exposure to the Māori language in the environment. One potential explanation for the results reported in the present study is that the EM group have developed a Spanish proto-lexicon as a result of exposure to Spanish heard in the environment. This Spanish proto-lexicon then helped the EM group rate the Spanish word-likeness of the nonwords. The possibility of an acquired Spanish proto-lexicon among the EM group might also help to understand why the range of ratings for the EM group was lower compared to the range of ratings for the SEB group. The SEB group is more likely to have greater input (more experience with Spanish words) than the EM group – this may result in having more confidence in their ratings of Spanish word-likeness. This richer source of input may also explain why the nonwords' PPs had a higher correlation to the nonword ratings in the SEB group compared to the EM group. Despite the difference in the magnitude of the correlation, it is critical to recognize that the EM group and the SEB group showed a significant increase in word-likeness ratings with PP suggesting that both groups have a non-negligible phonotactic knowledge of Spanish. Because the SEB group has more exposure to and experience with Spanish, they have a greater sensitivity to Spanish phonotactics.

There are reasons to believe that the knowledge of Spanish PP among the EM group has been implicitly acquired rather than explicitly learned. One reason is that by self-identifying as English monolinguals, the individuals are unaware of their knowledge of the Spanish PP they possess. The other reason may be that the knowledge of Spanish PP among the EM group has likely not been intentionally acquired. This suggests that by the mere exposure to a second language, the EM group have acquired sufficient knowledge of Spanish PP to have it predict their ratings of Spanish word-likeness. This implicit acquisition of basic knowledge required for language learning supports the importance of implicit learning opportunities for second language (L2) learning. One controversial position by Krashen (1981) argues that effective L2 classrooms should be intentional about providing opportunities for language acquisition and that language acquisition is more central to second language performance than the more typical explicit instruction. Research provides strong evidence that there are some aspects of second language learning that can be acquired through implicit learning (Rebuschat & Williams, 2012; 2013). Exactly how to intentionally provide effective opportunities for implicit language acquisition is a question that has yet to be determined. Krashen (1981) makes suggestions that are inspired by the language environment of infants and their interactions with caregivers. One such suggestion is that the L2 language directed at the learner be focused on comprehension, with a simplified form and structure that is focused on objects or events in the immediate present. A relevant feature of natural language learning that Krashen emphasizes is that comprehension precedes production. Therefore, it might be expected that, for L2 learners who are implicitly acquiring the rudimentary knowledge of the new language, there be a silent period where they may not be consciously aware that they are building up their knowledge nor do they have any intention of building up their knowledge. During this silent period of L2 learning, the learner may actually benefit from the casual exposure to auditory examples of the second language such as watching and listening to foreign language movies and television (Kuppens, 2010) or one on one interactions in a foreign language context (Philp & Tognini, 2009). Importantly, allowing the L2 learner the opportunity to actively listen to the target language may provide the dataset necessary for the inherent statistical learning mechanisms to begin to extract the rudimentary knowledge needed to then bootstrap themselves up to higher order linguistic knowledge. Oh et al., (2020) suggests that even casual exposure to the target language repeated over a long period of time will sufficiently allow for the implicit learning of a proto-language. The proto-language is a preliminary step towards successful language acquisition.

The results of this study affirms that Texans who do not speak Spanish have a sufficiently well formed understanding of the phonotactic constraints of Spanish that has likely formed from the incidental exposure to Spanish in an environment that has a historical, cultural, and economic connection with Spanish speaking individuals. Moreover, that understanding of Spanish phonotactics can be generalized to never heard before forms. Evidence of this knowledge of Spanish PP among the EM group is shown through the ability of the Spanish PP to predict the word-likeness ratings which was very similar to that shown among the SEB group. Unlike other studies, this study make use of auditory nonwords stimuli rather than orthographic stimuli that is much more similar the auditory stream of input that infant learners typically experience. This study provides a real-world example of the remarkable ability of the human ability to extract structure from the regularities in their environment without intention and without awareness. Harnessing the natural cognitive mechanism that tunes the human mind to linguistic regularities may be an important aspect of second language learning that may help motivated L2 learners. This study affirms the importance of providing opportunities for the natural process of language acquisition to take place in classroom settings in an effort to complement what is already provided through explicit instruction.

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