

## The Use of Virtual Reality to Reduce L2 Speaking Anxiety

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### Abstract

The Japanese Ministry of Education, Culture, Sports, Science, & Technology has issued a shift in the focus of English education from a test-focused grammar pedagogy to a four-skill communicative one by 2020, introducing new challenges for both teachers and students. One of those challenges is the increase in L2 speaking anxiety which students are experiencing in class. Public speaking anxiety and L2 speaking anxiety can both affect student L2 performance. Several anxiety-reducing methods exist but may not be appropriate for the language classroom.

This paper puts forward the argument that virtual reality exposure therapy (VRET) is a form of anxiety reduction which can be used in the L2 classroom. VRET has shown to be effective at helping people who suffer from a variety of psychological and anxiety related disorders. While its' application for treating learners affected by speaking anxieties is still on-going, the current research has been quite positive. Additionally, implementing VRET into a curriculum also provides students with more opportunities to use language in authentic settings, better preparing them for real world use. While some negative physical reactions,

such as visually induced motion sickness and other forms of visual discomfort, might happen with a few users, the perception of benefit and increased motivation which have been reported could encourage students to endure the initial discomfort. In the future, both VR headset and software developers should prioritize eliminating the discomforts associated with modern VR headsets.

## **INTRODUCTION**

One of the primary roles of a language teacher in the classroom is to identify learners that may be having difficulties producing language and addressing the needs of those learners. As primary and secondary school language classes in Japan have shifted from grammar-translation and exam-based grammar towards active communication as part of the Japanese Ministry of Education, Culture, Sports, Science and Technology's (MEXT) "English Education Reform Plan Corresponding to Globalization" (MEXT, 2014), an increased necessity for second language performance during class has increased the opportunities for public speaking anxiety (PSA) and L2 speaking anxiety to affect students. Anxiety has been identified as one reason which causes learners to have a kind of 'mental block' when in the second language classroom (Horwitz, Horwitz, & Cope, 1986). Anxiety is defined as "the subjective feeling of tension, apprehension, nervousness, and worry associated with an arousal of the autonomic nervous system" (Spielberger, 1983, as cited in Horwitz et al., 1986, p. 125). Whether with a partner, in a group, or during a presentation, PSA can interrupt the production of language. It is necessary, however, to recognize the differences in anxiety people experience.

People who are anxious in only specific situations versus those who are generally anxious are described as having a specific anxiety reaction by psychologists (Horwitz, 2010). One place that specific anxiety reaction can occur is in the foreign or second language classroom. More specifically, Horwitz et al. (1986) proposed L2 anxiety to be "a distinctive complex of self- perceptions, beliefs,

feelings, and behaviors related to classroom language learning arising from the uniqueness of the language learning process” (p. 128). Thus, anxiety is a causation of the language learning process itself, which can, in turn, impact the learner’s ability to perform well using their L2.

Horwitz et al. (1986) classified three types of anxiety in the classroom: Communication Apprehension (CA), Test Anxiety (TA), and Fear of Negative Evaluation (FNE). CA refers to “a type of shyness characterized by fear of anxiety about communicating with people” (Horwitz et al., 1986, p. 127). Gordon and Sarason (1955) described TA as a type of performance anxiety caused by a fear of failure (as cited in Horwitz et al., 1986). The third form of language learning anxiety, FNE, is defined as an apprehension about others’ evaluations, avoidance of evaluative situations, and the expectation that others would evaluate oneself negatively (Watson et al., 1969, as cited in Horwitz et al., 1986).

Anxiety specifically linked to language acquisition has been shown to negatively impact a learner’s ability to learn and perform when using L2. Horwitz et al. (1986) explained that learners that suffer from any specific anxiety in the classroom may experience similar psycho-physiological symptoms such as apprehension, worry, dread, poor concentration, forgetfulness, increased sweat, and palpitations. Moreover, these learners could also show signs of avoidance behavior such as missing class and postponing homework. These symptoms have been shown to affect the production of speech in terms of grammar forms used, communication strategies employed, and length of compositions (Kleinmann, 1977; Steinberg & Horwitz, 1986).

Researchers have proposed treatments for specific anxiety reaction for decades. Wolpe (1958, as cited in Heuett & Heuett, 2011) proposed Systemic Desensitization. Based on the idea that feelings of anxiety and relaxation cannot occur at the same time, situations are created to replace anxiety responses with those which people find more relaxing. Skills Training assumes the anxiety stems from the lack of skill required to give a speech, and thus focuses on

improving skills related to speech giving (i.e., organization, posture, eye contact, vocal variety, and gestures) (Ayres & Hopf, 1993, as cited in Heuett & Heuett, 2011). Visualization (VIS), based on the idea that perception influences when one feels anxious, aims to replace negative thoughts with positive thoughts through imagery (Ayres & Heuett, 1977, as cited in Heuett & Heuett, 2011). More recently, through technological innovations, Virtual Reality Exposure Therapy (VRET) has been receiving attention due to its success in aiding in the treatment of several psychological disorders (e.g., acrophobia, Hodges et al., 1994; obsessive-compulsive disorder (OCD), attention deficit disorder (ADD), post-traumatic stress disorder (PTSD), Parkinson's disease via augmented reality, and Internet-mediated visualization therapy in behavior therapy (North, North & Cole, 1996, as cited in Heuett & Heuett, 2011). Therefore, with such a wide range of applications, the possibility for VRET to reduce anxiety in the classroom must also be considered.

## **VIRTUAL REALITY**

It is important to first understand what Virtual Reality (VR) is and how it compares with other forms of media and interactive computer graphics displays. VR is defined as “an immersive computer-enabled technology that replicates an environment and allows a simulation of the participant to be present and interact in that environment” (Lloyd, Rogerson, & Stead, 2017, p. 222). Computers have been able to display the basics of VR since the early 70s – images generated by a computer and sent to a display system to provide sensory information to the participant whose position and orientation are tracked in order to update the images accordingly. The type of VR similar to what is on the market today only started to appear in the 1980s, but was not commercially available until the early 90s. Within the realm of VR devices, the method and level of immersion also differentiate. For example, the Cave Automatic Virtual Environment (CAVE) is described as a “Virtual Reality Theater”, in which images are displayed on

the wall while the participant looks at them with purpose-built tracked glasses (Cruz-Neira, Sandin, & DeFanti, 1993). Three-dimensional (3D) environments which are displayed with a monitor or projected have also been described as VR, however, for the purpose of this study, only VR which includes the use of a head-mounted display (HMD) is considered.

An HMD is a device worn on the participant's head, isolating their vision from the real world so that each eye can only see one of two displays separated from the other. These displays show a stereo "image [which] is computed and rendered separately with correct perspective from the position of each eye with respect to a mathematical description of a 3D virtual scene" (Freeman, Reeve, Robinson, Ehlers, Clark, Spanlang, & Slater, 2017, p. 2). In order to immerse the participant, the HMD position and orientation are continuously tracked so that the images correspond to the participant's head gaze direction. Additionally, the images, or frames, are updated at a very high rate – no less than 60 frames per second (FPS) if possible. This immerses the participant in a fully rendered 3D environment.

The goal of any successful VR system should be immersion of the participant, which is achieved through the perception of natural movement. The primary differences between VR and traditional multimedia systems is the sense of presence in conjunction with devices used to interact with the environment (Held & Durlach, 1992; Bryson, 1992; Sheridan, 1992). Hodges et al. (1995) defines presence as "the sense of being physically present in a computer generated or remote environment" (p. 9). Presence is the illusion of being in a place rendered by VR (Freeman, Reeve, Robinson, Ehlers, Clark, Spanlang, & Slater, 2017). It is this sense of presence that gives VR its defining quality (Loomis, 1992; Naiman, 1992; Sheridan, 1992; Zeltzer, 1992). In their taxonomy of sense of presence, they identify fidelity and extent of sensory information, consequences of participant's actions, and gestalt of the participant as the three primary determinates. Slater (2004) revises this into two concepts: place illusion (PI) and

plausibility illusion (Psi).

Drawn from the active vision paradigm, PI requires the participant to experience the VR environment through sensorimotor contingencies (Noë, 2004, as cited in Freeman et al., 2017). The active vision paradigm suggests that “we perceive through using our whole body, via a set of implicit rules involving head turning, leaning, reaching, looking around and so on” (Freeman et al., 2017, p. 2). PI showcases what VR technology is capable of. Current HMD systems can match the movement of the participant’s head, therefore ‘fooling’ their brain into believing the virtual surroundings are real. Psi describes the ‘believability’ of the virtual world (Noë, 2004, as cited in Freeman et al., 2017). The real world is not static. The air moves around the room, noises from outside can be heard, and people can be seen moving about their day. While these may seem unimportant, when similar models are added to a virtual world, they can make it feel more ‘alive’, better connecting the participant to the VR environment. Moreover, the world must also react to the participant and their actions. For example, if there are virtual characters present in the simulation, they should appropriately react to what the participant is doing. Psi better reflects the complexities within the VR environmental software itself.

Improvements in computer components have allowed modern VR devices (i.e., headset displays, hand controllers, sensors) to make significant improvements in the realm of PI. Current commercially available computers are significantly faster than those available in 1991 (Galouchko, 2012). Additionally, 3D accelerated graphics cards, which use their own graphics processing unit (GPU) and memory to display graphics at a higher fidelity and speed and have been available since 1995, have also seen significant advancements. As a result, VR display manufacturers have been able to gradually increase the fidelity of their display outputs over the years. As Table 1 shows, the resolution, field-of-view (FOV), and refresh rate have all increased as computers become more capable.

The high specifications of contemporary VR devices positively correspond to

Table 1

*Optical characteristics of representative head mounted displays.*

Representative HMDs	Year	Weight (g)	Hz	FOV (°) horizontal/vertical/diagonal	Resolution (pi × els)
Virtual Research Flight Helmet	1991	1670	–	100° diagonal	360 × 40
Virtual research V6	1995	821	60	60° diagonal	370 × 277
Virtual research V8	1998	820	60	60° diagonal	640 × 480
Glasstron PLM-50	1996	–	–	33.75° diagonal	–
Division PV100	1998	–	–	60° × 46.8°	–
ProView™ x L 50	1998	–	–	35° diagonal	1024 × 768
Virtual I/O i-glasses™	1995	226	–	30° × 23.6°	263 × 230
Visette 2	2000	–	60	105° × 41°	–
EyeTrek FMD-700	2000	105	56–75	28.5° × 21.1° × 35.5°	800 × 600
Emagin Z800 3DVisor	2005	226.8	60	20.8° diagonal	800 × 600
EMG iTheater BP4L	2005	78	–	23.2° × 17.4° × 29.0°	320 × 240
MicroOptical MyVu MA-0341	2006	70	60	12° × 8.8° × 14.9°	320 × 240
Vuzi x iWear AV920	2008	82	60	22.7° × 17.6° × 28.7°	640 × 480
Zeiss Cinemizer 1488-603	2008	115	–	20.8° × 15.4° × 25.9°	640 × 480
NVIS nVisor S x 111	2010	1300	60	102° × 64°	1280 × 1024
Google Glass	2013	–	–	14° diagonal	640 × 360
Oculus Rift DK 1	2012	220	60	110° horizontal	640 × 800
Oculus Rift DK 2	2014	320	75	100° horizontal	960 × 1080
Samsung Gear VR	2015	318	60	96°	1280 × 1440
Oculus Rift	2016	470	90	90° × 110°	1080 × 1200
HTC Vive	2016	555	90	110°	1080 × 1200
HTC Vive Pro	2018	470	90	110°	1440 × 1600
Oculus Quest	2019	571	72	90° × 110°	1440 × 1600

Note. Adapted from “The Visual Effects Associated with Head-Mounted Displays”, by J. Yuan, B. Mansouri, J. H. Pettey, S. F. Ahmed, & S. K. Khaderi, 2018, *International Journal of Ophthalmology and Clinical Research*, 5, 2. 2018 by “Yuan J., et al.”.

increased presence for participants. Refresh rates of under 60 hz in combination with FPS below 60 have been reported to induce feelings of motion sickness and nausea (Hunt, 2016), making the experience unbearable for the participant

in many cases (Yuan et al., 2018). Additionally, several studies have shown that FOV impacts a participant's sense of presence (Seay, Krum, Hodges, & Ribarsky, 2001, as cited in Fernandes & Feiner, 2016; Youngblut, 2006; Cummings & Bailenson, 2015). Patterson, Winterbottom, & Pierce (2006) suggested 60 degrees FOV as the minimum requirement to attain a complete sense of immersion. Moreover, increased FPS, decreased end-to-end latency, and haptic feedback also all contribute to presence (Meehan, Razzaque, Insko, Whitton, & Brooks, 2005). Modern day VR headsets can display higher resolutions at higher refresh rates and FPS in combination with a larger FOV. It is through these points that current VR headsets have improved both fidelity and extent of sensory information, thereby increasing the overall PI, and, consequently, presence in the participant.

## **VR AND EXPOSURE THERAPY**

In terms of application for treating anxiety, exposure treatment has been one of the most common methods (Freeman, et. al, 2017). Exposure therapy is defined as “the process of helping a patient approach and engage with anxiety-provoking stimuli that objectively pose no more than everyday risk without the use of anxiety-reduction ‘coping’ skills” (Abramowitz, Deacon, & Whiteside, 2019, p. 4). VRET, one of the many types of exposure therapy, has become more prominent in recent literature. Research includes the comparison of VRET to in vivo (Kampmann, Emmelkamp, Hartanto, Brinkman, Zijlstra, & Morina, 2016), and VRET in combination with cognitive behavioral therapy (VRCBT) versus traditional CBT (Bouchard, Dumoulin, Robillard, Guitard, Klinger, Forget, Loranger, & Roucaut, 2017).

While VRET has shown to be effective with social anxiety, there have also been several studies on VRET for public speaking anxiety (Ayres & Heuett, 1993; Heuett & Heuett, 2011; Wallach, Safir, & Bar-Zvi, 2009). Wallach, et al. (2009) highlighted the drawbacks of both natural setting (in-vivo) and imagina-



tion (in-vitro) exposure components of CBT. In-vivo tends to be more costly, time-consuming, difficult to manage external circumstances, and have possible issues with privacy. In-vitro therapy can be problematic for participants who cannot imagine things clearly or who flood themselves with images or avoid imaging the situation altogether. Therefore, VRET becomes a desirable alternative due to its ability to mitigate the drawbacks of both in-vivo and in-vitro therapy. Additionally, Wallach et al. (2009) reported that VRCBT was more effective in treating public speaking anxiety than waiting-list, and as effective as CBT plus imagery exposure.

Heuett and Heuett (2011) tested the efficacy of VRET on trait CA (Levine, & McCroskey, 1990), state CA (Speilberger, Gorsuch, Lushenes, Vaggs, & Jacobs, 1983), Willingness to Talk (WTC) (McCroskey & McCroskey, 1988), and Self-Perceived Communication Competence (SPCC) (McCroskey & McCroskey, 1988) in comparison to visualization treatment (Ayres & Heuett, 1993, as cited in Heuett & Heuett, 2011). Their results report that VRET showed a significant decrease in both trait and state CA, and a significant increase in WTC and SPCC. While trait CA, state CA, and WTC showed a positive improvement compared to VIS treatment, SPSS showed significant improvement with VIS more so than VRET. Even so, improvement of all four variables still indicated significance meaning that VRET has the potential to reduce public speaking anxiety.

## **STUDENT RESPONSES**

Since the early 1990s, VR efficacy in the classroom has been a highly discussed topic. While the usefulness and effectiveness of VR technology as an educational tool is important, learner reactions to the technology also affects its viability in the classroom. Therefore, it is necessary to look at the literature on learner perceptions and attitudes towards using VR technology as an educational tool.

Studies on learner perceptions have given insight on the potential of VR and dealing with its drawbacks. Learner perceptions are critical to the success of

VR in the classroom (Davis, 1989; Taylor & Todd, 1995; Nair, 2012). Learners who hold a perceived usefulness for VR as a language learning tool have more positive attitudes towards the technology, leading them to willingly use it (Majid, Ismail, Kassim, Kassim, & Bakar, 2018). Majid et al. also recommended that learners be told the benefits of VR so that, in the case of initial discomfort, learners might choose to continue with VR due to the perceived advantages. Therefore, by educating the learner about VR prior to use, the teacher might be able to help learners overcome any initial negative experiences with the technology or with their own anxiety.

Motivation is another factor on which VR can have a large impact. Several studies have shown the immersive quality, novelty, and interaction VR offers all have positive effects on improving learners' motivation (Bricken, 1999; Huang, Rauch, & Liaw, 2010; Limniou et al., 2008; Sims, 2007). Roussos, Johnson, Moher, Leigh, Vasilakis, and Barnes (1999) observed increased retention of symbolic information and more interest in a VR class due to immersion in comparison to a non-immersive class. Therefore, it is possible that through its positive impact on motivation, VR has the potential to help students who struggle with public speaking activities.

VRET also helps prepare users for the target activity. Since VR allows the user to rehearse speaking in virtual environments, practice which is typically impossible to do during class (e.g., speaking in front of a large audience, speaking at a location outside of the classroom) becomes an option. Students rarely can practice a speech in front of a large audience beforehand. Using VR, students can get the necessary experience presenting in front of a large group to help build their confidence and comfort level, which in turn encourages speaking (Mak, 2011). This suggests that students who do not suffer from PSA can still benefit from using the headsets in class, as it gives them a chance to practice. Therefore, while reducing anxiety might be a priority for a teacher who implements VR, there are secondary benefits as well.

## **IMPLEMENTATION**

Bringing VR to the classroom has its own set of challenges. However, within the past five years, innovations in HMD technology have reduced most of the difficulties that previously prevented the possibility of a wider adoption of HMD classroom use. With well-known tech companies like Google, Facebook, Samsung, and Valve investing heavily on HMD development combined with display technologies becoming smaller, higher resolution, and lower cost, to resulting commercially available products have made VR much more accessible than its predecessors. Thus, with a now widely accessible platform, software companies have also been focusing more on VR-specific applications. This has caused an influx in higher spec HMDs and applications, leading to a decrease in cost to the user.

### **Standalone units**

For most of their existence, VR devices have not been practical for classroom use. HMDs required a computer to render and generate the images necessary for the participant to see. Since the computer was not in the HMD units, they required a connection to a nearby computer, typically via wire, restricting the area of use and portability. While this may not impede home use or use in a designated room like a computer lab, the bulkiness of these systems made them unfeasible for the classroom. However, with standalone units (e.g., mobile device mounts and all-in-one) being commercially available, methods of how to effectively implement VR at home and in the classroom are becoming more of a reality. Compared to traditional HMDs, these standalone units offer increased portability, reduced classroom interruption, and do so at a greatly reduced cost.

One of the primary benefits of standalone units, specifically mobile device mounts like Google Cardboard, is increasing the opportunity for practice. Due to its small size, students can easily store the HMD in their bag or suitcase. Without the need of cables or a bulky computer to display the VR images,

users can transport and use the HMD practically anywhere. This shows that any teacher intending to use VR doesn't have to restrict it to classroom use only, and that the learner has opportunities outside of the classroom to practice with the technology.

Historically, VR devices have been quite expensive, priced at more than thousands of yen per unit. However, with Google Cardboard, the cost of a single headset can be as low as a few dollars in the case of the user already having a smartphone. It has been reported that Japan has a mobile phone penetration rate of 96.6 percent for people over the age of 14 (“Japan Demographics Profile”, 2018; “Number of...”, 2016). Of the 106.8 million mobile phones in Japan, 70.09 million are smartphones, a penetration rate of 65.6 percent (“Sumātofon no riyōsha...”, 2019). A recent study (“Kodomo no”, 2017), found that more than approximately 91.5 percent of Japanese high school students own a smartphone. With such a high percentage of smartphone ownership among Japanese high school students, it is estimated that university students also see similar rates. Therefore, the implementation of Google Cardboard at a Japanese university language classroom would be a rather inexpensive process.

## **Software**

Recently, several companies have released public speaking practice applications for HMD devices. VirtualSpeech VR, by the company Virtual Speech, is a free application for iOS, Android, the Samsung Gear, and Oculus Go. As seen in Figure 1, the application gives the user the opportunity to experience public speaking in an authentic virtual setting by exposing the user to a life-like virtual audience and venue. The locations used in the various software generally mirror real world situations, such as, but not limited to, a classroom, a conference room, a job interview, a press conference, and an office presentation, giving the user a chance to practice in a virtual environment that could be quite similar to the actual experience. The user can also import their presentation slides which will



Figure 1. Presentation hall virtual environment taken by Virtual Speech from the application *Virtual Speech VR*, Virtual Speech, 2019. <https://virtualspeech.com/product>

then be displayed in the virtual environment and can be manipulated to change the displayed slide within the application, giving a full presentation experience. The application mostly follows the Skills Training method, in addition to VRET, to help reduce public speaking anxiety by providing the user with numerous in-app videos which introduce effective public speaking skills. In addition to this, the application features a paid version which offers additional training videos, locations, and, as shown in Figure 2, a speech analyzer which tracks head movement, voice control, and tempo. After the speech, it will tell the user how much eye control they gave the audience, words per minute, and hesitations. This kind of information could be useful in building confidence in the user, further increasing their motivation. While lacking in certain features, the free version does still allow for VRET-based PSA treatment, making it a low-cost tool for teachers.

Commercial availability of inexpensive, portable HMD devices in combination with recent software developer interest has helped reduce the technical and financial challenges of classroom implementation. This will hopefully encourage educators and researchers to more widely pursue the use of HMDs in reducing PSA for L2 learners, hopefully leading to a deeper understand and



Figure 2. Speech analyzer feedback taken by Virtual Speech from the application Virtual Speech VR, Virtual Speech, 2019. <https://virtualspeech.com/product>

clear framework on HMD implementation. Affordable VR in the L2 classroom is still relatively new, but the potential for aiding students suffering from L2 anxiety demands further investigation.

## CURRENT VR DRAWBACKS

VR technology is not without its drawbacks. While companies are continuously improving HMD features and the software that they require, there is still much that needs to be done to create safe, comfortable, immersive headsets. Any educator planning on exploring this technology in their classes should understand the limitations of and risks involving HMDs. Some of the most commonly discussed complaints include visually induced motion sickness (VIMS), visual discomfort, and software concerns.

One common symptom caused by HMDs throughout their development has been VIMS. Keshavarz (2016, p. 148) defines VIMS as “a specific form of traditional motion sickness and can occur in users of Virtual Environments (VEs), such as in driving or flight simulators or during video games.” The main difference between VIMS and traditional motion sickness is that VIMS is a

physical reaction to visual stimulation during limited or absence of physical movement. It occurs when there is a mismatch between the sensory input and what the brain expects to experience (e.g., conflicting position and movement cues) (Kennedy, Drexler, & Kennedy, 2010; Ukai, & Kibe, 2003). This is known as a visual-vestibular mismatch, causing various symptoms including nausea, stomach discomfort, disorientation, postural instability, and visual discomfort (Keshavarz, 2016; Yuan et al., 2018). Errors with the position-tracking sensors which cause a time-lag between the real-world movements and the virtual avatar can also lead to VIMS. Another cause of VIMS is low resolution, as looking at unclear images can be uncomfortable for many people. High FOV, while improving presence, does have the drawback of increasing the chance of VIMS (Becker & Ngo, 2016). The optical design of the HMD itself might be incompatible with some users, leading to further visual discomfort or fatigue. Table 2 further explains conditions which may further exacerbate or minimize the effects of VIMS. Until HMD designers and VR software developers better understand the causes of VIMS and how to prevent them completely in their products, it is vital for users to be aware of the steps necessary to reduce VIMS.

Many studies have found that visual discomfort, such as eyestrain, dry eye, tearing, foreign body sensation, feeling of pressure in the eyes, aching around the eyes, headache, blurred vision, and difficulty focusing, often occurred with participants (Yuan et al., 2018). Researchers have observed that after 10 minutes of HMD use, about 60 percent of users experienced eyestrain, headaches, and nausea (Mon-Williams, Wann, & Rushton, 1993; Howarth & Costello, 1997; Lampton, Rodriguez, & Cotton, 2000; Kuze & Ukai, 2008). Additionally, visual discomfort symptoms have been reported to continue after removing the HMD (Yuan et al., 2018). Aaltonen and Pölönen (2009) found that longer usage of HMDs results in increased eyestrain discomfort. Increased discomfort for the user leads to decreased immersion, so avoiding extended periods of usage is necessary. Any discomfort has the potential of interfering with an anxiety

Table 2

*HMD induced VIMS observations and recommendations.*

Observations
<ol style="list-style-type: none"> <li>1. Lighter HMDs are associated with a decrease in discomfort;</li> <li>2. Monocular presentations should be avoided, as they are associated with more discomfort compared to binocular and dichoptic presentations;</li> <li>3. Exposure to VR in sitting position may decrease VIMS;</li> <li>4. Complex visual tasks and reading may increase VIMS severity;</li> <li>5. Rapid vection results in an increase in VIMS symptoms.</li> </ol>
Recommendations
<ol style="list-style-type: none"> <li>1. Manufacturers need to be attentive to system characteristics of the devices they develop and market;</li> <li>2. Users should be advised that children, women, users with visual field defects, postural instability, or history of motion sickness may be especially prone to VIMS;</li> <li>3. Inexperienced users are especially susceptible to developing VIMS, and users are different in their adaptation to HMDs;</li> <li>4. Users should be warned to not use HMDs for a long period of time, and to take frequent breaks;</li> <li>5. Users should avoid driving or operating heavy machinery after exposure to VR until VIMS and postural instability resolve.</li> </ol>

Note. Adapted from “The Visual Effects Associated with Head-Mounted Displays”, by J. Yuan, B. Mansouri, J. H. Pettey, S. F. Ahmed, & S. K. Khaderi, 2018, *International Journal of Ophthalmology and Clinical Research*, 5, 2. 2018 by “Yuan J., et al.”.

reduction treatment session and could completely prevent further sessions if the participant has a severe enough experience.

In addition to the physical discomfort that HMDs can cause, there are a few more caveats to using the technology. Bonner and Reinders (2018) pointed out several considerations, such as familiarity time, privacy and security, and, in the case of Google Cardboard, access to capable smartphone devices.

Hardware companies have focused on delivering technology that is designed to be used and handled by more casual users. VR devices, and the software



running inside them, is no different. Although the technology is becoming more user-friendly, there will still be an initial time investment for the teacher and students to become familiar with the HMDs and software. The initial time spent showing students how to prepare and wear the HMDs is quite disruptive to the class. However, once the students become familiar with the technology and software, using the headsets becomes quite trivial, like asking them to take out a calculator during a mathematics lesson. Therefore, it is important that the teacher take this into consideration when deciding on whether to use HMDs in the classroom.

Software can also raise several concerns. In the case of mobile software, students would be expected to download and install the software on their own personal devices. Data privacy is becoming an ever-increasing issue in the modern age, and many companies rely on obtaining and selling personal user data as their business model. “Social apps may access and keep an updated history of the users frequented locations for ad purposes, while more nefarious apps may request access to the phone’s microphone or camera, or scan a user’s browser history or access other sensitive content” (Bonner et al., 2018, p. 50). Understanding which permissions an application might request upon installation, what data it might need to function, and if that data is kept private must be known in order to protect students’ privacy.

Consumer VR is still in the early adopter phase. Content companies are still relying on their start-up investments to delivery inexpensive software to users, but as those companies start to focus more on profits, many of the free services and software they once provided will begin to decrease. It will be important for teachers to keep informed about the software they choose to use and confirm that the software or desired features of the free versions remain the same.

Finally, it is important to consider the different socio-economic situations for each student. Relying on students to use their own smartphone as the display unit means those who do not have one, or who have one with a cracked screen and

are unable to repair them, would require an alternative method to participate, or risk being alienated. Some ways to accomplish this would be having classmates share with each other or having backup devices on hand in case students need to use one.

For VRETs to be more applicable as a general tool, advancements in accessibility are required. VIMS and visual discomfort issues are current roadblocks to the widespread adoption of HMD technology. However, in the future it will likely be minimized as companies reiterate on the technology. Adding a frame of reference to the scene can help reduce the effect of VIMS (Yuan, et al., 2018). Until then, those choosing to use HMDs should do so with caution to help minimize these drawbacks.

## **IMPLICATIONS FOR FUTURE DEVELOPMENT**

While the understanding of how VR technology and software elicit VIMS is increasing, there are steps that need to be taken to reduce the alienation of those who are more susceptible to it. Until VIMS and visual discomfort are eliminated, software should include options for visual anchors which reduce FOV (Becker & Ngo, 2016) (e.g., car dashboard, airplane cockpit). Although a decrease in FOV reduces presence, it also helps reduce the effects of VIMS. Additionally, software studios should also ensure that their program can consistently run at 60 FPS or higher. Increased presence through immersion is another challenge, but one-to-one hand tracking is just one of many ways to achieve this (“Introducing...”, 2019). Finally, cost, albeit slowly dropping in price, is still quite prohibitive for wide adoption. Although great strides have been made in recent years, with standalone HMDs like the Oculus Quest, Oculus Go, and Samsung Gear becoming available, widespread adoption is still unfeasible for such a niche product. Mobile device mounts like Google Cardboard are still the most desirable due to the prevalence of smartphones. HMD technology is developing rapidly, so many of the concerns today may only be short-term.

This paper argues for the implementation of VRET in the L2 classroom, however, further research is necessary to establish VR as a vital tool for students. Research on larger, more diverse samples to add to the generalizability of the findings is needed (Heuett & Heuett, 2011). The psychological makeup differences between PSA for males and females may require different approaches. While there have been studies on PSA in L2 classrooms (Heuett & Heuett, 2011; Carinan & Beuno, 2019), studies on PSA and VRET with Japanese university students are few. Additionally, more comparative studies about the efficacy of VRET in the classroom versus outside of the classroom (e.g., at home) and whether having a teacher facilitate VRET versus students doing it on their own would better illustrate how to implement VR into a curriculum. Cross-cultural comparative studies are needed to determine the extent cultural background may also affect the efficacy of VRET, which software developers should also consider when deciding locations, virtual objects, colors, and character design to use. Lastly, comparative studies on the efficacy of VRET between mobile device mounts and standalone units is needed to see if the need to use the more expensive HMDs exists.

## CONCLUSION

By the 2020, Japan is attempting to restructure its approach to English education. By focusing more on the communication aspect of foreign language study, students in Japan are faced with an ever-growing demand to perform in a foreign language. As a result, students who show signs of PSA or L2 speaking anxiety are increasing. These anxieties have shown to impede language production. To better attend to these students' needs, it is imperative to implement anxiety management tools and techniques viable for the classroom.

VRET has shown to be effective in dealing with various anxieties. Specifically, it has been shown to be as successful as other types of anxiety reduction techniques, while having several important advantages over them. In-vivo is not

feasible for the classroom in some situations due to being unable to recreate certain environments. In-vitro provides little benefit to those who cannot imagine a situation well. Moreover, while not all students experience PSA or L2 anxiety to the point of affecting their output, VRET participants still benefit from in-class practice time, meaning the time of those who do not require the treatment is not wasted during a VRET activity. This allows VRET to supplement any in-class discussion activity in which the learner is preparing a speech or presentation. Additionally, it would be worth studying to see if there are any crossover effects of VRET and L2 speaking anxiety during pair or small group conversations.

Further advancement of the technology and software is still necessary to increase user presence and decrease discomfort. As headset displays increase in resolution, framerate, FOV, and tracking, ways of mitigating visual discomfort and VIMS should be made a priority. Whether or not all symptoms of VIMS can be eliminated for all users is still unclear, so software developers should prioritize including VIMS reduction techniques such as visual anchors. Further research on in-software methods to reducing VIMS is necessary.

Finally, this study primarily considered the most prominent modern VR headsets (i.e., produced by Google, Facebook, Valve, Sony), with Google Cardboard being emphasized the most. Therefore, future research should expand to include modern headsets available to consumers.

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