

**TEACHING AMERICAN SIGN LANGUAGE TO HEARING PARENTS OF  
DEAF CHILDREN WITH GAMES**

A Thesis Presented to  
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## **Introduction**

More than 95% of deaf children in the United States are born to hearing parents (Mitchell & Karchmer, 2004). With the majority of hearing parents having little to no exposure to American Sign Language (ASL) prior to the birth of their deaf child, many struggle to learn sign language while beginning to use it to communicate with their new infant. The lack of ability to easily communicate with their child leads to a large attrition rate in parents attempting to learn sign language, with many parents ceasing to attend language lessons within the first year (Young & Andrews, 2013). The language deprivation experienced by deaf children as a result of the high attrition rate of their parents has a monumental effect on their lives, including a worse short term memory (Boutla et al., 2010), poorer academic performance (Jackson, 2008), and delayed development (Kusche, 1984).

With the increased interest in ASL driven by social movements such as BabySign, a movement in which parents are teaching their hearing children sign language to speed the rate of their language acquisition, there are many classes and tools available to learn sign language. Unfortunately, in-person classes tend to have a high attrition rate (Kennedy, 2008). Additionally, it has been shown that individuals learning a second language via mobile devices tend to have better acquisition of vocabulary than individuals learning in a classroom setting (Lu, 2008; Oberg, 2013; Saran, 2008). Portable ASL lessons have been developed and have been shown to improve individuals' vocabulary acquisition, but they still struggle with a high attrition rate after a few weeks (Summet, 2010). In studies of such portable language lessons, one common piece of

feedback given by subjects is that the lack of goalposts makes it difficult to motivate themselves to review lessons (Lu, 2008; Xu, 2013). This need for goalposts in lessons is strongly supported by developments in student-centered teaching models (Oberg & Daniels, 2013).

To reduce the rate of attrition a popular, multi-level game with ASL phrases incorporated into the game play will be used to add goalposting to the lessons. These phrases will be formed from the words in the MacArthur-Bates Communicative Development Inventories, the conventional language acquisition test for children.

## **Historical Precedence**

### ***Importance of Sign Language Acquisition***

As demonstrated in Hoffmeister *et al.*'s study on deaf children's theory of mind, an early developmental milestone, language acquisition from a young age is essential to development (2007). Profoundly deaf children of hearing parents whose families used exclusively oral communication performed far worse on all assessments of their development of theory of mind than children whose families using sign language. The importance of families using sign language to communicate with their profoundly deaf children is underscored in Kusche, Calderon, & Greenberg's study on Total Communication (1984). Half of the families in the study took part in a simultaneous communication intervention program in which their families used both sign language and oral communication. The other half of families used primarily oral communication and did not take part in a particular language intervention program. They found that a mother's usage of sign with her child had the largest effect on the child's ability to communicate effectively (Kusche, Calderon, & Greenberg, 1984). A mother's ability to effectively communicate with her child is further underlined as the most predictive measure of the effectiveness of a language intervention technique in Pressman *et al.*'s 1999 as well as Moeller's 2000 studies on early language intervention.

### ***Language Learning Via Mobile Platforms***

As mobile phones and laptops have become ubiquitous, educational lessons have transitioned to being offered via mobile platforms as the new platform provides lessons to be better personalized

to individual students (Selwyn, 2003). While school districts within the United States have resisted the use of mobile platforms for lessons, studies on the effectiveness of these platforms for teaching versus the traditional teaching techniques show that students using mobile platforms acquire the material more effectively than students in a traditional classroom setting (Selwyn, 2003; Lu, 2008; Saran, Cagitlay, & Seferoglu, 2008). However, Saran's, Cagitlay's, & Seferoglu's study on English language acquisition emphasizes the importance of careful lesson planning for lessons hosted on mobile platforms as students learning via mobile lessons have a higher attrition rate than those attending in-person, traditional lessons. Lu demonstrates that these mobile lessons are most effective when the information is repeated in multiple ways including quizzes, videos, sentences, and written mini-lessons (2008).

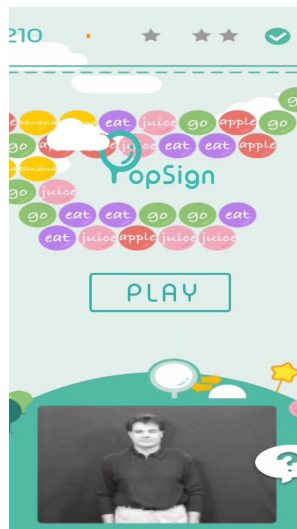
### ***Acquisition of American Sign Language via Mobile Platforms***

Henderson-Summet's thesis hypothesizes that mobile phones as a content delivery mechanism would lead to better comprehension of sign and a greater ability to reproduce signs than desktop computers would (2010). Participants in the study were put into four groups: those learning via phones with multiple lessons delivered throughout the day, those learning via phones with multiple lessons delivered at the same time each day, those learning via computer with multiple lessons delivered throughout the day, and those learning via computer with multiple lessons delivered at the same time each day. Subjects who received lessons via mobile phones and received the lessons at the same time each day had a lower attrition rate and retained understanding and a greater ability to reproduce signs than their counterparts.

## Creation of the Mobile Application

### *The Demo Mode*

The game (PopSign) begins with a short demo of the game which cycles on the main screen, demonstrating gameplay to the user. This looping demo was modeled the “attract mode” on old arcade machines where the game would place itself both to attract people to the machine as well as teach new players how to play the game (Houser & Deloch, 1998).

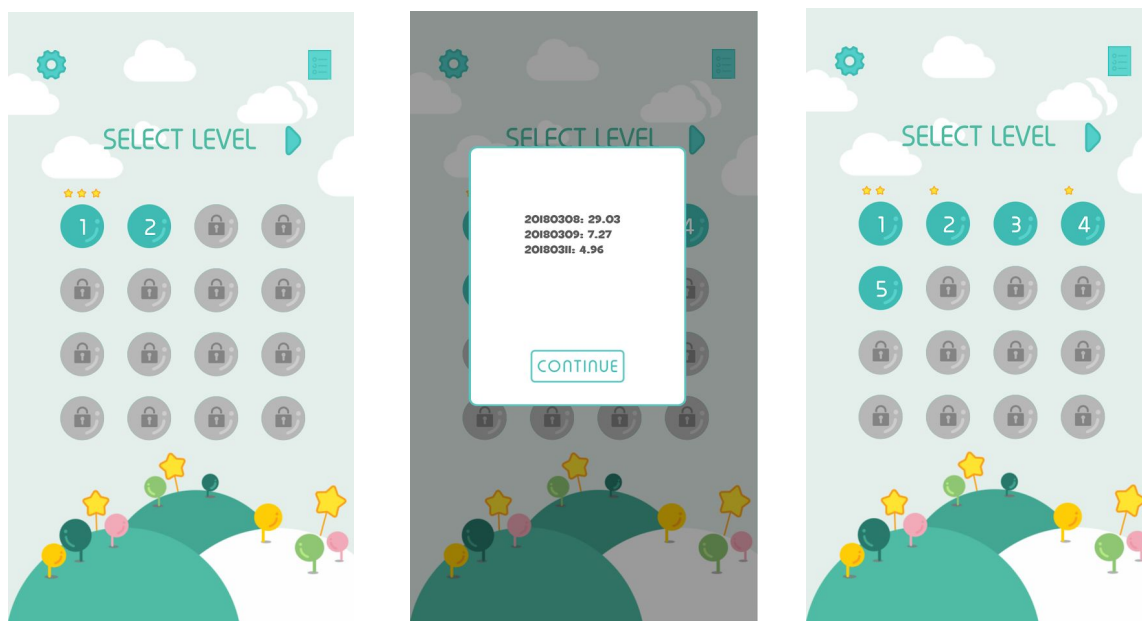


### *Level Selection*

After selecting the start button, users are then taken to a level selection screen. Initially, all but the first level is locked and the user must successfully complete the first level to unlock the next one. This is done to indicate to the user that the goal of the game is to successfully progress through each of the levels (and therefore all of the signs).

After the completion of a level, the number of stars earned during the level is displayed over the level icon in this selection menu. This encourages users to replay levels until they have the highest score possible, which helps reinforce recognition of the signs through repetition.

In the top right corner, there is a log button that, when selected, shows how much time a user has spent playing the game in the past week. This feature was added during beta-testing after a user expressed the wish to have some way of tracking that they were meeting their personal goal of practice ASL for at least 20 minutes a day.

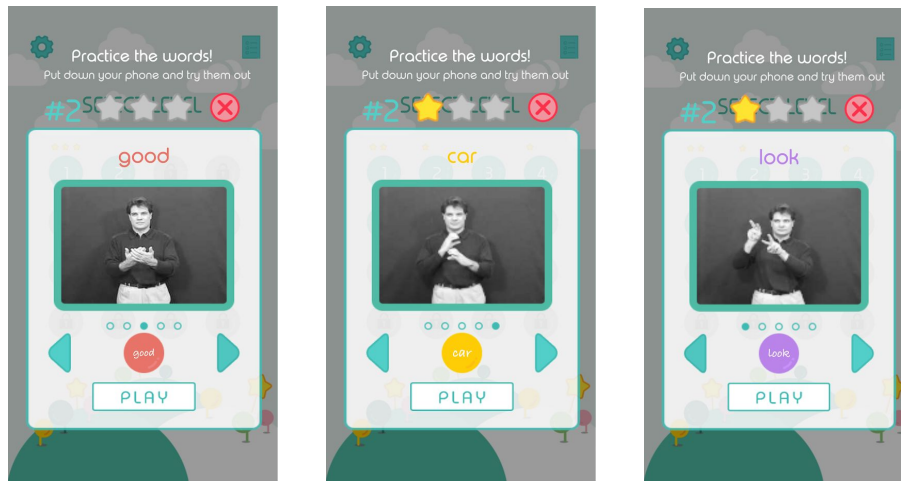


### *Teaching Mode*

After the user selects which level they want to play, they are taken to a screen that shows a video of each of the signs in the level as well as the the English word they represent. This allows users to practice the signs on their own and get comfortable with recognizing them before starting gameplay. This mode also displays the number of stars the user already has in the level as well as

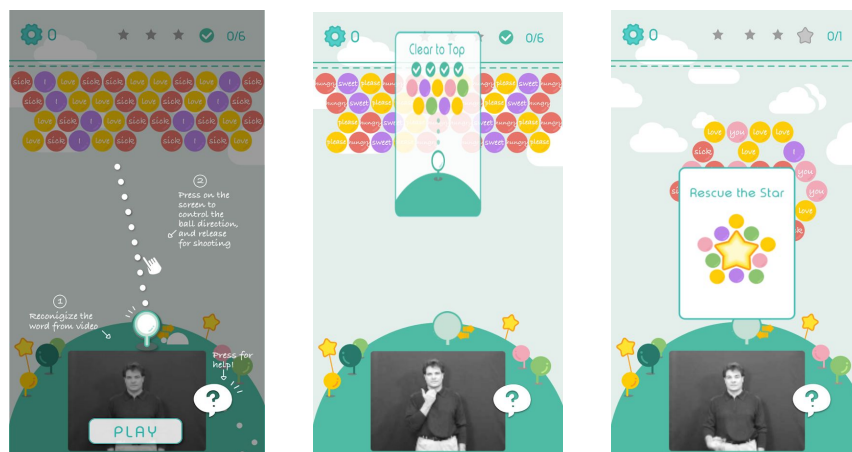


a red button that will allow them to exit back to the level selection menu. This is done to help ensure users are prioritizing levels they struggled with over levels where they already have three stars.

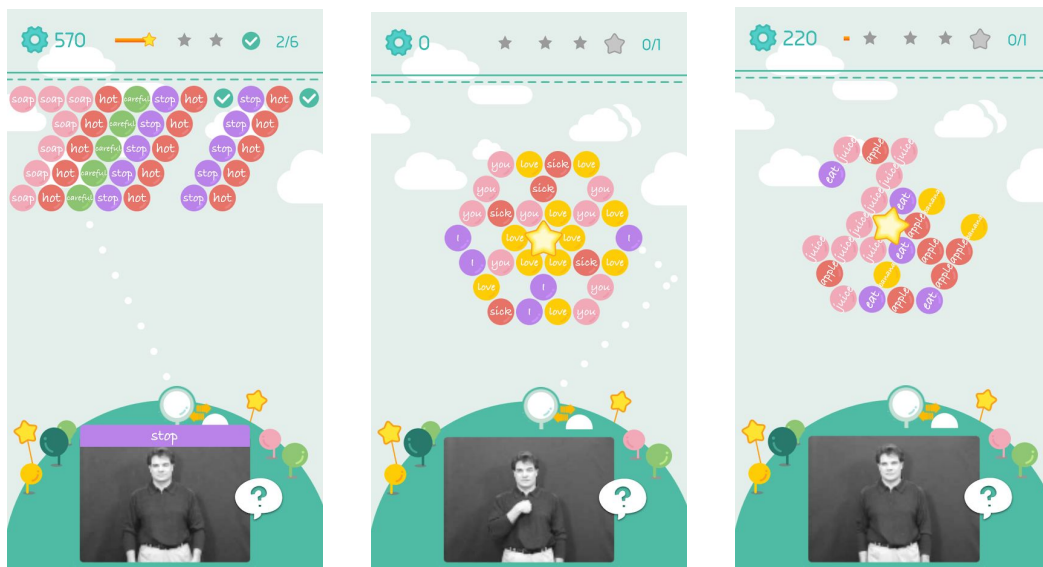


### *Gameplay*

After the user selects the play button in the teaching mode, they are taken to the game. For the first level, a short instructional guide is displayed on the screen to remind players how to play. For all other levels, a short message is displayed informing the users of the goal of the level.



The game play mode has three different buttons, two of which are “cheat” features and one of which gives you the option to go back to the level selection menu. The first “cheat” button is the question button. If a user needs to be reminded what a sign means, they can select the question mark button and the English word corresponding to the sign will be displayed. While this does have the potential to be abused, beta-testers with the question button were less likely to get frustrated by the game and typically played the game for longer stretches of time.



The second cheat button is the ball switcher which allows the user to swap out the current ball for the next ball. Again, while this does have the potential to be abused by users who find a particular sign hard to remember, beta-testers with this button were less likely to get frustrated by the game and typically played for longer stretches of time. Additionally, the room for abuse of the ball switcher button is smaller than the room for abuse of the question button because eventually, both the current ball and the next ball will have the same sign.

Finally, there is a gear button, which allows users to go back to the level selection menu before completing the level.

The gameplay mode also displays how many stars the user has earned during their current attempt on the level. This was done to provide motivation for users to earn more points, and therefore practice more signs.

After a level is successfully completed, the user is taken back to the level selection menu.

## **Revising the Game**

### ***User Testing***

After creating the game, user testing was performed again to examine the playability of the game. Testing was performed with six subjects who had not previously been exposed to the game during the beta-testing period. Three were in the 20-25 age range, two who were 40-45 age range, and one who was in the 55-60 age range. Four of the participants were parents. These participants were given a phone with the game on it and asked to play through the levels.

While all the participants felt that the game was a useful tool for learning ASL which helped them internalize vocabulary, many struggled with very basic aspects of the game. After being shown the instructional guide, none of the participants were able to accurately describe how to complete a level of the game. While certain “cheat” features were very intuitive, with 100% of users successfully identifying the purpose of the question button, others were entirely unusable, with 0% of users identifying how to use the ball switcher. Another usability issue encountered during testing included a misuse of the teaching mode. 66% of users only viewed the first out of the five signs displayed in the teaching mode before proceeding directly to game play.

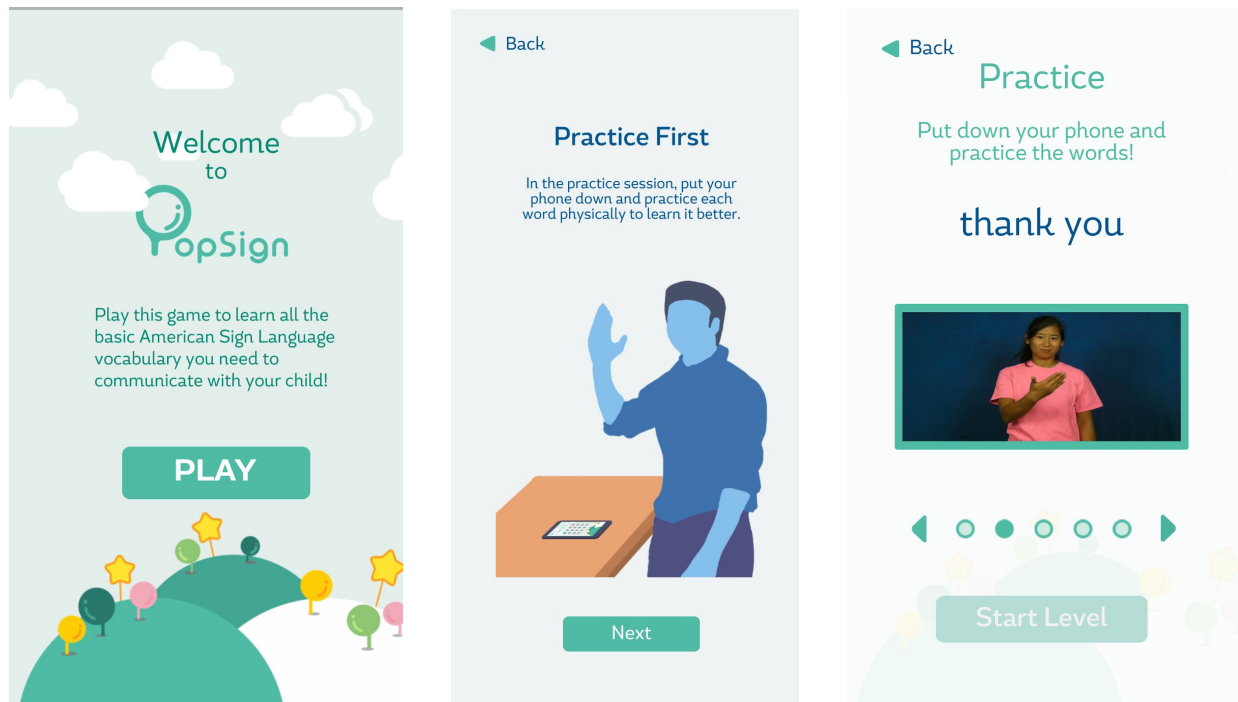
Additionally, none of the participants understood the log view, and only 50% were able to exit a level and return to the home screen.

Based on this user study, we began redesigning portions of the game with three main focuses: revising the game onboarding process, removing features which confused users, and enhancing

ease of gameplay. This redesign was initially done using wireframes and then, following another user study confirming increased playability, implemented in the game itself.

### *Revising Game Onboarding*

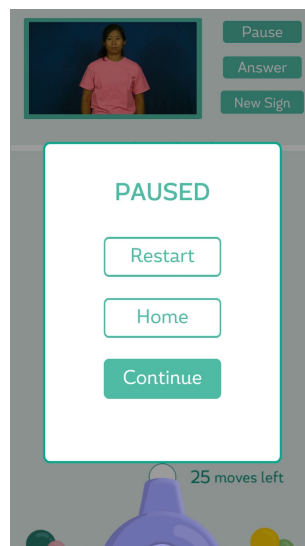
Taking into consideration feedback from the user testing, we removed the demo mode, replacing it with a message which explicitly explained the purpose of the game. Instead of instructing users how to play the game using the demo mode and short instructional guide, a new tutorial explaining how to practice signing was drafted and set to play automatically before the first level, and was then accessible at any point through the menu on the home page. Additionally, in response to the fact that the majority of users during testing would skip viewing most of the signs before the level, the play button in the teaching mode was disabled and greyed out until all five signs had been viewed.



### *Altering Confusing Features*

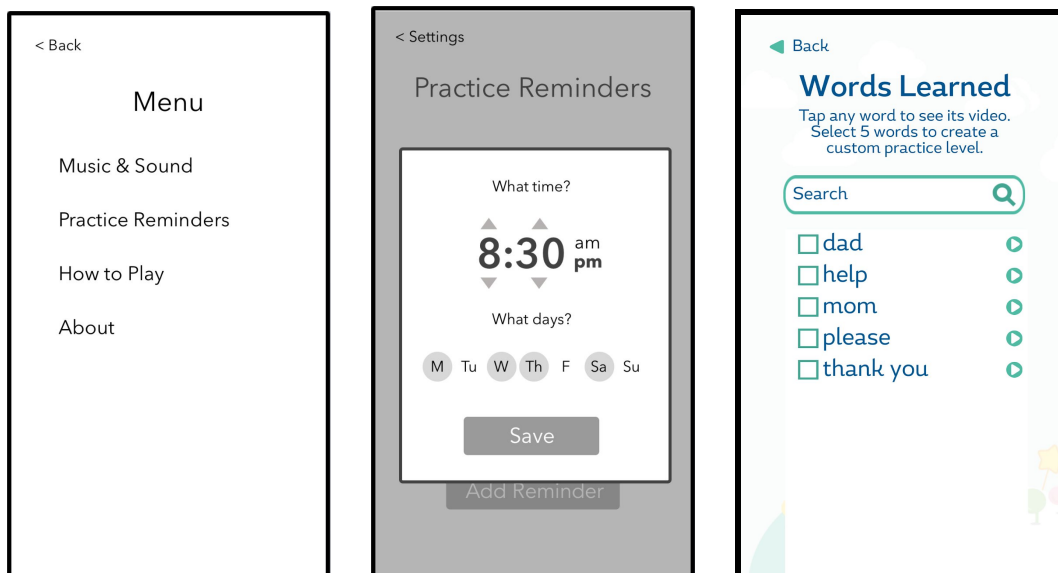
Following user testing, we were able to identify several menu and navigational features which confused users. There were two features we removed to increase playability.

The first feature removed from the game was a gear button present in the game mode which allowed users to navigate back to the home screen, which when clicked was often unintentional and led to user frustration due to lost progress. This was replaced by a pause button which when selected would give users the text buttons allowing them to restart the level, return to the home screen, or continue with gameplay.



The second was the log screen, which no users were able to identify the purpose of. This second feature was replaced by two new features, a reminder scheduler and a level-designer allowing users to practice custom levels. Based on the interviews from the user study, it was ascertained that a reminder scheduler would be more helpful to ensuring regular practice than a log of the amount of time spent playing the game. This reminder scheduler was added as a feature

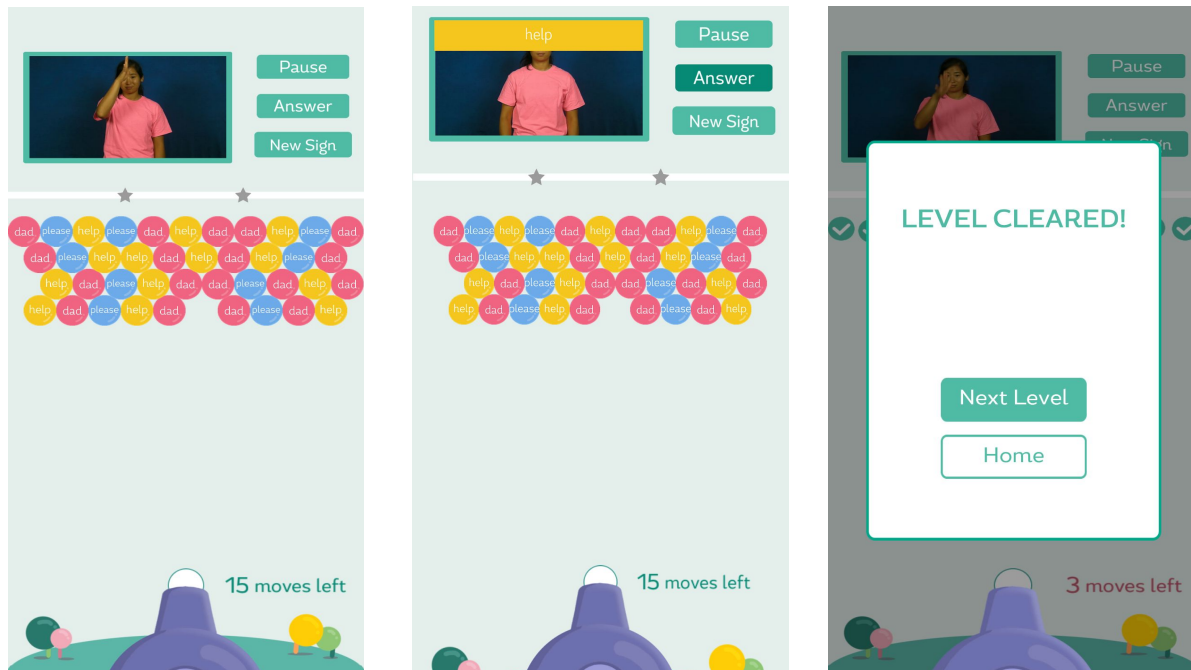
accessible through the menu on the home page and the log view was eliminated. The level-designer, which was added in the now unoccupied space of the log icon, allows users to practice custom levels based on already learned vocabulary, and was designed at the suggestion of one user who stated that they would like the ability to make custom levels that grouped related vocabulary together.



### ***Enhancing Ease of Gameplay***

The game mode layout was entirely redesigned due to difficulties viewing the video while shooting reported by the users and well as user difficulty identifying the purpose of the “cheat” buttons. The video was moved to the top of the screen, so that the user’s hand would not cover the video while they aimed the ball. Additionally, the “cheat” buttons were redesigned to contain text which explicitly identified what they did and moved to the right of the video so they would be easily visible to users. Finally, the portion of the screen that could be tapped to trigger a ball

firing was restricted to the space between the first line of balls at the top of the screen and slightly above the cannon to prevent users from becoming frustrated due to accidental misfirings.



### Future Work

Now that a basic game has been constructed and beta-tested, there are several different moves forward that must be made. The most significant step has already been done, making this game readily available to hearing parents of deaf children through online app stores. Next, the game should be modified to modularize the vocabulary, grouping words based on theme. This will further improve parents' ability to practice specific portions of their vocabulary that are lacking. Finally, the process of producing levels needs to be automated and needs to include a greater variety of levels. As of now, there exist a very limited number of levels with only two different gameplay modes. If parents are to learn a thousand vocabulary words, there need to be far more



levels than a group of people can easily produce by hand. Hopefully, with these improvements, the game will have a measurable, positive effect on the signing vocabulary and comfort level of hearing parents of deaf children.

### Works Cited

- Hoffmeister, R., Villiers, P., Villiers, J., & Schick, B. (2007). Language and theory of mind: a study of deaf children. *Child Development*, 78, 376-396.
- Houser, R., & Deloach, S. (1998, August). Learning from games: seven principles of effective design. *Technical Communication*, 45(3), 319+.
- Kusche, C., Calderon, R., & Greenberg, M. (1984). Early intervention using simultaneous communication with deaf infants: the effect on communication development. *Child Development*, 55, 607-616.
- Lu, M. (2008). Effectiveness of vocabulary learning via mobile phone. *Journal of Computer Assisted Learning*, 24(6), 515-525.
- Moeller, M. P. (2000). Early intervention and language development in children who are deaf and hard of hearing. *Pediatrics*, 106(3), e43-e43.
- Pressman, L. (1999). Maternal sensitivity predicts language gain in preschool children who are deaf and hard of hearing. *Journal of Deaf Studies and Deaf Education*, 294-304.
- Saran, M., Cagiltay, K., & Seferoglu, G. (2008). Use of mobile phones in language learning:

developing effective instructional materials. *Fifth IEEE International Conference on Wireless, Mobile, and Ubiquitous Technology in Education (wmut 2008)*, 39-43.

Selwyn, N. (2003). Schooling the mobile generation: the future for schools in the mobile-networked society. *British Journal of Sociology of Education*, 24(2), 134-144.

Summet, V. H. (2010). *Facilitating communication for deaf individuals with mobile technologies*. Georgia Institute of Technology.