¿Puedes Anagramar?: A Game That Helps Heritage Speakers Master Spanish Accentuation

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¿Puedes Anagramar?: A Game That Helps Heritage Speakers Master Spanish Accentuation

Senior Project submitted to

The Division of Science, Mathematics, and Computing

of Bard College

by

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Abstract

Sometimes the best way to learn a new topic isn’t through traditional means but by way of a game. Research has shown that games are especially helpful for learning a new language. Spanish heritage speakers grow up “knowing” Spanish, but do not have full oral or written fluency. The purpose of this project is to create a game that aids Spanish heritage speakers in understanding the rules of accent placement. Heritage speakers grow up in a home where Spanish is spoken, and are bilingual (English/Spanish) with respect to comprehension. The skill level of each heritage speaker varies but a number of them lack full oral fluency, and even more lack fully-developed written literacy. This project attempts to create an online web anagram game to assist Spanish heritage speakers in mastering an under-acknowledged component of their language: Spanish accentuation. Spanish accents, *tildes*, are used often in the language, in both writing and speech. With aid from the anagram game, Spanish heritage speakers will acquire better understanding of when to use *tildes* and where to properly place them. The results of this project suggests that, on average, when a Spanish heritage speaker plays the game more often, they have a better understanding of accent placement.
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Chapter 1

Heritage Speakers

1.1 What are Heritage Speakers

The number of Spanish speakers in the United States is rapidly increasing. As of 2015, the US had an estimated 52.6 million Spanish speakers, making it the country with the second highest number of Spanish speakers in the world. Of those people, 41 million are native Spanish speakers and the other 11.6 million people are bilingual (“US has more Spanish speakers than Spain,” 2015). Moreover, a large portion of the Spanish speaking population is made up of heritage speakers (HS). A HS is defined by Valdés (2000) as someone “who is raised in a home where a non-English language is spoken, who speaks or merely understands the heritage language, and who is to some degree bilingual in English and the heritage language.”

1.2 The Various Levels of Heritage Speakers

The obstacles that Spanish HS face often go unnoticed. Many people simply assume that because HS are raised in a household where Spanish is spoken, they must be fully fluent and have a
strong understanding of their language. This is not true for a large number of HS. The NYC Department of Education defines three subgroups to explain the wide range of ability of HS in speaking Spanish. NYCDOE Office of English Language Learners (2013) describes the three groups subgroups as follows:

Students who have full oral fluency and literacy in the home language, students who have full oral fluency in their home language, but their written literacy is not developed, [and] students who can speak their home language to a limited degree (e.g., second- and third-generation immigrants) but who may not be able to express themselves fully, either orally or in writing. (p. 10)

The first category covers the portion of HS who both speak the language at home and have also gone through formal training. Thus, these HS understand their language both formally and informally. Not only can they use slang and colloquialisms, but they can also understand the syntax and meaning of the things they say. This allows them to truly understand exactly why the things they say make sense. The second category is HS who primarily speak Spanish at home but have never undergone any type of formal training in Spanish. They have access to many components of their language such as the ability to speak fluently and the ability to understand the meanings of the things they say. However, Hancock (2002) explains that they lack the ability to understand the syntax that is involved in the things they say, leaving a disconnect between the things they say and a complete understanding of its structure. The third category of HS are not fluent in all aspects of Spanish. They can “discuss day-to-day topics related to home and community” but have difficulties when it comes to talking “about more complex topics, such as politics, literature, or careers” (Hancock, 2002). This group needs even more support as they are not orally fluent nor is their written literacy developed. These three categories overlap but show
that there is a large population of HS who need support in order to become completely fluent in Spanish.

1.3 Challenges in Supporting Heritage Speakers

There has been a lot of research into the best way to support HS but not enough concrete results have been discovered that can fully be considered solutions to the problem. In many ways, supporting HS is very difficult as there are both internal and external factors at play. The HS’s level of Spanish comprehension is an external factor that has a huge impact on supporting HS. Each Spanish HS has different experiences with their language in how they learned it and even how they use it. Thus, the support for each of them will look different. On the other hand, their internal perceptions of their language and particularly their dialect can play a huge role in their language learning process. Chandrasekaran (2008) writes, “Having a negative view about the dialect being spoken can create a negative view about one’s culture.” This is because some HS have “internalized that their language is defective and needs to be corrected” (Lacorte and Canabal, 2003). Furthermore, another study was done by Durán-Cerda (2008) in which she surveyed HS and discovered that many of them felt as though they only knew “bad” Spanish which refrained them from taking a course for HS. Cho (2000) also did a similar study and also discovered a similar sentiment in her participants. One of her participants even reported a feeling of embarrassment when around native speakers as he felt they would “immediately know that he was limited in vocabulary”. This all proves that there are Spanish HS who truly want to be orally fluent and want to improve their written literacy but simply need support and the resources to do so.
1.4 Classes for Heritage Speakers

In response, many classes have been created that center around supporting HS in providing them with the skills they lack or need to improve upon. The goal for these types of classes is “to develop skills in Spanish speakers that would allow them to participate in advanced placement courses in Spanish” (Lewelling and Peyton, 1999). Classes that specifically focus on supporting HS are beneficial because they provide them with the opportunity to receive the personalized support they need. Unfortunately, with the creation of classes that support HS, new problems arise in terms of the best way to teach classes that contain HS with varying levels of Spanish speaking, writing, and reading proficiency. Additionally, these classes have a large variety of different dialects spoken. Thus, the instructors of these classes must create very flexible and creative ways to teach such diverse groups of HS.

Teachers of HS classes have begun using a wide variety of tactics during class to ensure that the HS are receiving the best possible support that is catered to their learning style and needs. However, when teachers “work to build on what students already know, rather than trying to replace it” (Lewelling and Peyton, 1999) it has been shown to encourage and foster their own personal Spanish skills rather than replacing them with something that is foreign to them. This is especially important when it comes to the diverse dialects that will most likely be present. With different dialects, instructors apply an entirely new type of teaching process as different dialects in Spanish use words and phrases very differently. An expression in one dialect can have a completely different meaning in another dialect. For example, the verb *coger* means “to pick up” for most Latin Americans but for Mexicans, the verb means “to have sex.” For this reason, teachers of classes for HS can almost never ignore dialect differences in a classroom. The instructor must be aware and find a way that is best suited to deal with these differences.
Unfortunately for HS, the problem with different dialects in a classroom can be a challenging one to face if not handled appropriately by the instructor. This is because a majority of HS have not had formal training. For the few HS who have, they may still have minor problems speaking Spanish due to the fact that there exists no set or formal way of teaching HS. Another internal struggle with some HS is that they “may feel self-conscious about their particular dialect because they might think that it is inferior to other dialects” (Chandrasekaran, 2008). While there are a lot of problems that may arise when teaching HS, many HS teachers have embraced the variety of dialects in their class and use it as a teaching moment to learn about other cultures. This flips the obstacle and makes it an interesting way for the HS to learn more about a culture other than their own. As a result of there being so many intricacies when teaching HS, it is up to the teacher to strategically employ techniques that benefit the students in the classroom.

1.5 Observing Teachers of Classes for Heritage Speakers and the Strategies They Use to Teach Their Classes

Chandrasekaran (2008) interviews and observes four HS teachers to investigate the different ways that the teachers teach and also how they handle some of the obstacles they face. Based on the results and personal observation of Chandrasekaran, both the HS teacher and the strategies they use to teach the class are very important. While some literature suggests that having a native speaker as a teacher for HS is an integral part of supporting HS, Chandrasekaran’s research, instead, points out that it is less about who is teaching and more about how the teacher incorporates different cultures and fosters mutual respect between themselves and their students.
One of the teachers for HS in Chandrasekaran’s research, Julie, is a non-native Spanish speaker who Chandrasekaran notices “is frustrated and unsure of what to do for the [heritage language speakers] in her classes.” Chandrasekaran also notices that in the classroom the students don’t seem to respect her. Thus, a reason for the lack of mutual respect could be due to Julie’s frustration and lack of experience with HS. Another of the HS teachers observed was Susan, who is also a non-native speaker. Unlike Julie’s class, in Susan’s class, there is a high level of mutual respect between her and the students. When asked about how this level of respect came about and whether being a native Spanish speaker caused any problems she replied saying, “the key to working with these students is to establish a relationship of respect with them so that they respect you for what you know, and you respect them for what they know” (Chandrasekaran, 2008). Instead of trying to overcompensate and pretend to be perfect, Susan is honest with her students in acknowledging that sometimes she may say some things incorrectly and, in those moments, it will be a learning moment and class will go on. This is very important for the students to see because she is living proof that learning a language is something that is gradual and takes time regardless if you were raised with it or if you learned it in school. Having a non-native Spanish teacher has both its pros and cons.

According to Chandrasekaran’s research, another method many of the teachers for HS use is including culture in their classes. By including different cultures, students feel as though they matter and that the dialect of Spanish they speak also matters. This also aids in the process of encouraging HS “to value their culture and understand different ones” (Chandrasekaran, 2008) and to not think of their dialect as something inferior to other dialects but as something unique and special. Additionally, when talking about culture in the classroom, HS are able to continue to practice speaking Spanish while shifting away from only focusing on grammar. While there are
countless ways of teaching HS, fostering mutual respect and enjoying and experiencing each individual’s culture seems to be integral components of HS classes that aim to truly support HS.

1.6 Oral and Written Spanish: The (In)significance of Tildes

While it is beneficial that there exist classes for heritage speakers that focus on culture and increasing their comfort with speaking the language, Spanish HS must still learn the rules that govern written Spanish to fully utilize all components of their language. As stated before, there are still a large number of obstacles faced by Spanish HS in terms of understanding the properties of written Spanish and a large part of this is attributed to the fact that a “linguistically homogeneous group” (Montrul, 2012) does not exist. The most common mistakes made within grammatical properties for Spanish HS revolve around “tense, aspect, mood system, subject pronouns, prepositions, the copulas ser and estar, and gender agreement in noun phrases” (Montrul, 2012). The reason it can clearly be distinguished as a problem is because the type and frequency in which HS make these errors is much greater than that of native speakers. Although a large part of this is due to the lack of formal training that a HS receives, it is also because people are rarely corrected while they are speaking as their audience can still understand the intent of the message even if it contains grammatical errors. For this reason, grammatical errors made while speaking don’t obstruct the intended meaning of the speaker and can often go unnoticed.

Unlike oral grammatical errors, written grammatical errors are more noticeable. The majority of time that a HS writes under possible scrutiny from others will be in the classroom and more than likely in a Spanish for HS class. One aspect of the Spanish language that can only
be addressed through written grammar properties is the use of written accents, or tildes. There are specific rules in Spanish that signify the stress, or intonation, of syllables in a word. To be able to understand these rules and use the language at its full capacity, one must understand the grammar rules associated with it. Often, people don’t pay much attention to tildes and see them as more of a complex problem that can be dealt with later or not at all. While it is true that the use of tildes is not of the utmost concern when speaking, it becomes extremely important when writing in Spanish. Not only do most verbs in the past tense and a number of nouns and adverbs use tildes, “the accent mark is used to distinguish certain homonyms” (Douglass, 1988). For example, *hablo* means “I speak”, with the stress on the *a*, whereas *habló* means “he or she spoke”, with the stress on the *o*.

The use of tildes is not popular by all, as “a movement has been shaping to eliminate written accents in Spanish” (Scott, 2007). Not only does this limit the language as a whole, but it also prevents a Spanish speaker from being able to correctly understand the information when reading in Spanish. As shown before, this is because a verb can have two different meanings with the same spelling. The only way for the reader to know the distinction between the two is by use of a tilde as its purpose “is to show voice stress” (Douglass, 1988). The tilde assists in understanding both the meaning of the word and how to correctly say it. Thus, it is an essential piece of the Spanish language that, if ignored, can cause difficulties to arise later on.
Chapter 2

Language Learning Games

2.1 How Games Can Help In Learning Languages

Ketterlinus (2017) defines a game as “a fun activity involving a task that is accomplished by following certain rules, usually in competition with one or more individuals.” Much like a game, languages follow a certain set of rules. When you don’t follow the specific guidelines set in a game, you lose; whereas in language learning, making a mistake is another chance to try again and correct that mistake. One is bound to make mistakes while learning a new language, if not more often than in a game, but it is simply an opportunity to improve on those skills. After doing some research on how students respond to language learning through games, the results were astounding. The beauty of language learning games is that they “involve [the user] in different ways of using the language…without any fear of making mistakes with the language in public” (Curry, 2014). This allows the user to truly immerse in the language in a way that is both comforting and challenging. Teachers even reported that students “learned at an increased pace” (Curry, 2014) when learning languages using games. Another added benefit of using games as a way of learning languages is the competitiveness of the games and the drive they instill in
players to improve. That is the perfect atmosphere and motivation required to learn a language: challenge and drive.

2.2 How A Language Learning Game Can Benefit Heritage Speakers

As Spanish HS may not have full oral fluency and literacy in their language, fortifying and strengthening their Spanish skills through a game can also be useful for them. Language learning by means of a game is especially useful for them as it “provide[s] a positive environment in which the [HS] feel emotionally secure and do not fear public correction” (Ketterlinus, 2017). One great example of a Spanish language learning game is a website called “digitaldialects.com.” In the website, the game focuses on many fundamental elements of the language such as common verbs and nouns, numbers, telling the time, colors, and common phrases. However, what makes this a very good learning tool is the way that it presents the information to the player. Not only are the colors vibrant and inviting, the game isn’t a straightforward memory game. Instead, for each section there is an interactive and responsive element to it. For example, in explaining the use of the verbs *ser* and *estar* they force the reader to use context clues by looking at the scene and choosing the verb that is most applicable to the scenario. This requires the player to look at the number of people present, in order to determine which form of the verb, and additionally, the correct verb that matches the sentiment of the context. Ketterlinus (2017) writes that games like this that “focus on problem solving…contribute to an increase in interest in learning.” Furthermore, Ketterlinus finds that a benefit to using games in language learning is that they “provide rapid feedback” by allowing the player to get immediate results on their mistakes. With some modifications, a game similar to
this one would be very beneficial to HS. Not only could it increase a Spanish HS’s interest in learning their language, it would provide them with quick feedback and privacy while learning.

### 2.3 The Anagram Game

Upon discovering the benefits of language learning through games, I decided to create an anagram game designed to support the needs of Spanish HS. While there are many areas that can be focused on, I decided to concentrate the game on the placement of tildes. As previously stated, many of the classes for HS focus less on written literacy and more on oral fluency. Thus, I feel as though a game that fosters written literacy would be very useful for HS. Specifically, a game that is centered around the use of tildes and knowing when to use them and where to put them would be more beneficial to HS. Although one of the goals of the game is to increase the written literacy of HS, understanding the placement of tildes will help HS better at reading in Spanish and indirectly assist them in fostering their oral fluency. Another aspect of the game is that the game inadvertently teaches the HS new vocabulary by asking them to apply the rules of placing tildes to words they may have never seen before. This allows them to use problem solving skills to keep them both engrossed and excited about the game.
Chapter 3

The Anagram Game: A Game To Teach Spanish Accents

The purpose of the anagram game is to help heritage speakers learn the rules of accent placement in a fun and enjoyable way. By playing the game at their leisure and pace, it eliminates the stress of winning and allows them to focus on learning.

3.1 What is The Game?

I created an anagram game that outputs a Spanish word in which the letters have been randomly permuted. It is the job of the player to decode the scrambled letters to determine the word. However, as this is a game designed to help Spanish HS strengthen their Spanish skills, the player must use clues to try and guess the scrambled word. The clues the game provides to assist the player are the word’s definition, part of speech, and gender. All the words range from five to nine characters to ensure that all players are receiving words within the same range of length.

The purpose of the definitions is to encourage the player to consider word semantics when determining the correct word. The part of speech is to help guide them in the right direction, as Spanish, similar to English, has many words that all have similar meanings but are different parts of speech. For example, “to choose” and “choice” are very close in definition but “to choose” is a verb and “choice” is a noun. This ensures that they are both thinking of the correct form of the word and simultaneously learning new forms and ways that words can be
used and presented. Lastly, in Spanish, nouns and adjectives have two classifications: masculine or feminine. However, verbs and adverbs are not classified based on gender. Thus, it guides the player towards the correct word when provided the gender of the word. All of these aspects act as a way of encouraging the player to continue playing the game although it may be frustrating at times to not know a word. This is very important as HS need an educational and fun resource that challenges them but that also isn’t so difficult that it discourages them from playing.

3.2 Playing The Game

When the game starts, the timer begins and the player is presented with a scrambled Spanish word, its definition, its part of speech, and its gender as shown in Figure 3.2.1.

Figure 3.2.1. This image is the basic screen displayed while the user plays the game.
Underneath, there are empty text boxes for the user to fill in what letters they think make up the correct unscrambled Spanish word. Once the player inputs a word they think is correct, they can click the button that says “Submit” to first see if they got the word correct. If the word is not correct, the game continues without penalty and the player is given a new word. If they input the correct word, they receive three points and move to the next part of the game as illustrated by Figure 3.2.2 that asks the player whether there is an accent, and, if so, the text boxes transform into buttons and the player must then click the letter of the word where they think the accent belongs or click the button that indicates no accent is needed.

**Figure 3.2.2.** This is the second stage of the anagram game that appears when the user correctly guesses the scrambled word.

If they choose incorrectly, one point is deducted from their score. If they choose correctly, two points are added to their score and then they move on to the next word. Once they receive a total of 50 points, the game directs the player to a screen where they can see all the words they misnamed and also all the correct accent placements of those words as demonstrated in Figure 3.2.3.

**Figure 3.2.3.** This shows the screen that appears after completing the game.
This screen also tells the player how long it takes for them to get a total of 50 points. Afterwards, the player views the leaderboard which shows them the top ten fastest players along with the time it takes each of them to complete the game. This allows the player to see how well they did in comparison to others and hopefully instills in them a drive to improve by replaying the game.

3.3 Choosing The Data

I manually retrieved the data used in the game. The data consists of over 500 words that each have definitions, parts of speech, and genders. I acquired the majority of my data from lingolex.com, a language learning website that contains a large number of words and phrases in the target language with a variety of difficulties. This anagram game contains over 500 words in which each contain five to nine letters. Although it is a game, I still wanted to be intentional about the words I used especially when it came to the verbs and the nouns. I specifically included a portion of verbs from lingolex.com that were deemed to be some of the most used verbs in Spanish. I did this to ensure that the players would be gaining a deeper understanding of words they already know while also learning words they don’t know. Additionally, I also chose a wide range of nouns that range in context and meaning. However, when choosing the nouns, I chose nouns that both contain and don’t contain tildes, as the purpose of the game is to improve Spanish HS’s understanding of the placement of tildes. The definitions were obtained using a Spanish Reference Book Diccionario de la lengua española and Reverso Dictionary, which is an online Spanish dictionary and language translator.
3.4 Game Presentation

3.4.1 First Glance

The game was created to be played on a computer in full-screen mode. The placement of all the components within the game is intentional and meant to both grab and keep the player’s attention. The color scheme of the game is meant to draw the player’s eyes to the most important parts of the game to ensure that they are aided in completing the game as quickly as possible. Upon opening the website, the user is presented with the option to login or create an anonymous and unidentifiable username and password as shown in Figure 3.4.1.1. If the user logs in, Figure 3.4.1.2 will appear reminding them of their top three scores.

Figure 3.4.1.1. This is the first screen that appears when the player loads the webpage.

Figure 3.4.1.2. This presents the player with the three fastest times that it took for them to complete the game.
After the user logs in or creates an account, Figure 3.4.1.3 is displayed to the player which explains the rules of the game and tips about how to play it. Next, the player is presented Figure 3.4.1.4 which explains the rules of accent placement. Both of these pages ensure the player is equipped with the tools to successfully play the game.

**Figure 3.4.1.3.** This screen is presented to the player to understand the rules of the game before the it begins.

**Figure 3.4.1.4.** This screen informs the player about the rules of accent placement in Spanish to prepare them before the game begins.

### 3.4.2 User Input

Another aspect that aides the player in completing the game as quickly as possible are the text boxes, shown in Figure 3.2.1, where the player inputs the suspected answer. After inputting a letter, it automatically jumps to the next box so that the player doesn’t have to click each text box. Next to the text boxes are two buttons where one tests to see if they entered the correct word
and the other clears all text from the text boxes to quickly erase an incorrect word. The player can also press the “Enter” key on the keyboard to automatically submit the word for correction.

3.4.3 Visual Layout

The scrambled word is intentionally placed at the bottom of screen furthest from the view of the player as to keep their eyes most focused on the definition and the supporting clues. This is to encourage the player to determine the true word from the clues provided rather than simply guessing the word. As shown in Figure 3.2.1, after the player submits a word, a message will appear on the screen informing the player that their answer was correct or incorrect. This allows the player to receive immediate feedback on their inputs. This way the player immediately knows the results of their input and can continue to the next phase or the next word. The elapsed time and score are placed on the same line at the top of the screen so that the player can easily see it while playing without being distracted.

3.5 Software Requirements

I created the game using Brackets, a text editor made especially for web designers. The coding languages I used to create the game are HTML, JavaScript, CSS, and PHP. While I wrote the code for the game in Brackets, I used Heroku to build and launch my game onto a domain. Heroku is a cloud platform that aids the process in creating applications as it allows the creator to simply focus on the app creation while it handles the infrastructure component.
The anagram game is a static website which means that the content I write in HTML will always be the same for every user. Figure 3.5.1 shows that the code will not change unless I manually alter it and send the code from my local git repository to Heroku. A git repository is used to store information as it changes over time. The Heroku remote is similar to a git repository in that it holds information; however, a git repository is local whereas the Heroku remote is a server for Heroku. The master branch is the default branch of the repository where branches are used as pointers or “bookmarks to remind [the user] where the branches on the [remote] repositories were the last time [the user] connected to them” ("Git Branching," n.d.). Once this is completed, the application can be launched with the updated code.

![Diagram of the process](image)

**Figure 3.5.1.** This shows the process of adding files to the git repository, updating the new changes, and sending it over to the Heroku server.
The information outputted on the game, such as the clues, and the information inputted, such as the player’s username, password, and errors, are all saved on a database. Heroku offers PostgreSQL, a relational database management system, to its users as an already added component. A relational database is “a collection of data items organized as a set of formally-described tables from which data can be accessed or reassembled in many different ways without having to reorganize the database tables” (Khosrow-Pour, 2007). As a result of PostgreSQL being a relational database management system, it allows me to store and access data as needed. In conjunction with PostgreSQL, I use pgAdmin, which is a management tool for PostgreSQL, that allows the user to edit and browse the stored data. PostgreSQL and pgAdmin interact with one another similarly to a client-server relationship meaning the player uses pgAdmin to request the use of data from PostgreSQL. The three tables located on pgAdmin used to store data for the game are titled info, leaderboard, and users. “Info” contains over 500 Spanish words, definitions, parts of speech, and genders. “Leaderboard” contains each user who completed the game, the time it took for them to complete the game, and the number of times they have played the game. Lastly, “Users” contains all usernames and passwords of each person who has played the game.

### 3.6 Challenges

One of the main challenges in creating the web game is correctly integrating the different types of coding languages. This is especially difficult when both retrieving and sending data to pgAdmin where the data is stored. The game has SQL code written in its “script” section of the html document in which JavaScript is already being used. The game is able to function while using SQL code because the game is saved as a PHP file. However, when the game is started, the
SQL code only runs once regardless if it is called multiple times. Some research shows ways of transforming data from pgAdmin that is unrecognizable to JavaScript and make it so that JavaScript can interpret the information. Thus, anytime the game needs to send or retrieve data from pgAdmin, instead of getting the exact data it needs, it grabs or sends all the information at once, resulting in an incredibly long string of data. Fortunately, by using JSON, a data interchange format, it is possible to change the format of the string into one that JavaScript recognizes.

```
<?php
session_start();

# login to database
$dbh = pg_connect("dbname=d3r9frkoh4hcc host=ec2-54-83-37-223compute-1.amazonaws.com port=5432
user=ydsoksmjzubvqi password=c4460f163d0c55e0ef546aced6b0e8e1843ecabae05a8067d1c3461d001013bc4e sslmode=require");

# grabs all information from info and counts the number of rows in the info table
$sql = "SELECT words, def, pos, type, id FROM info";
$query = pg_query($dbh, $sql);
$rows = pg_num_rows($query);
$array = array();

# puts all the information from info into an array
while ($row = pg_fetch_assoc($query)){
    $array[] = $row;
}

# randomly saves each word with its corresponding information
$rand = rand(0, $rows-1);
$theword = $array[$rand]['words'];
$thedef = $array[$rand]['def'];
$thepos = $array[$rand]['pos'];
$thetype = $array[$rand]['type'];
$theid = $array[$rand]['id'];

?>

# saves the information from the array as a string
# then parses the string so that JavaScript can understand it
var theString = '<?php echo json_encode($array); ?>';
var jsonArray = JSON.parse(theString);
var randomNumber = Math.floor(Math.random() * jsonArray.length);

# randomly chooses a word with its corresponding information from the string
wordDef = jsonArray[randomNumber].def;
wordSpeech = jsonArray[randomNumber].pos;
wordType = jsonArray[randomNumber].type;
rando = jsonArray[randomNumber].words;
randIndex = jsonArray[randomNumber].id;
```
This code snippet runs a query to retrieve all the information from the table “info.” Next, it counts how many rows are in the info table which represents the number of Spanish words and its corresponding information that are in the table. Then, it creates an array and inserts all the information from “info” into it. After generating a random number between zero and the number of rows that exist in the table, it saves each word, definition, part of speech, gender, and id. Once this happens, the PHP portion of the code ends and the JSON is used to encode and parse the php array into a string in JavaScript. All the information must be gathered from PHP on the first try because PHP code only executes once. Once transformed into a string, JavaScript is now able to interpret and manipulate the date. Lastly, a random number is generated using JavaScript between zero to the length of the array, which is equivalent to the number of words and its corresponding information, and a random word and corresponding information is chosen from the array.
Chapter 4

Results

4.1 Testing The Game

The data reported is from a heritage speakers class taught by a professor at Bard College. The professor invited me to their classroom to allow their students to play the game and see if it actually helped them improve their usage and placement of accents. The students were given the opportunity to play for about 20-30 minutes before returning to classwork. The only information I gave the students was the link of the game and the offer to play the game as much as they liked. With this data, I measured how many times they successfully played the game, meaning how many times they played the game and achieved the goal of obtaining 50 points. Additionally, I measured how much time (seconds) each student and the class as a whole took to achieve 50 points. Lastly, I measured the amount of change in time between each play for the students who played more than once. My goal in taking these measurements is to determine if my game was helpful for HS in the professor’s class. I determined this by observing how frequently the HS completed the game. In addition, another goal is to analyze the time it takes for the HS to complete the game over multiple plays. This assists in evaluating whether or not the game truly assists HS in learning the rules of accent placement.
4.2 Observed Results

The amount of time that HS took to complete the game on the first play ranged between three minutes to twelve minutes. As Figure 4.2.1 demonstrates, the time it took each HS to complete the game was widely varied. This was suspected, as classes for HS can contain students at vastly different levels of comprehension and mastery of language.

![Figure 4.2.1](image1.png)

**Figure 4.2.1.** The time it took for the HS to complete the game on their first play was varied: while the fastest completion time on the first play was 220 seconds, the slowest time was 712 seconds. The average time of all the HS on the first play was 390 seconds with a standard deviation of 170.

While I hypothesized that most HS would play the game more than once, this was not the case. Only three students played the game more than once and of those three students, Figure 4.2.2 demonstrates that two of them finished the game more quickly on their second try. However, this exploration of use in one class does not provide general results.

![Figure 4.2.2](image2.png)

**Figure 4.2.2.** This graph compares the time it took users to complete the game on the first play versus the second play.
Although only two of the three HS that played the game more than once showed a decrease in the amount of time it took for them to complete the game after their first play, on average, the elapsed time for the first play was more than the second play. Based on Figure 4.2.3, one can infer that after the first play, the time that it takes to complete the game the second time is less than the first play. However, the results do not point to a cause of this result, but simply identifies a correlation.

![Figure 4.2.3.](image) The average time that it took the students who completed the game more than once was 298 seconds with a standard deviation of 46 on the first play and 222 seconds with a standard deviation of 89 on the second play (n=3). Thus, showing that on average, the three students completed the game quicker on the second play.

Only one student completed the game three times. As Figure 4.2.4 depicts, the student showed a drastic drop in time it took them to complete the game. While this cannot act as a model of representation for all the HS in the class, it does suggest that the game can be a helpful resource over multiple game plays.
The results suggest that the idea concerning HS having a wide range of mastery over the Spanish language is true. Although the data suggests that it is true, the results are inconclusive as not enough data was taken to determine the cause or the validity of the results. The results also suggest that after the first play, HS perform better. However, these results are also inconclusive as the exact reason and explanation behind this is unknown. Thus, knowing if the game succeeded in teaching HS the rules of accent placement cannot be determined.
Chapter 5

Discussion

5.1 Overall Observation

Most of the HS in the class reported that the game was fun and they enjoyed the competitive but private nature of the game. One student, instead, felt the game was not fun at all and left them feeling incompetent. The HS especially liked the leaderboard because they were able to see if they did better or worse than their fellow classmates while remaining anonymous. Although many of the HS reported that the game was fun and enjoyable, only three of them played and completed the game more than once. Although only three of the eight students in the HS class played the game more than once, the average of the three students’ time it took for them to complete the game on the second play was much faster than the first. Additionally, for the one student who played the game three times, the time it took for them to complete the game decreased, on average, by 100 seconds each play.

These results were taken from one HS class and can’t be used to derive results from HS in a general sense. Furthermore, as only three students completed the game more than once in the class for HS, no conclusive results can be gathered for the class as a whole. While the results
may suggest that the anagram game is beneficial to the HS that played the game more than once, there could be a variety of reasons for these results.

Naturally, people are better at things they have done more than once which could be the reason as to why some HS performed better after their first try. Another reason could be that some players were incorrectly inputting words on the first phase of the game which doesn’t deduct points. Thus, a player could possibly skip all the difficult words until reaching a word they are comfortable with, allowing them to finish faster than others who took the time to decode the word. Thus, in Figure 4.2.4 no real conclusion can be drawn from the data of the person who completed the game three times besides the obvious fact that they performed better after multiple plays.

5.2 Future Work

5.2.1 Improving The Experiment

Encouraging the students in the professor’s HS class to play the game more than once would be very beneficial in obtaining more data. While the data gathered shows that the HS who played more than once produced better results after the first try, the data gathered lacks enough conclusive results to be considered valid. Thus, my overall goal of evaluating whether or not the anagram game was helpful to the class as a whole is inconclusive.
In addition, it would have been beneficial to have recorded the number of errors for each play instead of simply outputting the results to the player. With this, I could have recorded the accuracy during each game and found a possible correlation between accuracy and time it takes to complete the game. This could have perhaps led to more conclusive results by showing that some of the people who took longer do, in fact, understand the rules of accent placement as they have higher accuracy but take longer and thus have a slower speed than others. Instead, Figure 4.2.3 can only be used to assume the reason as to why there was a change in time it took to complete the game on the first play versus the second play.

### 5.2.2 Game Improvement

Further, the game can be improved upon to provide different modes and also different levels. The different modes would offer variety for the HS and allow them to work on specific skills they believe they struggle most with. One of these modes could be a survival mode that tests accuracy by testing how long a HS could play without getting a word or accent incorrect. Additionally, adding different levels would account for the different levels of Spanish mastery amongst HS instead of one mode with one level of difficulty. With this, HS could not only play at their own pace, but also compete against others of the same level. This could potentially prevent any HS from feeling inept while playing.

Lastly, as many HS did not play the game more than once, the game needs to be improved upon in a way that instills in them the desire to play again. This could possibly be achieved by adding the different modes and levels but maybe another way would be to have more resources during the game to assist the player. For instance, having a word shuffler to aid
the HS in guessing the correct word. Also, adding a hint button that gives the player one letter as a clue at the expense of a decrease in their score by one point. Another resource could be a small in-game pop-up that would remind the HS of the rules of accent placement.

If I were to do this study again, I would submit my project proposal to the Institutional Review Board (IRB) so that I am able to gather participant data rather than observing classroom use. I would make sure to include an error tracker that not only measures accuracy but that checks to see if the player repeatedly incorrectly guess the same word or incorrectly places the accent on the same word over multiple plays. Additionally, I would make there be a penalty for guessing the word incorrectly. This would eliminate the problem of people simply guessing the word or leaving it blank. I would also keep track of how long a player spends on each word to later analyze the correlation between each word and find a possible correlation between players based on the time they took to guess the same word. As Figure 4.2.1 demonstrates, HS can vary tremendously in their levels of Spanish fluency. Tracking time spent on each word would give a broader idea of what level of Spanish the players operate at and what category they each fall in as a HS. Thus, upon completing the game, the game could suggest a level to the player. After completing the game, I would perform a pilot study to guide the first experiment.
Bibliography


