Brocca: Social Language Learning in Virtual Reality

Rayna Allonce, Gabrielle Gayles, Nur Icel, Swarnakshi Kapil, Molly Vierhile

Carnegie Mellon University

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INTRODUCTION

Learning a new language can be exciting and rewarding. It exposes learners not only to new vocabulary, but also to new cultures. However, learning a new language to the point of fluency is very difficult. In fact, less than 1% of American adults are proficient in a language they studied in school (Friedman 2015, para. 5). Further, though language-learning apps like Babel and DuoLingo are extremely popular, they aren't enough on their own to help users become fluent. As Robert Darland, a UCLA linguistics professor, pointed out: "I'll never, ever get anywhere close to fluent with Duolingo...it is only going to possibly be a very helpful part of a multi-component program" (Pearl 2017, para. 15).

Why aren't school programs and mobile applications very effective in helping people *really* learn a new language? Our literature review suggested that this is because language is best learned in an *immersive context*, where users can observe and interact with native speakers in real-life scenarios. To become truly fluent in a foreign language, learners must absorb language via comprehensible input— that is, repeated exposure to grammatical and verbal patterns of a language. Language learning is further enhanced when users are embedded in native speakers' culture, enabling them to make connections between words and phrases they are learning and the real-life situations and objects.

However, most in-school language programs and language-learning apps emphasize repetition and memorization over immersive, contextual input (Krashen 2012; Pearl 2017). This pitfall is especially pertinent for language learning apps. In conducting a competitive analysis of such applications, including Rosetta Stone, Babel, and DuoLingo, we discovered that while these apps excel in teaching of grammar and vocabulary, they fall short when it comes to developing listening and speaking skills. This is ironic, given that listening and speaking are the most crucial skills of all when it comes to achieving fluency. Users of these apps are drilled with grammatical rules and vocabulary without really understanding how native speakers employ these words and rules in their daily lives.

From these observations, we realized that there was an unmet need for an immersive language-learning tool that helped users learn language in native speakers' context, enabling them to make connections between language, culture, and surroundings. To address this need, we created Brocca, a virtual reality (VR) based collaborative language learning game.

Brocca enables users to explore virtual cities where their target language is spoken. They learn how to apply words and phrases in real-life scenarios, whether it be ordering items from a restaurant menu or exploring popular landmarks. To encourage true cultural immersion, learners can interact with content uploaded by native speakers, such as photos, stories, music, and popular phrases. This enables users to learn the intricacies of language, such as slang and humor, that apps and schools just can't provide. We believe Brocca is a way to immerse users a foreign

language. It helps them learn both the words of a new language and culture that come with them, until they truly understand that language to its core.

In this paper, we will go into depth about how we developed Brocca. We will begin with a discussion of literature that inspired us to create Brocca, followed by user research/design methods we engaged in to develop the platform. We will then discuss results from those methods and how they informed design decisions. Finally, we will conclude with a reflection about what we learned from this process.

We have created a product we believe revolutionizes language learning. Now, let's take a look into how we got there.

LITERATURE REVIEW

We investigated several major topics in our literature review in order to gain a better understanding of language-learning techniques. These areas are as follows: 1) cultural immersion and acceptance, 2) language learning science, 3) feedback and goal setting, and 4)gamification and engagement.

1. Cultural Immersion & Acceptance

Overall, we discovered that immersing oneself in a new culture not only improves language learning, but also results in more awareness and acceptance of different cultures. Smith et al. (2017) demonstrated that students who interact with individuals abroad (via an online pen pal system) to develop language skills have also raised their own cultural awareness as a result. Smith et al. (2017) further demonstrated that an open line of communication can solve misguided assumptions and cultural misunderstandings, increase cultural awareness, intellectual/moral reasoning, openness, and willingness to change their own beliefs. Maddux et al. (2010) found that when compared to a control group, participant who lived abroad showed higher rates of creativity, which was embellished by an open-minded approach to a new culture. Maddux et al. (2010) also found that recalling a multicultural learning experience, while enhancing creativity, facilitates idea flexibility (the ability to solve problems in multiple ways), increases awareness of underlying connections and associations, and helps overcome functional fixedness. An important part of acquiring new cultural perspective also includes acquisition of cultural factors such as rules and mores. Bacon (2008) found, in an ethnographic study of language development and cultural and academic adjustment, that the most influential difference in language proficiency came from learning social and academic language "rules." These rules allow students to function more fluidly within a culture.

However, both informal and formal experiences (inside and outside the classroom) contribute positively to this acquisition, due to their interplay (Bacon 2008). While students learn informal, colloquial language outside of the classroom, encouraging students to discuss and write about their experiences also positively contributes to their cultural and language acquisition

(Bacon 2008). However, cultural adjustment, including adopting said culture and language, cannot happen over a short period of time such as the course of a semester (Zhang & Zhu, 2014). Related to this perspective, we were also curious: can learning a new language attribute to re-shaping one's personality? Zhang & Zhu (2014) claim that cultural acquisition is associated strongly with identity shifting, emotional changes, career choices, and learning practices. Through cultural exposure, in addition to mores, students can also learn about which qualities certain cultures value, such as teamwork or critical thinking ability (Zhang & Zhu, 2014). Based on the research above, it is evident that cultural and language acquisition can have a significant effect on expanding one's worldview, at least in the context of students. Having validated this with the research thus far, we then decided to ask the question: what is the best way to acquire a language?

2. Language-Learning Science

The language-learning literature suggested that language is best learned in context; that is, interacting with native speakers in real-life situations. Learning a new language is not easily facilitated via classroom settings, and language is best learned via an immersion narrative (Kearney 2010). Immersion narratives involve meaning-making processes that include synchrony between language and culture, which include: gaining access to frames of reference used by others to shape and interpret their world, coming to an awareness about different points of view, taking on unfamiliar perspectives, and reflecting upon one's own familiar cultural perspective (Kearney 2010). Kreshan (2012) emphasizes the importance of local narrative and context that cannot truly be achieved via drilling vocabulary, grammar, and repetition of pronunciation. Context is crucial for comprehensible input, such as reading or listening to a language outside of a textbook setting, which facilitates learning patterns (Kreshan 2012). Even acquisition of vocabulary should be done in a sentence and semantic-specific context, as it results in better storage and retrieval in human memory (Mulder et. al 2018). In fact, school-type tasks that do not mirror activities in the real world have a negative impact on students' robust knowledge development, as the characteristics of activities that are authentic to the real world are critical (Ozverir & Herrington 2011). Therefore, our future design must incorporate critical elements of authentic context to avoid this negative impact. While we will still include vocabulary and reading comprehension, we will do so in a way that introduces users to different aspects of culture. One way to do this authentically is by allowing users to provide their own contextual knowledge, e.g. by uploading images of their home, neighborhood, and favorite landmarks. We can also facilitate this by allowing them to upload music samples and/or other favorite types of media. All of this will positively contribute to the strength of their understanding of comprehensible input, which is a critical marker of language learning.

More evidence for the power of comprehensible input is supported by Stokes et. al (1998), who found that free reading is a great predictor of competency, even more than length of

residence, formal study, and specific study (in this case the acquisition of Spanish subjunctive). Reading (rather than formal study) and subconsciously absorbing the rules of a language is most effective for language learners (Stokes et. al 2012). We discussed incorporating this feature into our app, via, for example, a mechanism that allowed learners to read stories to each other or assign short optional readings for them to do. Mulder et. al (2018) also emphasizes reading comprehension as a good predictor of learning outcomes, as students with good reading comprehension tend to have better language learning outcomes. However, it has also been shown that students of new languages benefit from pauses between the language learning periods. According to Kreshan (2012), highly successful second language learners experience what is called a "silent period," which translated to a time where they produce little to no second language. This goes against our original assumptions that users would want to start speaking as soon as possible, but is understandable considering the potential anxiety and insecurity of speaking a new language that comes from fear of making mistakes, etc. Learners may also be overwhelmed by the combination of new language, cultural themes, mores, and additional aspects that come with learning, and may indeed benefit from such pause. Kreshan (2012) claims that forcing second language learners to speak too soon is both uncomfortable and ineffective, leading to no real positive value. This supports our own research regarding conversational language learning in experience prototyping, which we will discuss further in this paper.

However, after the initial silent period, the power of social learning is demonstrated by several academics. Palfreyman (2011) discusses how patterns of interactions with others (i.e. social networks) play a key role in the absorption of learning language in context as discussed previously. This is especially true for adult learners, who use contextual information to identify and absorb meanings of new words (Verga & Kotz 2017). Verga & Kotz (2017) claim that social partners can facilitate word learning by directing the learner's attention towards the correct new word meaning, and that participants in their study who learn new words in social interactions are faster at identifying the word in variable sentence contexts. Learning interactively results in better recognition and recall, especially in different contexts (Verga & Kotz 2017). Verga & Kotz (2017) maintain that it is critical for adults learning a second language to interact with a more knowledgeable person due to the concept of joint attention. Joint attention allows for correction of mismatches between words and meanings in a real-time context. In a task where some second language learners had to label objects, language learners who had learned socially (from a partner) rather than contextually responded more quickly, though it is important to note that the accuracy was still comparable (Verga & Kotz 2014). Feedback, positive or negative, is also a significant influencer of the learning process.

4. Feedback & Goal Setting

Another area we explored was goal setting and feedback; we wanted to investigate how we could encourage users to continuously pursue their language-learning goals. Fishbach & Finkelstein

(2019) discuss the importance of positive and negative feedback in regards to goal pursuit: that universal research demonstrates that "people express greater motivation to persist on a goal after they receive either positive or negative feedback" (p. 3). This research is demonstrated initially by Fishbach, Eyal, & Finkelstein (2010), who state that both positive and negative feedback can both contribute to goal pursuit, depending on the context. Positive feedback results in an increase in motivation "when people infer they have greater ability to pursue the goal or associate the positive experience with increased goal value," while "negative feedback increases motivation through a discrepancy-reduction mechanism" (Fishback & Finkelstein 2019, p. 3). While the nature of a relationship influences the amount of negative versus positive feedback (people tend to seek more negative feedback in closer relationships), as individuals begin to gain more and more proficiency in a skill, the value of negative feedback also increases, as it provides more specific information that can be helpful when an individual is proficient in basics (Fishbach & Finkelstein 2019). Through this, positive feedback may be more valuable when individuals are attaining a brand-new skill as positive feedback (focusing on strengths, etc.) makes a goal seem more attainable. Positive and negative feedback can be facilitated through either peers or gamification systems. In Brocaa, we apply these learnings by incorporating multiple avenues for novice users to receive positive feedback, thus encouraging them to continue progressing towards their language learning goals.

5. Gamification and Engagement

The last area we investigated in our literature review was gamification and engagement. We wanted to find ways to bring users to our platform and encourage continued interest in it.

First, we discovered that gamification is a helpful element in driving engagement. Multiple papers espouse the usefulness of gamification, when paired with an already engaging idea, in keeping users motivated to continue using a product. Gamification of language learning tasks has been a popular way of effectively engaging and attracting language learners. One way in which this can be done is through online or virtual avatars that can be customized by users. In their paper, Turkay & Kinzer (2016) talked about user retention in online games and how avatars affect player identities. They suggest that games are a way for players to perceive themselves differently in alternate worlds. In these worlds, customizable avatars can affect enjoyment in the game as well as reduce self-discrepancy (Turkay & Kinzer 2016). They made users play the Lord of the Games online game for several hours and collected data related to avatars through interviews, surveys, and observations. They found that Avatar-based customization played an important role in players' identification with their characters and overall increased their sense of autonomy. Players who customized their avatars also tended to have a more positive experience in the game (Turkay & Kinzer 2016). However, they did note that further study is required to differentiate the effects of customizing avatar appearances versus customizing avatar skills. For our purposes, these learnings play a key role in ensuring continued engagement of language

learners on our platform. Because of these findings, we incorporated gamficiation and avatar customization into our final prototype.

The trend of employing gaming mechanisms in non-game contexts can help in increasing user engagement and brand loyalty (Kankanhalli et al. 2012). In their research paper, Kankanhalli et al. explored potential theories to understand motivations, design mechanisms, and impacts of gamification. They found that gamification of content highly depends on the context in which it is used. For example, gamification for marketing purposes is likely to brand awareness and loyalty but gamification of Q&A might lead to poor user satisfaction. The reason gamification plays a key role in user satisfaction is that people, in general, have a desire for monetary rewards, status, and achievement. If the right motivation of users is tapped into, it can lead to designing successful incentives that are used in gamified applications (Kankanhalli et al. 2012). They also state that while it is important to have these motivating factors such as badges, in order to ensure long-term user engagement, it is more important to get users to internalize these motivations. Therefore, gamification needs to be done in a way that extrinsic motivators can become intrinsic over time (Kankanhalli et al. 2012).

We also explored how to increase the visibility of our product. From a marketing standpoint: how will users find out about our product? In a study of 193 mobile apps, Rutz, Aravindakshan, & Rubel (2019) found that post-download engagement is critical to an app's marketing success. In-app advertising, as a result, has been a successful monetization strategy (i.e. freemium) when this engagement is present (Rutz, Aravindakshan, & Rubel 2019). Electronic Word of Mouth (eWoM), defined by Rossman, Ranjan, & Sugathan (2016) as likes, comments, and other forms of social media engagement, can have a significant effect on brand engagement, as users who comment using eWoM reach out to other members of their network, and members of their network's network, etc., which can result in increased visibility. As our product takes a user-centered approach, especially by incorporating feedback from users of language learning apps and potential users of language learning apps, we believe that we have kept the user experience of our product at the forefront. We can supplement this via advertising avenues on platforms such as Facebook and/or Instagram.

METHODS

We conducted research with 16 participants in total over three phases of user research. Our research included semi-structured interviews, speed-dating of storyboards, and experience prototyping. Experience prototyping was the most significant influencing factor of our project, as it allowed us to test language learning in many different context with several learners while providing a contextually sensitive environment.

Semi-structured interviews (n=6)

Study population and sampling strategies. We interviewed 6 participants ranging in age from 22-27. All of our participants were college graduated professionals and graduate students who had had experiences learning a foreign language either in an academic context or an informal context. Our only screening consideration at this phase was that the individual must have had experiences learning a language other than their native language. All individuals interviewed at this stage were from our team's immediate social network (classmates, family, and friends). We felt that this was appropriate as this age and socio-cultural demographic were our initial targets for an MVP (minimum viable product). However, in the future we might consider conducting research with older language learners, as well as those from different socio-cultural contexts.

Research goals and objectives. Semi-structured interviews were the first form of user research we conducted after our initial literature review and initial concept of a platform that would connect language learners to foreign pen-pals to facilitate language and culture exchange. Our research goals were to better understand the following key issues related to our problem space:

- What is the context for language learning and in which ways do different language learning contexts facilitate or impede language learning? (i.e. academic vs informal)
- What are the greatest difficulties that language learners face in their language learning journey?
- Which methods, if any, worked best for individuals learning a new language, and why? (i.e. conversations with native speakers, vocabulary drills and exercises, consuming media in another language, travel or living abroad, etc.)
- How do respondents feel about pen-pals -- and if they have had pen-pals in the past, to what extent, and in which ways, was this experience beneficial to their language learning journey?

Procedure. Interviews were conducted either face-to-face (n=4) or virtually (n=2) and lasted about 30 minutes.

Speed-dating (n=5)

Study population and sampling strategies. We interviewed 5 participants ranging in age from 22-27. All had had experiences learning a new language and one had experiences as a foreign language instructor.

Research goals and objectives. Here we wanted to validate needs and insights that arose from the synthesis of our semi-structured interview results. We developed five storyboard concepts for testing:

- Interactions that take place in virtual reality to enable social connectivity in a shared context regardless of physical location (Figure 1)

- Context based interactions (ie. ordering food in a restaurant or buying plane tickets) (Figure 2)
- Watching movies together and discussing (Figure 3)
- Facilitating a long-term relationship between just one pen pal (Figure 4)
- Matching people together and emphasizing shared experiences (ie. favorite movie or game genres) to reduce burden of finding pen pals and foster trust

Procedure. Respondents were shown storyboards in a randomized order and asked to react to and give feedback on each storyboard individually before moving on to the next storyboards.

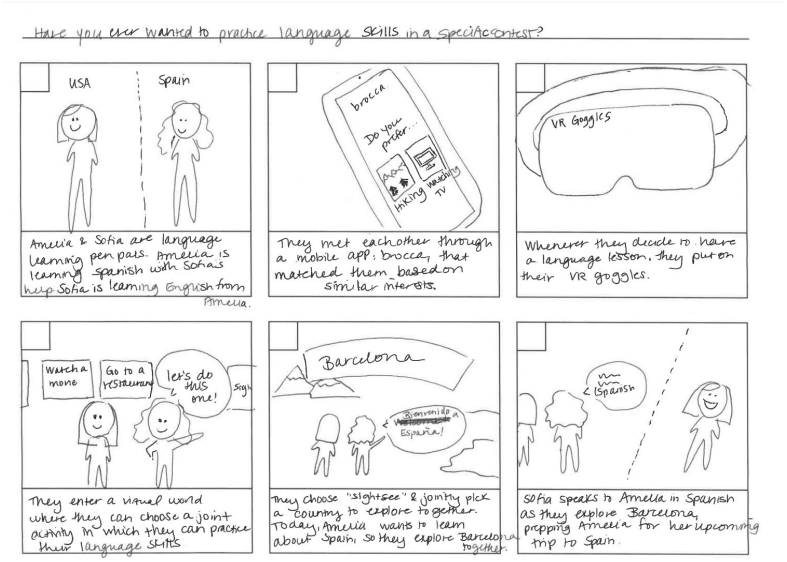

Figure 1. “Have you ever wanted to practice language skills in a special context” storyboard

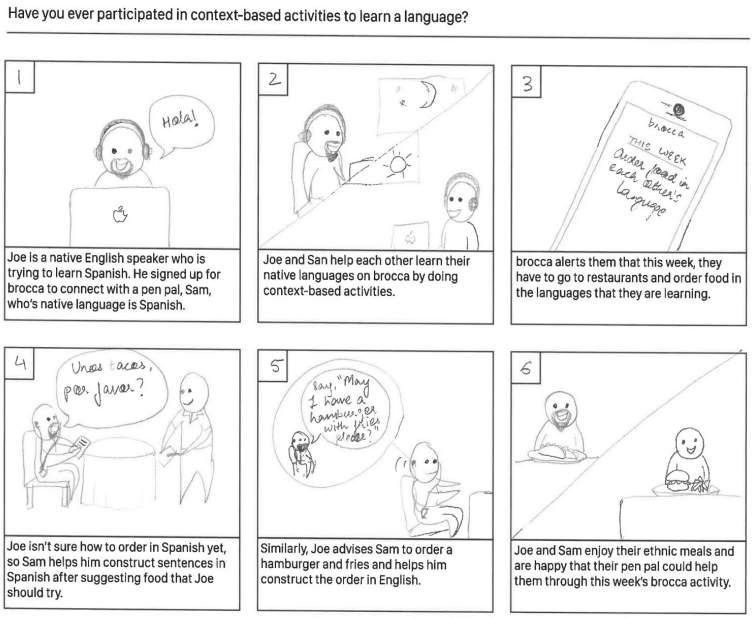

Figure 2. "Have you ever participated in context-based activities to learn a language?" storyboard

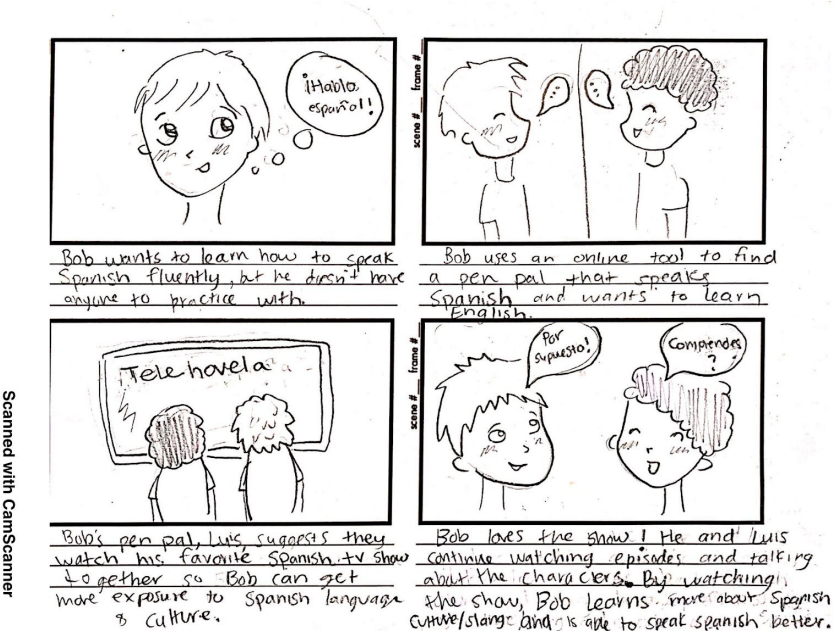

Figure 3. "Have you ever wanted to practice your language skills by watching movies together" storyboard

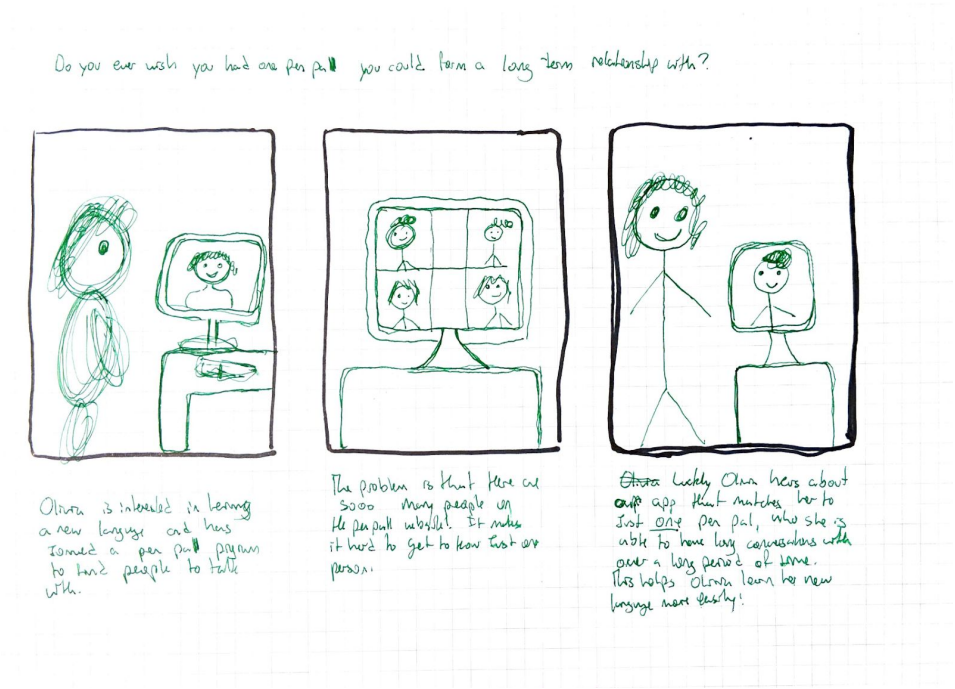

Figure 4. “Do you ever wish you had a pen-pal you could form a long-term relationship with” storyboard

Figure 5. “VR movie + discuss/ video games” storyboard

Experience Prototyping (n=5)

Study population and sampling strategies. In total we conducted our experience prototyping with 5 participants: 3 at the beginner level of our virtual reality experience (level 1), and 2 at the advanced level (level 2). Participants were all MHCI graduate students with an age range of 22 - 25. Participants for the beginner level experience prototyping had a range of fluency in french, the language we chose to test our product: one had no experience with the language, another had taken french in high school but identified as a beginner, and the third was conversationally fluent at an intermediate level. Of our two participants at the advanced level, one was conversationally fluent in french and the other had no previous experience with the language.

Research goals and objectives. Our final user-research phase was experience prototyping of our medium fidelity virtual reality concept. As it is time consuming to prototype a functional VR environment for the purposes of testing interactions, activities, and concepts, we wanted to conduct experience prototyping as a quick and data rich way of gathering user feedback on our core functionalities as a social VR learning language platform.
For the both levels our goals were to:

- Understand if users liked the experience
- Understand which areas were most delightful, as well as which parts were most confusing/ unpleasant
- Understand how users would feel if they were completing the experience alongside strangers
- Understand if users remembered anything that they learned

For the beginner level specifically our goal were to:

- Understand if the user understood that the waving feature was meant as a way to non-verbally interact with other users in the game

For the advanced level specifically our goal was to:

- Understand how users felt when asked to have a 2 minute conversation with another user
- Understand if users would have prefered subtitles during this experience, as well as why/why not

Procedure. The research lasted approximately 30 minutes per respondents. Using print-outs of our medium-fidelity screens and components, we had users attempt to complete several different key activities of their level. While the rest of the team was involved in various wizard-of-oz activities for the prototype, one team member wrote down notes and observations for later analysis. At the end of each session we held a 10 minute debrief session with the participant where we gathered more direct feedback on the experience.

Figure 5. Participant interacting with our virtual navigation menu in level 1.

Figure 6. Participant learning how to say window in french as part of the labeling game in level 1.

Figure 7. Participant waving to another user in level 1.

Figure 8. Participant interacting with a restaurant menu in level 2.

RESULTS

Given our findings from our literature review and several rounds of iteration and experience prototyping, we reached our final product: Brocca, a virtual reality-based collaborative language learning game. In summary, as detailed in our introduction, Brocca is a language-learning game in which players virtually travel to different cities in their target language, completing challenges along the way. As users complete challenges, they unlock new cities and eventually reach more difficult levels of gameplay. Progress throughout the game is reflected by both stamps in one's virtual passport as well as XP points gained during challenges throughout the cities and by uploading content about one's own culture to the site.

Gameplay for Language Learners

The Brocca experience differs depending on one's status as a language learner or native speaker. During onboarding, language learners self-identify as beginners, intermediate, or advanced players. This determines the various challenges available in each city. As highlighted in our literature review, we found that it is essential for beginners to endure a "silent period" during initial stages of language learning, in which they soak in vocabulary, but do not speak the target language themselves (Kreshan, 2012). This was also supported by our experience testing, in which we examined whether beginners could benefit from either hearing or participating in conversations with native speakers. We found that unless language learners have some baseline knowledge of the language they are trying to learn, neither listening to nor participating in a conversation are useful to them. Thus, the beginner levels of Brocca mainly focus on exercises that enhance users' vocabulary and baseline language knowledge.

The key activities that we decided to embed into novice levels of Brocca include a labeling game and a restaurant game. Users are also welcome to consume content by visiting

various landmarks in the virtual city or by absorbing the various music and photographic content that native speakers have uploaded to the site. The labeling game consists of two phases: word learning and labeling. During the word learning phase of the challenge, players first visit a landmark or site with core vocabulary (in our example, the interior of a house) and are instructed to click on various objects related to the site to learn object words in the target language and hear them being spoken. Next, players are brought into a new environment that has the same components arranged in a different way (i.e., another room of the house). The players' labeling skills are put to the test as they must accurately label the items in this new location according to the vocabulary learned in the previous step.

Another activity that we created is a restaurant challenge, in which users must order food from an AI-generated waiter at a restaurant in the target language. Users are initially presented with an interactive menu, which they can use to learn about each individual menu item. In our second round of experience prototyping, we learned that individuals fare best when menu items are accompanied by photos as well as words, allowing them to make visual associations with the various items on the menu. Thus, the menu is structured in such a way that users are presented with items in visual and verbal forms. When players are ready to order, the AI-generated waiter interacts with them in a written and verbal form, requesting their order in the target language. Players are presented with a pre-populated list of responses that they can utilize to interact with the waiter. As they implement these responses, they are encouraged to not only read the responses, but to also say them aloud to begin familiarizing them with speaking the target language. Our reasoning behind this design decision is that this challenge comes later than previous vocabulary challenges, at which point users would likely begin to start speaking the target language.

Gameplay for Native Speakers

We expect that any native speakers who participate on Brocca will be brought to the VR app by similarly learning a different language. However, to encourage them to participate on the platform in multiple ways, we created both a music and photo gallery for native speakers to contribute to the site. The music gallery is present in each city. Native speakers can upload songs (or link via Spotify) by their favorite artists native to their country. To avoid potential copyright issues, we anticipate that these songs would be available via clips rather than in their entirety. They would be accompanied by lyrics for language learners to absorb while listening.

Native speakers can also contribute to Brocca by uploading different photos from their personal lives (i.e., photos of their homes, cars, pets, hobbies) or their favorite landmarks around their city of residence. They are encouraged to add a caption to the submission for other readers to better understand words in context, as well as various conjugations. The images that native speakers submit are also used for various challenges throughout one's journey through Brocca.

For example, a selection of food items submitted to the gallery are featured for the restaurant activity mentioned above. After native speaker submissions reach a certain threshold, items for the restaurant activity are swapped out, allowing novice speakers to complete the challenge multiple times if necessary. This partnership between native speakers and language learners is essential given the importance of social language learning and context in our literature review.

A caveat that we struggled with throughout the ideation process was how to ensure that we properly incentivize native speakers to contribute to Brocca. After much consideration, as outlined in our methods section, we decided that earning XP allowing native speakers to customize their avatars/profiles would be enough encouragement to contribute music and images to the site.

Our concept video: https://www.youtube.com/watch?v=jOJgceaWFr8&feature=youtu.be

DISCUSSION

In our social language learning VR application Brocca, we combined cultural immersion with gamification to provide a learning experience based on contextual information and tasks. After experience prototyping, we found that our VR environment fosters immersion and can lead to developing strong language skills as well as more awareness about another culture through interactions between novice language learners and native speakers, which supports the findings by Smith et al (2017) in their study of online pen pals. We designed our tasks so that users have contextual information, which led to them grasping on to a new language quickly. This finding relates to work by Mulder et. al (2018) and Kreshan (2012), who asserted the importance of context during language acquisition. Moreover, gamification of content by giving language learners positive reinforcement through earning XP, which may later be used for customization of their virtual avatars, led to continued engagement of users through tasks during our experience prototyping sessions, as can also be seen in studies by Turkay & Kinzer (2016) and Kankanhalli et al. (2012).

To make sure that our design process was iterative, we focused on experience prototyping to validate needs and design decisions. While we tested with multiple participants, we do recognize that interactions in a virtual world may be different than what we created through Wizard-of-Oz prototyping. Specifically, navigation and transitions in a VR space differ significantly from the real world, and this might impact the way our users explore the city. Therefore, going forward, we plan to create a VR prototype in Unity and playtest various levels within the game. We also want to test our prototypes with a broader audience, since a limitation we faced was access to a broader user base, which led to our testing sessions being primarily done with students at Carnegie Mellon University. Additionally, we tested 2 levels of language learning during experience prototyping and found that one of those levels was too advanced for novice language learners. A next step would be to iterate on our levels of language learning and

construct a system where users can organically transition through different levels.

We envision that this platform may be used by individuals anywhere in the world who want to learn a new language. By connecting learners to native speaker, where native speakers may also be trying to learn a new language, we want to create an ecosystem of immersive learning in a social context. This platform may especially be beneficial to those who want to learn a language but cannot travel to the part of the world where that language is spoken. By allowing users to connect with multiple users throughout their language learning journey, we removed the limitation of having a commitment to a single or multiple pen pals. To make this platform more accessible to those who do not have access to a VR headset, we discussed a mobile or desktop version of the app. However, the interactions in these environments would differ significantly to that in a VR environment and therefore require further testing.

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