EMERGING TECHNOLOGIES

AUGMENTED REALITY AND LANGUAGE LEARNING: FROM ANNOTATED VOCABULARY TO PLACE-BASED MOBILE GAMES

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APA Citation: Godwin-Jones, R. (2016). Augmented reality and language learning: From annotated vocabulary to place-based mobile games. *Language Learning & Technology 20*(3), 9–19. Retrieved from http://llt.msu.edu/issues/october2016/emerging.pdf

INTRODUCTION

The Pokémon GO craze in the summer of 2016 focused public attention on augmented reality (AR). As always occurs with newly popular uses of technology, the education community soon started to explore how to use the game in teaching and learning, including in second language learning. Through its ability to use add-on digital assets to explore and expand scenes and locales from the real world, there is an obvious connection between AR and current theories of second language acquisition which emphasize localized, contextual learning and meaningful connections to the real world. In fact, AR has been in use for some time in language learning applications. Especially well-known are mobile, place-based games created with the ARIS platform. In this column we will explore the variety of ways in which AR is being used by language educators and look as well at other ways in which language learning is tied to digitally enhanced spaces.

THE *POKÉMON GO* PHENOMENON

Pokémon dates back to the mid-1990s with popular video games, trading cards, comics, and videos featuring the *Pokémon* creatures ("pocket monsters"). The mobile game Pokémon GO, created by Niantic, was introduced in July, 2016, and is available on both iOS and Android devices. It was released initially in a limited number of countries, presumably so that Niantic could build up its infrastructure to support increased server traffic. The object of the game is to catch as many Pokémon as possible; there are some 150 available to date. When starting up the game, a map view of the player's location is displayed, showing the player's avatar and any Pokémon in the area. The presence of Pokémon depends on the location and the time of day. Clicking on a Pokémon switches the display to an AR view, with the creature overlaid on the live scene as captured by the player's camera. At the bottom of the screen is a small red and white *Poké Ball*. To capture the Pokémon, a player throws the Poké Ball at the monster, by swiping up on the screen with a finger. To find additional Pokémon, players need to change locations continuously. Of particular importance are *PokéStops* (shown as blue towers), locations tied to particular places of interest, such as monuments, squares, or museums. At the PokéStops, players may find Pokémon to capture, and can also obtain game assets including eggs and Poké Balls. The eggs turn into Pokémon if a player walks a certain distance, which, depending on the egg, may be from 1 to 6 mi (2 to 10 km). The fact that one has to be on the move in order to be successful at the game has resulted in the spectacle of numerous Pokémon players seen walking in urban spaces focused on tracking down the elusive creatures. As was true of the similar predecessor app from Niantic, Ingress (2013*)*, the game does offer the benefit of taking players outdoors and providing walking exercise. The term exergame has been coined to describe such games.

Language educators have found different aspects of playing Pokémon GO amenable to language learning, as was the case for Ingress as well. This has principally been for learning English. The first step in playing the game is to create a personal avatar. One blog post points out how that process involves vocabulary surrounding physical appearance: you pick your sex, dress, eye and hair color, etc. (King, 2016). Another blog post describes how creating image files based on playing Pokémon GO could be used in digital storytelling (Schrock, 2016). Players, for example, can turn on the AR view upon finding a Pokémon, then take a screenshot, putting the monster in the context of the live scene. A series of such images can be put together into a narrative. That process can be aided by built-in tools available in Pokémon GO, including the journal, which records all game actions and the *Pokédex*, which provides information about each Pokémon. Part of the narrative could involve mapmaking, based on gathering GPS coordinates. Players might as well create narratives or multimedia artifacts based on the area around a PokéStop. That might involve creating a panoramic image using an app such as Google Street View or Ricoh Theta S. ESL library provides a set of discussion starter lessons based on Pokémon GO.

Pokémon GO was not designed for language learning and many of the ways in which language teachers have enlisted the playing of the game in the service of learning could apply to other commercial mobile games. The advantage of building activities around Pokémon GO is the popularity of the game. This enables possible integration of learning into a fun activity in which learners are engaged by their own choice. The large number of game players also means it is easy to find fellow gamers. In fact, at the PokéStops it is possible to team up with other players. That is also likely at a *gym*, a location where a player's Pokémon can do battle. As with all digital games, there are also forums and companion websites that have been created in support of gameplay and as a meeting point for players. The social interactions which may accompany gameplay for Pokémon GO or other online games can provide a fertile space for language use and learning. As the game has expanded geographically, it has been accompanied by a global, multilingual, and multicultural online community offering rich opportunities for social contact.

MARKER-BASED AR

Most language learning AR applications are quite different from Pokémon GO in approach and scope. They typically are developed by researcher-educators, who lack the resources available to commercial game developers. In fact, early examples of AR technology are rather limited in terms of functionality and sophistication. Most applications do not use the physical location to create an AR experience, but instead rely an optical sensors, most commonly a camera mounted on a computer or embedded into a handheld device. This involves using *markers*, images that are hard-coded into the application, which trigger some kind of action. The LearnAR site provides web-based examples of AR (using Flash), with modules for vocabulary quizzes in English, French, and Spanish. Most commonly, the AR markers are simple black and white square printed objects, which are easy for the application to recognize and track. The easy processing means that this kind of AR activity can be accomplished on devices without a lot of processing power. Markers can be attached to walls, embedded in books, or tagged to objects (sometimes using radio frequency id tags). When an AR app recognizes that a marker has come into view through the user's camera, an action is generated, such as displaying text, showing an image, or playing a sound clip. This *print AR* is used by publishers to supplement and update information in textbooks or in other print materials (Hawkinson, 2014). A specific image is used as a trigger to overlay media, hyperlinks, or social media feeds. There are a number of reported projects that use marker-based AR to help teach vocabulary: learning characters in Chinese (as demoed in a YouTube video), facilitating English to Tamil translation (Rose & Bhuvaneswari, 2014), learning Filipino and German vocabulary (Santos et al., 2016), helping in pronouncing new English words (Solak & Cakir, 2015), or generating flash card interactions for English (Li, Chen, Whittinghill, & Vorvoreanu, 2014).

Typically in these applications, the word to be learned will either be illustrated (serving itself as the AR trigger) or will be attached to the physical object it represents or is associated with. The concrete visual connection to the item is likely to help in vocabulary retention. Valle (2015) has blogged about her use of a variety of marker-based AR applications for teaching Spanish. The actions generated in these examples vary considerably, from simply displaying a translation to playing an animation. A common reported outcome in the studies is increased motivation of the students, likely generated by the newness of the experience, as well as the welcome opportunity, in some cases, to move around the classroom. In terms of language learning gains, the reported results are modest (see Santos et al., 2014).

Tags and markers for activating AR behaviors may be attached to concrete objects. The European Kitchen project (Seedhouse et al., 2014) used sensors embedded in utensils, ingredient containers, and some appliances (e.g., oven knob, scales) to provide feedback to pairs of learners engaged in learning to cook through the L2. The system was designed to provide just-in-time, scaffolded assistance as needed, while encouraging the participants to assist one another both in the task and in understanding the feedback, provided in the L2 on a tablet on the countertop. The project is an interesting illustration of situated, task-based language learning. The conversation analysis of the recorded dialogues of the learners in the article demonstrates how the learners helped each other while taking advantage of the feedback provided. A similar project, described by Beaudin, Intille, Tapia, Rockinson, and Morris (2007), used a system called TANGO (tag added learning objects) to tag a variety of items in a house. They also added sensors to detect such actions as opening or closing a cabinet door or even flushing a toilet. When a particular action was detected by the application, the word and associated phrases were played on the mobile device. The HELLO project (Liu, 2009) used quick response (QR) codes attached to objects spread around a school to have students at those locations engage in a triggered dialog with a virtual learning tutor.

Involving students in the creation of marker-based AR projects is likely to serve to engage students more in the learning process. Results of studies by Bower, Howe, McCredie, Robinson, and Grover (2014) and Slussareff and Boháčková (2016) confirm the positive learning outcomes of student-generated AR. Students can be involved in both creating markers, by capturing images on their mobile devices, and in helping to create the augmentation, which can range from text annotations to video animations. The resulting products can be used to teach vocabulary and grammar or used in more creative projects such as digital storytelling, incorporating the AR objects into the narrative. Tools for creating digital stories are available for both desktop computers and smartphones (see this list for examples). There are also tools created specifically for using print AR to tell a story, such as Zooburst. Mahadzir and Phung (2013) describe a project in which students created a pop-up book with Zooburst in support of learning English.

It is easy to imagine how marker-based AR could be used in community or study abroad projects. Students, for example, could explore the linguistic landscapes of their surroundings, capturing signs, menus, graffiti, or billboards to explore topics such as urban multilingualism or neighborhood profiles. Socio-economic and political issues could be studied as well, by photographing and mapping particular kinds of stores (e.g., luxury or grocery) in different districts or by filming street demonstrations, protest rallies, or other public gatherings. With the capabilities of today's smartphones, the media captured could include video, which could be used when creating an AR app to overlay clips over still images or map locations.

PLACE-BASED LANGUAGE LEARNING

Through the addition of markers, QR codes, or sensors, the European Kitchen and similar projects are able to create *smart* areas within a school, classroom, or other location, where a particular action may generate feedback of some kind. It may be that the heralded Internet of Things will provide in the future a limited version of such a smart environment. In fact, sensors built into gaming consoles such as Sony PlayStation 4 or Microsoft Xbox One are able to track body movements, providing the opportunity for actions based on body movements and interactions with the environment. However, the field of vision in that case is limited. Another way to generate events from AR is to use GPS-supplied locations. This is, in fact, how Pokémon GO works. It is possible to combine that location information with data supplied by other means on a handheld device, principally through the camera, but possibly also by other sensors such as GPS, gyroscope, compass, accelerometer, and so forth. Together, they can provide additional information about the physical surroundings. Google's Project Tango anticipates the advent of mobile devices with many additional sensors, so as to provide even more detailed information.

One of the frequent uses of GPS-based AR is to function as a digital tour guide, providing information on sites, based on global positioning and on the scene captured by the embedded camera. This offers obvious opportunities for creating virtual tours of culturally or historically significant sites in the L2. These could range from quite basic to media-rich, depending on the intended usage and on the resources available. A simple example is provided by Liu and Tsai (2013), in which a campus tour was created as an AR app, to help students with learning English. When students point the camera at one of several predefined locations, a text description is overlaid on screen. The learner can click to receive more detailed information. A more complex application of AR is represented by Imparapp, a mobile game for learning basic Italian, being developed at Coventry University. The game begins with a treasure hunt, taking place in the student's immediate environment. As the learners move around the city, the app gives directions in Italian and at particular location generates an activity. This might involve such things as counting and reporting the steps up to Coventry Cathedral or asking and reporting queried information. The current developmental version of the app has students trying to solve a time travel mystery. In the process, students gain game assets, learn to navigate a city map in Italian, and collaborate with one another in Italian to advance in the game.

Moving from guided tours to place-based games places the learner in a more active role, using the target language potentially to read, listen, speak, and write. If the game is well designed, it also offers engagement and entertainment along the way. One of the better-known examples of a location-based mobile game for language learning is Mentira, designed to teach Spanish pragmatics to intermediate-level learners (Holden & Sykes, 2011). The game is intended to be played over three to four weeks and combines classroom activities, independent gameplay, and a site visit. The setting for the game is the Los Griegos neighborhood of Albuquerque, New Mexico. The goal is to solve a prohibition-era murder. Players take on a role as a member of one of four Spanish-speaking families from the neighborhood. The families represent quite different backgrounds and communication styles. As players interact with family members, present in the game as non-playing characters (NPCs), they learn certain pragmatic behaviors such as how direct to be in framing requests. Each of the families also has different information helpful to solving the murder mystery, requiring students to collaborate and share information. The students are sent by their families to explore the Los Griegos neighborhood, where they encounter both NPCs and actual, Spanish-speaking inhabitants. The game incorporates six different locations in Los Griegos, each important in terms of local history, present-day life, or game narrative. Each player's decision on where to go and what to say can trigger an event (such as an NPC's abrupt refusal to speak if a request is perceived as rude) or a game asset (like a helpful clue for solving the mystery).

In articles about the learning outcomes for students playing Mentira, the developers, Holden and Sykes (2011, 2013) write that while there was only slight improvement in performance on specific pragmatic behaviors, it was clear that playing the game did increase the students' awareness of pragmatic issues in Spanish. They were able to see, for example, how different speech acts (requests, refusals, apologies) could be formulated quite differently depending on context and individual speaking patterns. In the game, the very same wording for a speech act might get quite different results (i.e., feedback from a NPC), illustrating the individual variability of pragmatic behaviors. To make sure students perceived differences in pragmatic features among the NPCs, their communication styles were portrayed in a somewhat exaggerated fashion. For example, if a NPC preferred a direct speaking style, the character was much more direct in their communications than would realistically be the case in Spanish. As part of the effort to make the game sociolinguistically reflective of Spanish as a world language, the NPCs also use different varieties of spoken Spanish.

One of the goals of the Mentira project was to increase student motivation for learning Spanish, and reported results indicate was in fact the case (Holden & Sykes, 2011). It is likely that came about at least in part due to students experiencing Spanish *in the wild* while visiting Los Griegos. Classrooms tend to be place-agnostic and do not offer the same opportunity for reinforcement of learned content through place associations, an aspect of learning that educational psychologists have shown to be important (Holden & Sykes, 2011). A game-based approach provides a uniquely effective means for learning language pragmatics (Holden & Sykes, 2013). Pragmatic behaviors are difficult to teach, due to the absence of easily defined rules, the considerable variation in appropriateness depending on context and individual, and the always present possibility of a speaker choosing not to use a particular learned pragmatic feature for personal reasons. In a game environment, pragmatic choices can be shown to have quite dramatic consequences. It also offers the possibility of making such choices in a safe environment— you can always just restart the game. As Holden and Sykes (2013) point out, due to the scant discussion of pragmatics in most instructed language learning, learners' first pragmatic feedback may be "through miscommunication in high stakes environments such as study abroad classes, host family interactions, and job interviews" (p. 156). A game can provide virtual, but potentially emotionally engaging, feedback to a pragmatic misstep, making the experience immediately relevant and meaningful, leading to successful uptake.

AR TOOLS

Mentira was created with ARIS (Augmented Reality and Interactive Storytelling), a free open-source game editor from the University of Wisconsin. It is designed to be used by nonprogrammers, although a knowledge of HTML and JavaScript allows for customization of look and feel as well as being able to create additional interactivity. The trigger for actions in the game is frequently the location, namely a set of GPS coordinates. The player normally must be at this location to see the content. Alternatively, the action can be generated by a player scanning a QR code or completing a sequence of steps in the game. Activating a trigger in the game can result in a number of possible events: starting a conversation, viewing a *plaque* (text plus optional media), providing information about an item, going to a webpage, or switching to a different scene in the game. ARIS can be used to create quite simple apps, such as tours or scavenger hunts, or quite complex branching games such as Mentira. A number of other language learning related apps have been authored with ARIS, Chronos-ops (from Portland State University) and Visitas de la colonia (from the Local Games Lab ABQ in Albuquerque). Several ARIS games have been created through the Center for Applied Second Language Studies (CASLS) at the University of Oregon, including Explorez, for first-year French (Perry, 2015), Analy Nyuwiich (for learning about Mojave culture, a Native American community in Arizona), Why butterflies are silent (integrating grammar of indigenous language Tohono O'odham into a game), EcoPod, (a post-apocalyptic survival game), and Finders Keepers (an ethics and justice oriented game). For most of these games, free language teaching materials are available from CASLS, geared to different proficiency levels. In addition, CASLS maintains the Games2Teach blog and has cooperatively developed—with the Center for Open Educational Resources and Language Learning at the University of Texas—a place and experience based database for language learning. Both the ARIS editor and the player app are cloud-based, meaning that one has to be connected to the Internet to play. ARIS games are also iOS only, although an Android player is under development.

Another open-source AR mobile game editor, TaleBlazer (out of MIT) creates games playable on iOS or Android devices. The previously mentioned ImparApp is being created with TaleBlazer. Once a TaleBlazer game is downloaded to a device, players do not need an Internet connection to play, although in that case, there is no access to web resources or social media. The TaleBlazer editor is browser-based (as is the case for ARIS) and uses a block-based scripts format, like the popular Scratch programming environment. In comparison to ARIS, TaleBlazer is role-based, which provides the default structure (characters with different roles interacting), rather than the storytelling structure basic to ARIS. TaleBlazer has more game mechanics (options for gameplay, character movement, and scenes), as it was designed in part to teach programming principles. ARIS places more emphasis on maps and location-based interactions. ARIS also allows for more functions without the need for coding. Part of the rationale for how TaleBlazer operates is to allow code sharing, something that is generally not applicable to ARIS.

Both platforms offer powerful vehicles for creating interactive stories, augmented tours, or place-based games. They are both designed to be used by nonprogrammers, but, depending on one's technical experience, it may take a considerable amount of time and effort to learn one's way around either tool. For both platforms, detailed user guides as well as developer forums are available. Instructors of Japanese at Purdue University have provided a step-by-step walk-through of the process of creating a basic game in ARIS, using Japanese as an example. For simpler uses, such as generating actions from static images or QR codes, other applications may be better choices, as they have shallower learning curves. Aurasma, for example, is cross-platform and can be used easily to create basic tours which can contain pictures or video clips, generated by viewing markers or images. Aurasma has been used in a variety of language learning settings (Antonopoulos, 2016; Driver, 2016; Valle, 2014). Ogata, Yin, El-Bishouty, and Yano (2010) describe the use of Aurasma, together with student-created videos clips, in teaching French. Richardson (2016) describes a quite extensive game titled Mission not Really Impossible created in Aurasma. Players are sent on a mission within the German city of Karlsruhe, to thwart an evil plot. They use a map to locate images and markers located at different places around the city, which when scanned within the app provide useful information for accomplishing the mission. A video trailer for the game is available. Another AR authoring option is Layar, which also assumes the use of markers or pictures as triggers. Layar is used widely in publishing, such as in the popular Lonely Planet series of guide books.

Not all language educators have the time or inclination to develop AR apps or games. Given the likely scant professional rewards for doing that kind of work, it is likely to be game enthusiasts or hobby coders who engage in AR creation. Of course, enlisting student help, if available, can be a tremendous advantage, as can be peer or institutional assistance. Workshops are being offered at conferences and at other venues for creating place-based mobile games, especially for using the ARIS platform. For those researcher-practitioners who do jump into creating an AR project themselves, there are a number of advantages. Typically for such projects, there will be a lot of trial and error, even if a detailed road map or storyboard has been created. As a consequence, such projects tend to go through many iterations, with multiple testing cohorts; each time resulting in minor or major adjustments. Waiting for programmers to make adjustments to the program can be problematic (and possibly expensive). Of course, the simpler the game and easier to use the authoring tool, the quicker adjustments can be made. Reinhardt and Sykes (2012) suggest other advantages to researcher-designed games, namely the ability to collect and analyze game data (to gauge learning and improve the game) and to more effectively integrate gameplay with instruction (to make changes to the game based on class discussions). They also make the point that having some experience as a game designer makes it much more likely that one make informed decisions in evaluating games for possible instructional use.

On the other hand, there is the possibility that, compared to commercial games, educator-developed games will have bugs or less than optimal game flow. The quality of the game experience is central to student acceptance. Students are already likely to be skeptical of anything labeled as an educational game. A compelling narrative presented in an attractive and clearly organized way is likely to result in more time on task and therefore the potential for more learning. As Holden and Sykes (2011) point out, there is a trade-off between game quality and language learning potential. Many developers will likely lean towards maximizing language learning, but if the game does not reach a minimal threshold of player interest, there will be no learning, as the student will have stopped playing. Developers should be aware of the fact as well that not all students will be eager gamers. Providing sufficient gameplay scaffolding for non-gamers is important, as is including enough challenges to maintain the interest of experienced gamers. Perry (2015) found that in playing the ARIS-developed Explorez, students without gaming experience had a good deal of difficulty in navigating gameplay. Reinhardt and Sykes (2012) point out that one other consideration in game design is the degree to which interactions with other players are built into gameplay. For language learning purposes, requiring collaboration and communication among game players is a no-brainer. Mentira was meant to be played by small groups of students sharing information among themselves. On the other hand, it is advantageous if a game can be played independently. In fact, an individual's preference in gameplay may be for playing on her own rather than with other players. Reinhardt and Sykes call for more research into learning styles and learning strategies in the context of digital games, something which would be quite useful in shaping educational game design.

AR IN CULTURAL CONTEXTS

In addition to using AR tools for language learning, there is also the possibility of creating applications which specifically target historical, cultural, or literary topics. Using ARIS, Terri Nelson (from the University of California San Bernardino) has created a game environment for experiencing everyday life in Paris during and after the Nazi occupation, called Paris Occupé. The game enables students to appreciate the hard choices and everyday difficulties facing Parisians during this time. With limited finances available, students as war-time Parisians must choose what items are most important to them, from bottles of water to family photos. They must decide whether to get along with the occupiers by following the rules or risk imprisonment by engaging in illegal activities such as listening to Allied radio broadcasts. Day-to-day decisions affect both the quality of life in the present time and possible consequences after the war. The goal is to have students gain a deeper understanding of historical events, while avoiding knee-jerk reactions to situations, such as automatically assuming one would join the French Resistance. ARIS was used in this instance, not to take advantage of its AR capabilities, but because of its strength in storytelling. Paris Occupé also takes advantage of the ability to integrate multimedia, with the incorporation of vintage photos, audio clips, and daily newspapers, all in French, thus supplying a rich linguistic and cultural game environment.

Paris Occupé also makes extensive use of the mapping features in ARIS, another strength of the tool. In this instance, the location of the game story does not correspond to that of the students playing the game. That is the case as well for Shintaku's (University of Arizona) ARIS-developed Hiroshima game, in which players navigate the streets of Hiroshima and other localities in Japan, seeking to complete a quest initiated by an A-bomb survivor. As is the case for Paris Occupé, student interest is generated by high quality design in the selection of media and creation of character speech:

> Key to creating a sense of place were realistic conversations and dialogues; images, videos, and sounds; and choices that were consequential to the game outcome. Also key were well designed supplementary pedagogical materials that directed students to make connections between the language, culture, and history that they encountered in the game and their own understandings, and that compelled them to practice the new language and engage with the new content in meaningful ways (Reinhardt, 2016, para. 6).

In his blog post, game developer Reinhardt emphasizes the key role of both developers and instructors in the successful roll-out of place-based learning applications. If a game is being used within the context of instructed language learning, it is essential that the instructor show both understanding and enthusiasm for gameplay.

There are other options for exploring location-based topics which take users out of their current location. Google Expeditions allows educators to create virtual field trips. Students use Google Cardboard (an inexpensive virtual reality viewer) to have a 360° panorama of scenes. This holds the possibility of taking students on virtual field trips to important cultural or historical sites. A Shakespeare class used Google Expeditions to provide a detailed tour through the Italian city of Verona, the setting for *Romeo and Juliet*, including locations featured in the play as well as those of historical or cultural interest in the city. Another possibility is to explore literary works by following the trajectories of the characters as they move through a story. The Google Lit project uses Google Earth to do just that, with examples such as

Thomas Mann's *Buddenbrooks* (1930, a student-created project) or the *Diary of Anne Frank* (1952). Google Earth has also been adapted to the foreign language classroom and offers rich possibilities for integrating language learning into cultural geography and history (see Yeh & Kessler, 2015). Calling up different time views in Google Earth or using AR to overlay transformations of a particular setting over time can provide a rich and dynamic cultural and historical experience. Augmenting views of sites such as Tiananmen Square, Beijing, or the Brandenburg Gate in Berlin enables students to go beyond the normal tourist gaze, to appreciate the sites as locations of strife and transformation.

CONCLUSION AND OUTLOOK

There is considerable interest today in the development of AR and virtual reality (VR) headsets. VR differs from AR in that it creates a self-contained other reality, blocking out the view of the user's actual environment. The best-known VR headset currently is Oculus Rift, which totally immerses the user in an artificially generated world. The processing power needed to create that virtual reality requires the Oculus Rift (and similar headsets such as the HTC Vive) to be tethered to a (Windows) computer. AR headsets are smaller, offering a semi-transparent screen in the user's field of vision. An AR headset which generated a lot of buzz when it was under development was Google Glass, but it was never released as a commercial product. Google is rumored to be working on a successor. One of the attractive features of Google Glass was that it was less bulky than the traditional headset. Making headsets smaller (and therefore less geeky) is a major direction in headset development, as components and batteries both shrink in size and gain in power. The current crop of AR headsets, such as the Microsoft HoloLens or the Meta 2 have created some interest, but have not as yet been widely used or even publicly available. There has been a good deal of anticipation surrounding the MagicLeap project, including a cover story in Wired earlier this year. That AR headset, currently under development, has been described as "Google Glass on steroids" (Hollister, 2014). A video demonstration of the view from a MagicLeap prototype shows how the system promises to work. There are clearly language learning possibilities with these headsets, as a review of Google Glass pointed out (Forinash, 2015).

The touted potential of these devices is to provide a *mixed media* experience. The idea is that users would not just have the possibility of seeing Pokémon overlaid on their views of the real world, but truly useful information. In looking at a restaurant, for example, the overlay might present specific information such as price range, hours, menu, or reviews, possibly displayed in different quadrants of the overlay. The user could call up additional services to view as overlays, such as a calendar or a notebook. Interacting with such services would likely be accomplished through gestures and voice commands. This scenario promises an enhanced version of what apps like Wikitude already provide, namely the display of information about a building being viewed live. Pearson's LangAR was a project which used Wikitude for language learning. With advanced mixed media, there would be many more options available, and the information could be personalized according to user profiles and preferences. Language learners could in this way be supplied with a rich just-in-time support environment as they navigate through a city, have a service encounter, or even engage in conversations. Ideally the system would rely on an online learner model for that particular user, which would inform the kind of support provided. If an open learner model were used, it could provide the option for users to have some control over preferences (see Bull & Wasson, 2016).

One of the concerns in the mixed media scenario is the nature and source of the information being automatically supplied to the user. Today, there is an increasing amount of geographically specific information available online. That ranges from commercially supplied data, such as navigation or search results from Google, to user-generated input, such as reviews or social media feeds. Extensive layering of online information in reference to places is sometimes referred to as the *geoweb* (Graham & Zook, 2013). The information on the geoweb is not necessarily neutral or disinterested—there may be commercial or political interests at play which determine what information is shared in what priority order. There are not only privileged points of view represented, but information is also linguistically varied. Graham and Zook (2013) show how different the information is about places in locations in Israel and Quebec, depending on the language used:

> In this analysis we have seen a lot of content about certain objects of attention in some languages because those objects are necessarily of interest to speakers of that language ('Christian' in English in Israel, for example). But does it matter that different augmentations are being created for different groups of people? Users are not just being presented with filter bubbles of information, but are actually being presented with fundamentally different cities and material places. Balkanised bubbles of augmented information could thus help to reinforce real, material, balkanized spaces in a very real way (p. 97).

As we look towards a future of increased AR penetration into our daily lives, it is good to remind ourselves that tools, services, and data generating our digitally enhanced view of the world are neither neutral nor universal.

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