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Presence and agency in real and virtual spaces: The promise of extended reality for language learning

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Abstract

Augmented and virtual realities (together "extended reality") offer language learners the opportunity to communicate and interact in real and virtual spaces. In augmented reality (AR), users view computer-generated layers added to a phone camera's view of the world. Virtual reality (VR) immerses users in a 3D environment that might simulate aspects of the outside world or project an entirely imagined reality. This column looks at opportunities and challenges in the use of extended reality (XR) for second language learning. Opportunities include higher learner motivation and personal agency through XR uses that feature collaboration and open-ended interactions, particularly in simulations, games, and learner co-design. That direction offers more alignment with current theories of second language acquisition (SLA)–emphasizing holistic language development and ecological frameworks–than most commercial VR apps currently available. Those posit a linear language development and focus largely on vocabulary learning and language practice within closed role-play scenarios. Offering both AR and VR access, mixed reality may present opportunities to combine the best features of each medium. Advances in generative artificial intelligence (AI) provide additional possibilities for personalized language learning in a flexible and dynamic VR environment.

Keywords: *Augmented Reality, Virtual Reality, Second Language Acquisition, Artificial Intelligence*

Language(s) Learned in This Study: *English*

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Introduction

Extended reality (XR) references virtual reality (VR; today mostly immersive with headsets) and augmented reality (AR; used predominantly through projecting digital artifacts onto smartphone screens). Of all the technologies emerging for computer-assisted language learning (CALL) in recent years, VR has been one forever on the cusp of breaking into mainstream use. That expectation was fueled in 2021 by Facebook's transformation into "Meta." Mark Zuckerberg's vaunted "metaverse" relies heavily on the widespread availability and use of immersive VR. While new VR headsets have arrived, the familiar factors that have slowed their rollout remain, namely, cost, comfort, and compatibility. VR's younger sibling, AR, is considerably more accessible, as the equipment needed is widely distributed, namely, smartphones. While compelling examples exist of AR and VR applications for second language acquisition (SLA)–often featuring gaming elements, learner collaboration, and/or cultural exchange–, neither technology is widely used today in either instructed or autonomous language learning. XR used for SLA mostly involves the limited domains of vocabulary learning and scripted dialogue practice. Creative and constructivist XR experiences are the exceptions, rather than the norm.

The usefulness of XR for language learning depends primarily on contextual appropriateness but will normally involve moving beyond the built-in functionality of apps and devices. That can take the form of customized solutions that fit specific goals and student profiles or the use of commercial apps that take advantage of social and collaborative functionality to offer tasks and interactions that are open and dynamic. Optimized use of XR can build learner agency through presence and copresence, enhancing motivation and confidence, and offering opportunities to practice language skills while taking on different identity roles. That was the vision for VR in early CALL. In this column, we will discuss how projects today fulfill that promise, and how such XR use aligns with an ecological perspective on SLA. The discussion of VR will focus primarily on immersive usage, as that represents the main variety today. Looking to the future, mixed reality applications (integrating both AR and VR) appear to offer possibilities for expanded learning spaces, with generative artificial intelligence (AI) adding opportunities for virtual interactions that are personalized and open-ended.

Augmented Reality: Enhancing Interactions with our Environment

Since last I wrote a column on AR (Godwin-Jones, 2016), the dominant use in language learning remains vocabulary development and guided tours, with some use of place-based gaming (Bonner & Reinders, 2018; Cai et al., 2022; Godwin-Jones, in press; Karacan & Akoglu, 2021; Parmaxi & Demetriou, 2020). Most published AR studies use marker-based approaches, in which scanning a printed picture or a QR code generates a digital overlay (Hockly, 2019). This most commonly occurs on a smartphone through the user's camera. The digital overlay appears within the image displayed on the phone and can range from a textual annotation (translation, commentary, explanation) to playback of audio, video, or animation. Markers can be embedded in cards, posted on objects or walls, or in print materials of all kinds. This technology can be combined with location-based AR, which uses the Global Positioning System (GPS) and other geographical data to trigger actions or displays within an AR app. This is the case, for example, in the use of AR-based guided tours, which may take advantage of markers on signs or buildings along with the user's geo-mapped location. Pegrum (2019, 2021) provides an overview of AR "mobile trails" used for language and culture learning. The Singaporean heritage trails, for example, assist school-age students in learning about Singaporean history and culture through multiple languages available (Mandarin, Malay, Tamil, English). Students engage with the overlaid information on each stop of the trail, but also with each other and, at a last stage, interview and record conversations with passerbys or owners of nearby businesses. Student groups collaborate but also compete with other groups, adding a game-like element to the experience.

Location-based mobile gaming offers a compelling use case for AR. Gaming projects like *Mentira* (Holden & Sykes, 2011) or *Chrono-Ops* (Thorne, 2013) incorporate collaborative problem-solving based on real and virtual interactions with other players, community members, or non-game-playing characters. *Mentira* requires the use of appropriate pragmatic language in Spanish in order to progress in the game. In *Chrono-Ops*, groups consisting of mixed fluent and learning speakers of English collaborate while walking and working together to resolve game challenges. The embedded and situated learning taking place during gameplay is likely to make the experience more memorable. In contrast to VR experiences, AR leverages local resources—people physically present, natural surroundings, built environments—to make the learning experience immediate and (literally) transparent. AR offers an effective and attractive approach for developing an open, porous learning experience (Godwin-Jones, 2020; Thorne et al., 2021).

AR is an ideal vehicle for environmental or space-oriented topics, as shown in Dalim et al. (2020), which used AR to present spatial relationships and colors for Malaysian children learning English. In fact, AR has been shown to be easily and effectively integrated into early language learning (Fan et al., 2020). AR can make aspects of physical surroundings more understandable and immediate, offering place-based language learning opportunities. Tang and Young (2014), for example, developed an app which allows learners of Chinese to experience the menu and order items the way Taiwanese students do in the student cafeteria. Another way in which AR can leverage local venues for learning is through historical simulations, such as *Occupied Paris*, about choices Parisians faced during the Nazi occupation. Pacheco et al. (2015) presents an app which enhances through textual and graphic overlays the experience of visiting the Bergen-Belsen concentration camp.

As AR projects typically target defined learning goals, its use fits well into project or task-oriented teaching methodologies. AR, more easily than VR, invites users to be co-constructors of the learning environments. That process can happen through posting commentaries or uploading photos or videos (Bonner & Reinders, 2018). In that way, AR allows for a degree of agency and freedom that can motivate learners, which is especially true if game elements are incorporated. Integrating gaming can facilitate breaking away from institutional thinking and behavioral patterns. Sydorenko et al. (2019) found that open-ended AR activities provided the kind of free exchanges that encouraged the rise of metalinguistic, language-related episodes.

One of the widely used features of AR that allow for creative and individualized use is AR filters, sometimes called AR lenses. Filters were introduced by the social media app *Snapchat* in 2015 and are popular today on *Instagram* and *TikTok*. They originated as face filters, with computer-generated effects added to modify selfies, combining virtual overlays with real-world images. Filters can be used to superimpose backgrounds or modify aspects of captured images; they can feature video and incorporate audio. Apps often allow the creation of user-generated filters through a drag-and-drop codeless process. For example, *MetaSpark* is a tool from Meta for making AR filters; *Effect House* is available for that purpose for *TikTok*. AR filters have been used in pronunciation training (Zhu et al., 2022). Similarly, Wen et al. (2023; this issue) combines the use of filters with other AR apps to assist in providing corrective feedback for pronunciation practice, finding that the filter directed students' attention to important articulating factors while reducing the embarrassment and anxiety of personal interactions with the instructor.

In meta-analyses of the use of AR in education, the positive effect on learner motivation has been highlighted (Aldossari & Alsuhaibani, 2021; Avila-Garzon et al., 2021; Parmaxi & Demetriou, 2020). For language learning, actual learning outcomes have been mixed (Bonner & Reinders, 2018; Cai et al., 2022; Hockly, 2019). Many studies have been of short duration, with often no tracking of longer-term benefits. One of the common findings in AR studies is that a highly motivating factor in project design is to involve learners in creating or co-creating aspects of the experience, leading to enhanced learner engagement. When learners are creating materials to share, they tend to take greater care in language use, checking grammar and spelling. Reinders (2014) found that to be the case in EFL students in Thailand creating multilingual campus tours for visitors. Parmaxi and Demetriou (2020) advocate relinquishing control to learners in creating and using AR, with instructors providing overall guidance and scaffolding. It is also the case, as with all technology use, that the actual implementation of the technology and the learning contexts make all the difference in the degree of success. Studies that are longer term and which place AR use in the larger context of learners' overall language learning environment would help in evaluating the usefulness of AR, particularly as combined with other approaches. From that perspective, it would be welcome to see more studies that make use of learner diaries or other means to gauge how useful learners perceive AR to have been.

One of the primary advantages of AR is the ease of access, with most AR apps designed for use on widely available mobile phones. That has made it an attractive approach in education across all age groups. Because it does not require specialized equipment, AR use is flexible, easily integrated into formal learning environments, and available for informal learning outside the classroom. Pegrum (2021) envisions future AR use taking place through the use of smart glasses, rather than through smartphone screens. It remains to be seen whether that scenario plays out in the near future, but if it does, that may enhance the experience (more natural and immediate visualizations) but also reduce the wide accessibility of AR. It does seem likely, as discussed below, that AR and VR are likely to merge in mixed realities which leverage and combine the strengths of the two.

The Promise of Virtual Reality Informed by CALL History

Although used for some time in commercial training settings, AR as a widely available technology is relatively recent, dating from the advent of the touchscreen smartphone (iPhone released in 2007). The popularity of the AR game *Pokémon Go* in the summer of 2016 introduced many people to the technology for the first time. In contrast, VR has existed since the 1980s, although radically different in form from today's immersive VR. In language learning, there have been several distinct waves of VR. The first implementation of what was considered at the time VR was in text-based adventure and collaboration platforms, principally multiuser, object-oriented environments (MOOs), derived from multi-user dungeons (MUDs). This era reached its peak with LambdaMOO and similar platforms in the early 1990s (Lin & Lan, 2015; Schwienhorst, 2002). The advent of multimedia for PCs and Macs, along with the burgeoning Internet in the mid-1990s, led to a second wave, using desktop computer screens to show graphically an alternate reality. This phase was dominated by *Second Life*, released in 2003 from Linden Labs. *Second Life* had enthusiastic users in the SLA community who built and maintained "islands" which featured communities of interest and opportunities for language exchange (Godwin-Jones, 2004). Hubbard (2019) chronicles the meteoric rise and equally fast decline of *Second Life*. For a discussion of low-immersion VR (i.e., using a 2D computer screen and mouse), see Lin and Lan (2015) and Sykes et al. (2008). The latest wave of VR dates from the 2010s with the availability of head-mounted viewers and handheld controllers, more particularly from 2015 when lower-cost VR headsets started to become available, along with the inexpensive Google Cardboard (Dhimolea et al., 2022). VR saw a spike in interest during the Covid-19 pandemic, with some brands of headsets selling out (Sadler & Thrasher, 2021).

Looking back at early VR, I believe, is instructive in terms of today's developments in immersive VR. The first two waves of VR were above all about providing a space for collaboration and socialization. For language learning, open conversational exchanges predominated, in the early period often through tandem exchange, later within virtual worlds like *Second Life*. That is quite different from what one associates today with VR, namely wearing an isolating head-mounted display, cutting off contact with others. A main reason for that widespread impression is that gaming predominates in VR use. Of course, the loner image does not reflect the reality of what often happens within that virtual space, which can involve contact with other VR users represented as avatars. Indeed, one of the more exciting implementations of VR today for language learning are applications which connect users with one another. Gaming itself can be an experience bringing users together in both competition and collaboration (Reinhardt & Thorne, 2020).

Yet, looking back at the history of VR for language learning, it is evident that the emphasis on community building, group and individual creativity, and personalized learning has changed, with the priority in most commercially available VR implementations today on multimedia-enhanced and fixed role-play and vocabulary training. Kronenberg and Poole (2022) comment:

> One noticeable trend in the application of VR for language education is the creation and exploration of VR environments that are incredibly limited in scope and application. Many of these VR environments are used in research studies as highly immersive flashcard systems (e.g., Legault et al., 2019). Such studies send the message that VR systems are no more than a novel tool to be used to inspire learners to spend a few more minutes looking over vocabulary words. (p. 3)

Learning scenarios in immersive VR software are fixed and present mostly tourist-like experiences, such as checking in at a hotel, taking a taxi, or shopping. The actions tend to align with a neoliberal social orientation emphasizing consumption and leisure travel.

In contrast, early VR was designed to "support learners in becoming more autonomous language users who can select and organize their own learning resources" (Schwienhorst, 2002, p. 197). In that article, Schwienhorst, an enthusiast for text-based VR, discusses how in MOOs users were able to create their own "rooms," then integrate selected online media and experiment with objects such as bots. In fact, Schwienhorst (2002) downplays the value of role-play:

> [VR researchers] have emphasized the importance of experimenting with different roles. This should not be misunderstood as role playing as in "at the train station" scenarios in some language classrooms but in the more fundamental sense of using alternative personas to approach potentially construct-altering situations. (p. 198)

The author argues for learning activities, such as tandem exchange, which support free-form use of the language and allow learners to take on real-life roles (shifting roles as L2 learner or L1 expert speaker/cultural informant). He recounts one MOO exchange in which students were upset when a teacher entered the space, as that changed the dynamic from a mutually created social space to a formal instructional activity.

Similarly, Sykes et al. (2008) in analyzing the second wave of VR, “synthetic immersive environments,” such as *Second Life*, highlight the ability to create “a meaningful collaborative space in which learners themselves are at the center of their own learning” (p. 536), thus emphasizing the potential for developing learner autonomy. The view on simulated role-play echoes that of Schwienhorst (2002): “Participants may take on numerous identities in immersive spaces through careful manipulation of sociopragmatic factors as they carry out and creatively transform roles they visually embody in the virtual space” (p. 535). Indeed, just as one develops a second self in learning a new language, that can also be the case in collaborative or gaming VR environments. This take on immersive environments for SLA advocates for a holistic view of language development, embracing its complexity and openness. Immersive VR “encourages the use of an integrated set of complex features to learn about complex language functions (i.e., pragmatics) in a realistic amount of time, not something that is merely created for a learning exercise” (Sykes et al., 2008, p. 537). The emphasis on pragmatics points to the importance of designing activities in the VR space which offer realistic and open-ended exchanges, rather than limited and pre-programmed interactions, such as menu selections or multiple choice.

Depending on the context and learner level, there is certainly a valid place in SLA for structured role-play, as well as for dedicated vocabulary learning activities. However, of all the technologies in use today, VR–with its powerful multimedia, simulation, and collaboration possibilities–is the technology that most invites experimentation with experiential and expansive learning. Instead, as Berns and Reyes-Sánchez (2021) write:

> Very few of the apps explore the real potential of VR, either providing novel teaching and learning approaches and new types of interaction, or offering novel learning scenarios that could allow the learner to experience a greater sense of immersion. (p. 159)

In analyzing VR apps, the meta-analysis by Berns and Reyes-Sánchez (2021) found no apps which “explore adaptive, constructivist, or experiential learning approaches” (p. 160). Furthermore, all apps examined focused on individuals, none on collaborative learning. Nicolaidou et al. (2021) point out that in fact immersive VR is not well suited for conveying structured, discrete language knowledge, being instead ideal for working with 'll-structured knowledge’ That is the advantage of VR for SLA, providing an environment that can deal with the complexity of real-world language use, and supplying support for enhanced learner agency. That can happen in the widely used Cognitive Affective Model of Immersive Learning (CAMIL) model from Makransky and Petersen (2021) through (a) immersion, (b) user control, and (c) realism. In the next section, we examine some VR projects that follow that pattern.

Varieties of VR

While most commercially available implementations of VR tend to be routinized and rigid, assuming a linear and predictable language learning trajectory, there are examples of VR that point to the enormous potential of the medium. Those involve innovative uses, such as 1) integrating in a symbiotic way different types of VR products to provide individualized learning pathways; 2) adapting/modifying an off-the-shelf product for a particular language learning context; 3) using VR for experiential cultural and historical simulations; 4) conducting virtual exchanges through VR for culturally informed language development; 5) and using VR for kinesthetic/tactile learners and for special learner populations. Examples of each are discussed below, but this is by no means an exhaustive list, intended only to illustrate possibilities.

#1) Leveraging VR for Personalized, Constructivist Development

Karimi et al. (2023) offer an example of combining multiple VR apps in a study inspired by the multiliteracies framework outlined by the New London Group (1996). The authors point to three principal affordances of multimodal interactions in a 3D environment they sought to implement: a) experiential learning, b) transfer of learned skills to real situations, and c) collaboration. Using a design based on those characteristics, the "City in the Sky" project brought together a group of undergraduates, graduate students, and adolescent bilinguals. Together, they created multimodal texts through the use of VR drawing applications (*MultiBrush*), place-based exploration (*Wander*), and collaborative gaming/authoring environments (*Minecraft*). In the case study of one adolescent participant (LK), the variety of VR tools at his disposal enabled him to draw on his artistic creativity and on his scientific learning (in the area of husbandry) to design his virtual world. He was able to "practice urban planning in a VR context and bring in knowledge from other non-VR games he engages with on his own, such as *Minecraft*, in which farming plays a large role in developing the Minecraft world" (Karimi et al., 2023, p. 36). LK's experience led him to mentor others involved in the project (including college students), representing the kind of agency and personal engagement difficult to provide in normal classroom settings.

The multimodal and collaborative storytelling in this project allowed each participant to contribute according to individual backgrounds, interests, and capabilities. The process involved locating, presenting, and synthesizing information from different sources and in different modalities, exemplifying the multiliteracies approach necessary in our digital and real-life environments today. Blyth (2018) points out that immersive VR is well-suited for students to "develop the ability to produce and interpret multimodal communication that mixes multiple modes with multiple languages" (p. 229). Indeed, VR seems designed for exploring *transmediation*, the transforming of content from one mode, plane, or sign system to another (Mills & Brown, 2022). The need for reciprocity, teamwork, and leadership evident in the "City in the Sky" project likewise are desirable life skills for today's students. A similar collaborative storytelling project (involving AR) is discussed in Asquith and Frazier (2022).

In contrast to most VR projects, the "City in the Sky" project was conducted over an extended period of time. The longer time frame enhanced the open-ended creativity in the construction of a virtual world with a variety of multimodal literacy practices and modes of thinking (artistic, scientific). One of the other consequences of the longer time frame of the project was that it provided the space for discussion and reflection. That is particularly important in such an open-ended and creative project that offers many options and possible outcomes.

#2) Incorporating Commercial VR Software as a Collaborative Tool

Kronenberg and Poole (2022) emphasize reflection as well through pre- and post-task activities centered around the use of a commercial VR game. In an advanced German class, the game, *Keep Talking and Nobody Explodes*, was adapted for collaborative language learning. The game is designed ideally for paired problem-solving, as one player is given a bomb to defuse and the other a defusing guide. The game requires use of clear and precise language for successful defusing. Playing the game is essentially an information gap activity, requiring communicating effectively so as not to be blown up. In that way, feedback on mistakes is immediate (and potentially deadly). A useful feature of this game is its flexibility, as it can be played in low immersion environments through a phone or computer or in high immersion mode with one partner (the defuser) wearing a headset and the other outside the VR environment using a print or digital copy of the defusing guide. The authors found that the isolation (through the headset) forced learners to rely solely on their linguistic skills while preventing possible distractions.

Gaming offers entertainment benefits as well as the possibility for competition (which pair defuses the bomb first), providing further engagement in the activity. VR-delivered games can be on a small scale, as here, or in massively multiple-player environments such as *World of Warcraft*. Pinto et al. (2021) provide a systematic review of VR gaming for language learning (see also Reinhardt & Thorne, 2020). Gaming does not by any means provide automatic benefits for language learning, but if used, as here, within a carefully planned and supportive framework of learner training and wrap-around activities, it can add an exciting alternative to regular learning activities. Integrating into gaming use both linguistic tasks and reflective practices invites more focused attention on language, thereby helping learners to develop metacognitive skills (Godwin-Jones, 2014). That process can also demonstrate to students the affordances of leisure and entertainment materials for lifelong language learning. Designing gaming environments for language learning can bring substantial benefits, as student interest is likely to be high. Simon (2022) found that to be the case in using the *Elixir* game (available in multiple languages) which features an invisible sorceress providing instructions, involving actions like poking a dragon's belly, chasing runaway eyeballs, or immersing ones virtual hands in a cauldron. Here the learning also comes through wrap-around language activities, while the sorceress provides the entertainment.

#3) Simulations for Experiential Learning

Blyth (2018) points out that to be maximally beneficial to longer-term learning, experiential VR projects should allow for ample opportunity to reflect on the experience. He cites as a prime example *global simulations*, in which an entire community or environment, such as a street or village, is created for extended role-playing. The "global" in the term references the fact that it is "comprehensive, and tasks and activities are fully integrated within the broader project" (Michelson & Petit, 2017, p. 139). For global simulations in educational settings, students playing the roles of fictional characters interact in an immersive simulation, such as living in a Parisian apartment, as in Michelson and Dupuy (2014). In that study, students enact the roles of the apartment dwellers; each given a specific identity tied to friends/family relationships, profession, personal interests/hobbies, personalities, etc. After playing out those roles in the VR scenarios presented, the students discuss with each other the experiences of French urban living, family relationships, and other aspects of everyday life in Paris. This kind of debriefing following experiential VR is an essential component of the learning process and is particularly important in gaming environments (see Crookall, 2010; Reinhardt & Thorne, 2020).

Experiential learning through simulation is one of the most important benefits of VR for language learning, especially when designed to enable learner collaboration. The role-play represented here is quite different from the episodic, tourist-oriented experiences typically featured in role-play activities in commercial VR products. For maximum benefit, global simulations are carried out over an extended period of time and integrated into the curriculum. Levine (2004) describes global simulations as "simultaneously an approach, a set of classroom techniques, and the conceptual framework for a syllabus" (p. 27). In that article, the author emphasizes the importance of setting up a structure for the simulation which incorporates specific tasks that needed to be carried out in the target language and involves real-world connections. He gives as an example a simulation for an intermediate German class in which students performed a variety of tasks to set up a retail store in Germany, including investigating different locations in Germany, deciding together on which youth-oriented products to sell, and pitching their idea to a set of potential investors.

The simulations in Levine (2004) were based on students creating Web pages, using Web template software. A later simulation (Mills, 2011) was conducted through *Facebook*. Michelson and Petit (2017) added additional social media and tools such as *Google Docs*, *VoiceThread*, and *eComma* (a digital social reading tool). Today immersive VR offers the possibility of making the experience more realistic and graphically authentic, as well as offering enhancing multimodal elements such as audio narration, animation, and varying viewing perspectives. Characters can be represented as avatars with the ability to interact in the VR space and connect through apps such as *Immense* or *vTime*. Additionally, the setting in which the simulation takes place can be a version of *mirror worlds*, in which a specific location is duplicated in a digital, virtual space (Kelly, 2019).

A virtually mirrored site can provide a true-to-life cultural representation, with the possibility of incorporating neighborhood characters (represented as non-playing avatars) that could play appropriate roles (local baker, street vendor, policeman, etc.) in the simulation. Mills et al. (2020) in a beginning French course used a similar approach to create a microcosm of life in Paris by having four actual Parisians from different backgrounds and who lived in the same space—in and around La Place de la République—record their personal, social, and professional lives with a 360° camera for a two-month period. The videos, along with other materials, were then put together into a VR program (using *WondaVR*) that introduced life in Paris through those different cultural narratives. The students subsequently participated in a global simulation in which they themselves took on roles as Parisians. Mirror worlds used in global simulations can provide multiple layers of information with the additional possibility of past representations of a particular space. That could enhance considerably the quality of historical simulations, as in the project described in Péron (2010) involving French apartment dwellers in 1939. As discussed below, one could envision AI-powered chatbots playing a significant part in conversations within global simulations, taking on specific identities with assigned characteristics.

#4) Virtual Exchange and Cultural Learning

Across the VR projects discussed thus far, reflective activities are important in linguistic and cultural development. Self and group reflection is particularly important for the development of intercultural awareness and communication competence through the use of virtual exchange (sometimes labeled telecollaboration). Integrating VR into virtual exchange is an area of growing interest, but often difficult due to cost, compatibility, and other technical and practical issues. Typically, learners on both ends of an exchange need to have the same VR equipment or opt to use low-immersion alternatives. That may help to explain why in Hein et al.'s meta-analysis (2021), the development of intercultural competence was listed as the least frequently researched topic among VR projects. Using VR can provide more intimate and immediate rendering of exchangees' locations, as well as offering a compelling space for holding conversations. The *vTime* app has been used for that purpose in studies involving exchanges (Liaw, 2019) and for speaking practice within domestic groups (Thrasher, 2022). Compared to standard videoconferencing software such as *Zoom* or *Skype*, collaborative VR software offers multidimensional exchanges (Bonner et al., 2023). The ability to incorporate nonverbal communication more fully brings VR exchanges closer to real-world communication. That allows learners to engage in practical, pragmatic communicative practices, as discussed in Taguchi (2021; 2023, this issue). Sociopragmatic language development has been a feature of VR since the early CALL days and is discussed more fully in the next section.

An innovative approach to VR in virtual exchanges is discussed in Baralt et al. (2022). This project involved English and Arabic learners in the US. Algeria, and Morocco. Students used inexpensive Google Cardboard viewers in virtual exchange sessions to perform real-world tasks in a VR space. Topics discussed and presented in VR scenarios included expected themes such as food culture and family relationships, but also more expansive and socially sensitive topics like Muslim communities in the US or tourism issues in Algeria. The activities promoted cultural awareness and problem-solving in students' local communities through the use of linguistic landscapes and the creation of 360° videos shared among all participants. The project's goals are ambitious, targeting both language and cultural understanding: "Language learning is designed to happen as a result of becoming a global citizen; with Virtual Tabadul, students achieve language proficiency by completing real-world tasks that promote global awareness and that serve their community" (p. 172).

Similarly, Yeh et al. (2022) targeted intercultural learning through having EFL students in Taiwan create VR content depicting local sites of cultural significance. Interactive content was added, then uploaded to the *EduVentures VR* app (from the Chinese University of Hong Kong) and shared and discussed in the target language. Lan (2020a) points out that 360° videos, which can be created with apps like *Discovery VR*, are well suited for creating immersive field trips or guided tours. *Google Expeditions* has been a popular choice for engaging in this VR experience (Craddock, 2018; Xie et al., 2019), but it is unfortunately no longer available, as is true for *Discovery VR*. The inexpensive commercial app *Wander* can be used for this purpose (Uebiyev & Baydar, 2023). Tytarenko (2022) used 360° images and video from *YouTube VR* and *360 Cities* to combine art experiences (outdoor art installations, sculptures, museums) with Russian-speaking activities. Cultural learning through a VR tour of London was featured in Shih (2015), which used *Google Street View* of London sites loaded into the *Blue Mars VR* tool.

#5) Kinesthetics and Special Learners

In addition to visually based learning, VR can also be used to generate kinesthetic-oriented learning (Lan, 2020a). VR environments typically track a variety of bodily movements, including head turning, walking, arms manipulation, and hand/finger actions. Cheng at al. (2017) used the ability of a VR system to track upper body movements to enable students learning Japanese to experience bowing in connection with greetings in Japanese, adapting the language learning game *Crystallize* (Culbertson et al., 2016) for that purpose. Vázquez et al. (2018) took advantage of a room-scale VR environment to have learners enact motions and gestures in combination with learning vocabulary through the app *Words in Motion*. Using VR in this way aligns with theories of embedded cognition that learning is situated and enhanced when physical actions are associated with learning activities; according to 4E cognition theory, body movements can aid cognitive processes (Godwin-Jones, 2023). The incorporation of nonverbal communication was studied in a Taiwan-Spain virtual exchange project which uses the social VR platform *Spatial* (Chen & Sevilla-Pavón, 2023). Interestingly, the study found that nonverbal resources such as head movement and gestures used "most commonly used by the participants to solve communication breakdown and reach comprehension when negotiating meaning" (Chen & Sevilla-Pavón, 2023, p. 127).

Special learners, including those on the autism spectrum or with attention deficits, may profit from the alternative learning approaches offered through VR. VR can offer a safe, less socially challenging environment. For many VR users, the anonymity or masked identity of avatars in VR is welcome. Liaw (2019) discusses several ways in which indirect, more abstract interactions through avatars are advantageous to learners who suffer from difficulties in normal social situations. She reports on studies that have shown positive transfer for such learners from VR experiences to the real world. Lan et al. (2024) created a game-based learning environment in *Second Life* to enhance linguistic communication skills in children with attention deficit hyperactivity disorder. Lan (2020b) reported on a student on the autism spectrum who benefited significantly through using immersive VR in developing Chinese writing competence. In describing the activity, he mentioned liking the ability to "walk around in pictures" (Lan, 2020b, p. 12), a wonderful description of what an immersive VR experience can be.

VR from an ecological perspective

The value of VR for language learning can be understood from a variety of theoretical perspectives, including spatial/multimodal learning theories and ecological frameworks. Immersive VR enables the creation and use of dynamic multimodal texts which provide a strong sense of *presence*, the "transformation of the contextual surround, taking users to destinations that can be seen, heard, and felt" (Karimi et al., 2023, p. 27). The learner has the impression of being embedded in and embodied in the VR space, providing the "illusion of non-mediated connectedness" (Karimi et al., 2023, p. 27). Because actions and movements trigger dynamic or scripted responses in the VR application, the learner can have a sense of personal agency, using both the learner's body and mind to engage in the experience. With some exceptions, VR software for language learning takes little advantage of object manipulation or touch, as typically users select options from an app's menu with a finger click (Berns & Reyes-Sánchez, 2021). Because the user feels embodied in immersive VR, there is an expectation that the system will be responsive to user actions and movements. If the system does not register a gesture as expected, that may limit the sense of *presence* felt by the user, leading to reduced user engagement. This can have a negative impact on the sense of flow in a gaming or simulation environment, lessening learner interest (Lan, 2020b).

The VR experience can involve social interactions, so that there is a sense of *copresence* (Kronenberg & Poole, 2022). Lin and Lan (2015) trace the history of "open social virtualities" that emphasize interactions among users such as in *Second Life* or *Active Worlds* (p. 486; see also Sykes et al., 2008). Player interactions have a major role as well in the motivation to engage in massively multiplayer online games such as *World of Warcraft* (Sykes et al., 2008). None of these platforms were designed for language learning but have shown to be effective vehicles for incidental learning for some users. The degree to which that is true varies considerably. Individual differences among learners play a significant role in learner receptivity and learning outcomes (Hein et al., 2021; Legault et al., 2019). Users with prior experience in 3D gaming are most likely to embrace a VR learning opportunity. Because backgrounds in this area vary so significantly, many VR studies have emphasized the importance of user training. Kronenberg and Poole (2022) have students first play a non-VR version of the game used before going to the lab for VR. In that way, the students could focus on learning how to navigate the VR system rather than having to learn how the game works. In fact, cognitive overload has been shown to be an issue when students are simultaneously learning how to function in the VR while also engaging in processing an L2 (Llyod et al., 2017). That has been shown to be the case for AR use as well (see Wen et al., 2023; this issue). Although pre-task activities have long been recognized as important in task-based language learning (Ellis, 2003), task preparation is vital for immersive VR in that the technical, physical, and emotional dynamics added to the potential L2 challenges could be overwhelming for unprepared learners.

An approach that has shown to be useful in motivating learners and engaging their interest in VR is to invite them to create VR themselves. That can range from making 360° videos, as in Baralt et al. (2022), or actually helping create a virtual world, as in Karimi et al. (2023). Wu et al. (2019) had Taiwanese medical students design their own role-play scenarios (in English) for use in VR doctor-patient relationship training (built with *Omni-immersion vision*). Wang and Sun (2022) found that having 10th grade English learners in Taiwan co-create VR narratives (using *CoSpaces VR*) was more highly motivating than 2D or paper versions (see also Guo & Lan, 2023). Yeh and Lan (2018) found that having elementary school English learners collaboratively build their own VR environments (using a tool developed on the *OpenSim* platform) was highly motivating and enhanced learner autonomy. Lan (2020a) discusses a variety of VR creation tools and points out that students involved in collaborative VR creation "will engage in critical thinking, collaboration, problem-solving, and self-directed learning" (p. 7), likely enhancing learner autonomy and engagement. Due to its popularity among school-aged children, *Minecraft* has been used in educational settings to have students create their own virtual worlds to share (Gallagher, 2015). That includes use in language learning (Egbert & Borysenko, 2018; Craft, 2016; York, 2014).

One of the reasons that explorative and experiential implementations of VR represent attractive alternatives to applications which use fixed dialogue or vocabulary practice is that in that way learners can experience the dynamic give and take of authentic human communication. Although there is often in articles about VR claims about its "authenticity", that is a stretch in describing preset role-play scenarios. Authentic human language is spontaneous and contingent, dependent on context, such as the background identities of the interlocutors, their relationship, the purpose of the exchange, the physical (or virtual) setting, and the previous utterances in the current conversation or in previous conversations. Closed role-play scenarios lack the features of spoken interactions, as typical features of interactions such as turn-taking and collaboration are not present (Taguchi, 2021). Real-world conversants seek to establish common ground through negotiation and accommodation, and, as Taguchi (2021) points out, through nonverbal means such as gestures or gaze. That process is fluid; socially appropriate body language is "co-constructed" (Taguchi, 2021, p. 616).

Since VR enables both verbal and nonverbal semiotic resources to be used, it can be an ideal vehicle for pragmatic language use and learning. An early use of VR for pragmatic learning was described in Vilar-Beltrán and Melchor-Couto (2013), where they used *Second Life* to create scenarios in which invitations in Spanish were accepted or refused, having students develop the appropriate language around that speech act. Taguchi (2021) provides an example of experimenting with immersive VR for pragmatic language learning. Native and non-native speakers of English completed versions of a role-play scenario involving requests in both a standard computer-based version in which participants read a written scenario on screen and recorded their responses and an immersive VR version. In interviews with participants, the major finding that emerged was that the VR version evoked greater emotional resonance. Taguchi states that "The actual presence of the interlocutor and a direct face-to-face interaction with him made participants feel nervous and anxious, prompting them to attend to their language use even more" (p. 195). The author concludes that the VR scenario was realistic enough, close enough to the real world, to provoke emotional reactions. Taguchi (2021) urges further investigation into VR and pragmatics, which she labels "still unexplored territory" (p. 198). Taguchi (2023; this issue) herself explores one road into that territory in a project which uses 360° VR videos to assess gains in abilities to practice intercultural conflict mediation.

The closeness to the real world that VR is capable of generating has suggested to researchers that immersive

VR may represent a way to learn an L2 that is more analogous to how one learns an L1 than is the normal instructional approach to SLA. That has been applied in particular to vocabulary acquisition in that the names of objects, for example, are learned in the L1 at home, where there is a direct, concrete connection made between an (auditory) word and its meaning (through its physical manifestation). Given its simulation of the real world, immersive VR may offer a way to map lexical items more effectively than in the classroom to meanings (Ma & Yan, 2022). That theory seems to have been borne out through the use of new noninvasive neuroimaging techniques. Employing that approach, Li and Jeong (2020) found that brain patterns during the use of immersive VR fostered long-term memory.

It is relatively straightforward to measure learning outcomes in VR (at least short-term) for discrete areas of L2 competence like vocabulary when practiced through role-play or specific lexis-directed activities. More complex abilities, such as speaking or socio-pragmatic competence, are more difficult to measure. VR studies have shown mixed results overall, and particularly in reference to improving speaking ability (Dhimolea et al., 2022). This is due in part to the fact that VR use is usually a one-time or short-term intervention, not something integrated into the curriculum. According to Bonner et al. (2023), "few studies have moved beyond the novelty of single lesson be our experiences" (p. 45). Relatively small numbers of learners are targeted in most VR studies. There are likely multiple reasons for that limitation. VR equipment remains expensive and is subject to becoming outdated fairly quickly. For both AR and VR, the software can suddenly no longer be supported. That is the case even for popular and widely used platforms. AR mainstays *Aris* and *Aurasma* are gone, as is the popular *Google Expeditions*. It is also the case that setting up VR in instructional settings can be disruptive and time-consuming, possibly involving moving the class to a lab environment. In addition, an added issue is that headsets are awkward and uncomfortable and still too heavy to be worn for long. Motion sickness is not uncommon in VR use.

Dhimolea et al. (2022) conclude from an extensive analysis of VR for SLA that studies of VR so far show "potential rather than evidence" of usefulness in instructive language learning (p. 820). Indeed, studies have been inconclusive about the learning benefits of VR. A study of the same application (*Mondly*) used in a VR environment and as a mobile app showed no difference in outcomes, but students preferred the "usability" of the phone interface (Nicolaidou et al., 2021). One study cited in that article found VR to be less effective in terms of learning outcomes than the same material presented in *PowerPoint.* Given the practical barriers to VR use (Novash, 2022), meaningful, normalized integration of VR will necessitate showing teachers that VR can be more than a fun "tech day" episode. Lan (2020a) points out that without integrated learner-centered and sustainable activities, namely collaborative, problem solving, or discovery learning, VR will remain "just another fancy technology" that will lose support as its novelty fades (p. 3). It may be that for immersive technology to become mainstream, new alternatives for working through 3D content and its connection to the real world may be needed, as discussed in the next section.

Mixed Reality: The Wave of the Future?

It seems inevitable that VR headsets will become lighter and more comfortable as well as less expensive. A likely development is the greater growth of mixed reality devices, which support both AR and VR. Such hybrid headsets have been available for some time, like those from Microsoft (HoloLens) and Magic Leap. With the advent of Apple's Vision Pro, such devices could become more widely used. Apple has positioned its device as enabling "spatial computing," with the default use being oriented to AR, as the user sees apps and screens overlaid on a real-world view. A "digital crown" on the device controls the level of immersion, allowing for VR use. Google's demonstrated smart glasses have limited VR functionality and are less bulky than the ski goggle like appearance of the Vision Pro. The Google glasses feature simultaneous translations or transcripts displayed on-screen (Boxall, 2022). Such a device does not offer the immersive experience of head-mounted displays. While smart glasses may be able to capture head movements, they cannot register the use of gestures or tactile actions, although pairing with the handheld or worn device may be possible. Apple's Vision Pro introduces a novel approach using downward facing cameras to capture hand and finger movements, thus allowing control of the device without controllers, through gestures, voice commands, and eye tracking. The biggest advantage of the smaller footprint of smart glasses is the potential for more natural integration, both into everyday life and possibly for use in the classroom. Ideally, smart glasses would be owned by learners. Personal ownership entails wider use, personalization, and greater likelihood of integration of use into everyday activities that might involve language learning. That has been shown to be the case with smartphones (Godwin-Jones, 2017b). It remains to be seen, however, whether forthcoming devices will be affordable as well as mutually compatible.

Smart glasses are likely to increase the data flow from individuals, particularly if the devices include forward-facing cameras. The digital devices already in consumer use—smartphones, watches, smart wristbands—leave extensive digital trails. That data together with other personal digitized materials can be collected as a “lifelog”. Lifelogging has been available for some time, sometimes associated with the ‘quantified self’ community (Godwin-Jones, 2017a). Having access to a collected personal knowledge base has been shown to have positive effects in areas such as memory, self and social reflection, and cognitive abilities (Dingler et al., 2021). At the same time, lifelogging can be personally disruptive and disturbing. That was demonstrated in a VR version of a user's lifelog entitled “Bad trip” (Murray, 2013). For language learning, lifelogging has the potential to provide personalized learning help and encouragement toward lifelong learning. That is shown in the project discussed in Ogata et al. (2018) in which personal logs for language learners were maintained for ten years. According to the study, this provided “ubiquitous learning” with the ability to retrieve and review experiences connected to the target language. AI built into the system was able to find patterns and habits and thus make personal recommendations for revision and further study. The “Wordhyve” project (Hasnine & Wu, 2021) used lifelogs to enhance vocabulary learning through a recommendation system incorporating image analysis.

While lifelogging is designed to occur largely in the background, by passive and unobtrusive data collection, explicit data sources such as diary entries or photos may be integrated as well. At the same time, sensors have become available on wearable devices such as armbands and watches that monitor health by tracking measurements like heart rate and pulse. Some VR headsets have been developed with integrated physiological sensors. “Affective computing” technology looks at ways digital devices, through sensors and VR tracking, can measure moods and feelings. That aligns with “empathetic computing,” which looks at how computer systems can create greater understanding and empathy. Clearly, VR can play a significant role in that process in that users can be immersed in another person's view. The immersive movie, *Clouds over Sidra*, takes the viewer inside of the Za’atari refugee camp in Jordan from the perspective of a 12-year-old girl, following her through the day from her family's tent, to school, to a bakery, and to an athletic field. Similarly, the VR *Project Syria* takes us into a Syrian market where the user experiences a terrorist attack.

Such experiences can evoke empathy through the very realistic depiction in VR of real-world scenes, thus enhancing the feeling of actually being there and sharing their experience. The concept of ‘mirror worlds,” discussed above, has been used to describe the ability to duplicate digitally real locales. Once created, mirror worlds can be experienced remotely through VR (i.e., showing real-world events within a simulation), sometimes called *augmented virtuality*, or at the actual locale location through AR, with possibly VR participants integrated into the overlay as avatars. Versions of mirror worlds technology have been available for some time. Ibanez et al. (2011) used the open Java toolkit *Open Wonderland* to create a mirrored version of a boulevard in Madrid around which a set of interactive Spanish language and culture activities were created. Mirror worlds can provide multiple layers of information about a site, available through AR or VR, with users having different degrees of presence depending on the mode of access. We are seeing emergent technology which provides collaborative possibilities between AR and VR systems, such as *Microsoft Mesh*. The *Wearable RemoteFusion* system combines real-world capture with display options through AR or VR.

One of the features of mirror worlds is the possibility of creating digital layers that show the location in different time frames, offering interesting options for historical-cultural explorations, starting to be used in AR guided tours. A compelling example of the power of that kind of 4D (3D plus time) view of spaces is a project like *Child of Empire*. That is an immersive film developed as part of the Dastaan project, created by a non-profit that reconnects refugees from Pakistan, Bangladesh, and India to their ancestral communities through storytelling and films. *Child of Empire* features villagers left behind in Pakistan, interviewing older villagers and in one scene using a handheld map by a displaced villager to find familiar landmarks. The 360° videos and audio were made into VR and shown to the displaced. The project combines aspects of lifelogging (recalling past events) and mirror worlds.

Conclusion: Extended Realities in an AI World

Devices such as smart glasses as well as others supporting ambient intelligence offer a vision of an interconnected space in which language learning activities could be integrated into personal living spaces (Godwin-Jones, 2023). This would be a boon for autonomous language learning. We are already seeing commercial language learning apps which cater to independent learners. *Mondly*, for example, uses VR to provide an immersive environment which features a chatbot for individualized language practice. While the *Mondly* chatbot is scripted, recent developments in generative AI could enable chatbots to offer free-flowing conversations. An advanced AI chatbot integrated into an app could provide an opportunity to track AI-user interactions, which could generate a learner profile in terms of individual interests and language capabilities. That might provide the kind of adaptive, personalized learning that has long been a goal of intelligent CALL. We are already seeing in OpenAI's *ChatGPT* the capability of that chatbot to take on different roles in its interactions with users, namely conversation partner, but also tutor. Another model for this AI vision of the SLA future are social bots such as *XiaoIce*, widely used in China, which offer entertainment and companionship but could also provide incidental language learning (Godwin-Jones, 2022).

Chatbots can easily be integrated into immersive environments, as has been demonstrated by *Mondly* and other apps (Fryer et al., 2020). That provides the possibility of a chatbot using advanced intelligent avatars that could more effectively mimic nonverbal communication, such as displaying realistic facial expressions. *Spatial VR* enables learners to create from selfies realistic 3D avatars that are capable of lip-synching and facial recognition, allowing for interactions that incorporate nonverbal communication. Closer identification of a learner with personal avatars can enhance learning. As AI enables ever more realistic avatar construction, users may have a greater sense that the avatar is an extension of themselves or a second self. Of course, one of the popular aspects of avatars in gaming environments, is that an avatar can represent a more desirable or powerful version of the user. AI chatbots will need to be used with caution, given the unfiltered, potentially biased information through which they are trained.

While human conversation partners offer advantages not duplicated by AI, the anytime, anywhere availability of an AI living and learning companion would be of obvious benefit in a variety of learning environments. Such a development would represent “a change from the notion of a place to that of space or spatiality” (Hampel, 2019, p. 289). This aligns with the spatial orientation that has emerged in social science research and more recently in SLA and CALL studies (Klimanova & Lomicka, 2023) which postulates a closer, more interconnected relationship between the environment and humans. With the current wide usage of AI, that interconnection extends beyond the physical environment and others\humans present to incorporate embedded AI. That complex relationship of human-machine-language may be unwound with the help of ecological frameworks such as sociomaterialism or biosemiotics (see Godwin-Jones, 2023). The latter, based on pioneering work from biology pioneer Jakob von Uezküll, postulates a close reciprocal relationship between an organism and its environment. His concept of an organism’s receptivity to its *Umwelt* (an entity’s particular world) is based on the idea that all creatures—from amoebas to humans—are endowed with built-in mechanisms for recognizing and reacting to external stimuli. Biosemiotics offers an intriguing model for understanding the dynamics of VR. A VR system sends out stimuli—visual, auditory, haptic–to which we have a built-in sensitivity as humans. VR and the AI behind it become part of our *Umwelt*, establishing a natural, organic connection between us and the machine.

VR works because it aligns with the physical beings we have evolved to become. That point was made by a VR pioneer decades ago:

> Virtual reality reduces the need for abstract, extero-centric thinking by presenting processed information in an apparent three-dimensional space, and allowing us to interact with it as if we were part of that space. In this way our evolutionarily derived processes for understanding the real world can be used for understanding synthesized information. (Carr, 1995, p. 1)

That connection, once established, can make the VR system in which we are immersed and embodied lose its artificiality and become transparent, an accepted and integrated component of our *Umwelt*. Depending on how a VR system works—and how well it mirrors our world—the exchange of verbal and nonverbal signals may seem as natural and straightforward as a conversation around the water cooler. In that way, there is a merging of personal agency and control between humans and the VR system. We control actions in the VR space only within the limits of what the system allows us to do. As discussed in this column, some VR systems maintain tight control over interactions (role-play scenarios, vocabulary exercises) while others (social VR) provide for choice and user-based initiatives. The concept of shared or distributed agency is an idea central to sociomaterialism (Guerrettaz et al., 2021). From the perspective of sociomaterial theory, humans and non-humans (scripted VR and freewheeling AI) are 'entangled' and represent 'semiotic assemblages'. Multiple layers of information about spaces accessible through AR and the unpredictability of interactions in social VR make for a dynamic that can vary substantially depending on individual learners. That aligns with the direction in SLA and CALL that focuses on individual variation in learning trajectories (Benson, 2017; Larsen-Freeman, 2018).

Variation and unpredictability, interestingly, are part and parcel of generative AI, the systems built on "large language models" that have produced *ChatGPT*, as well as Google's *LaMDA* and *Bard* chatbots and Microsoft's *Bing*. Systems built on large language models generate texts (as well as images or video) on the fly in response to a prompt, with each iteration generating a unique artifact. That contrasts with traditional computer coding, in which software is written line by line, with programmers developing and understanding the entire process and being able to predict outcomes. Generative AI systems are in large part black boxes. They function not through linear code, but generate output based on patterns that the system itself has learned through translating huge sets of data (such as texts) into mathematical symbols ("vectors") and relationships ("parameters") and storing and accessing that information in multiple layers simultaneously ("artificial neural networks"). That kind of deep machine learning results in systems that the (human) creators don't fully understand and that cannot be accurately predicted (resulting in occasional machine "hallucinations"). Generative AI is certain to bring profound changes to XR. We are already seeing the ability of AI systems to generate not just texts from brief user prompts, but also images, audio, animations, and video (Metz, 2023). The resulting multimodal systems, built into VR environments, will be able to combine images, sounds, and video and, importantly, interact with users in dynamic, unscripted encounters. One could imagine, integrated into a VR app, fully embodied versions of virtual assistants (e.g., Siri, Google Assistant), enhanced with generative AI backends, assisting learners in achieving VR goals or completing tasks. By building on information stored in a system's user profiles and taking into account prior encounters and other individualized data, VR interactions could be transformed into rich, personalized learning experiences. Such a scenario foretells an interesting brave new world for language learning.

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