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# Efficacy of virtual reality in reducing fear of public speaking: A systematic review

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**Abstract.** Public speaking is no doubt one of the most feared mode of oral communication. Such anxiety is often treated through cognitive behavior therapy (CBT). An arising alternative to this treatment is virtual reality exposure therapy (VRET) where user confronts feared stimuli in a controlled 3D environment designed for such purpose. Sense of presence in this medium elicits similar feeling when standing in front of a real audience. Because of this, several studies were conducted to test its effect on individuals suffering from PSA. This paper attempts to look into the undertakings of studies within the last 10 years with the objective of gaining enlightenment on the efficacy of virtual reality in reducing public speaking anxiety. From Google Scholar search engine and online libraries PLOS ONE and ScienceDirect, 14 were short-listed for final review based on the set inclusion/exclusion criteria. Findings of these studies reveal that VRET can be as effective as CBT, and more advantageous in terms of cost-efficiency and manageability. The use of virtual reality is then highly recommended as a tool for treating PSA. It is worth noting that the length of time spent in this therapy is a great factor in its efficacy.

## 1. Introduction

Public speaking is one of the most feared mode of oral communication. Survey from decades ago reveals one third of the general population experience anxiety when speaking to a larger audience, and a third of this group report some clinically significant distress or impairment due to their public speaking anxiety (PSA)[1]. In an analytic study with 1135 undergraduates aged 17-58, 63.9% reported fear of public speaking, and 89.3% would like their undergraduate program to include classes to improve public speaking [2]. This condition is treated with cognitive behavioural therapy (CBT) that usually includes vivo exposure therapy. The procedure includes allowing the patient to physically encounter the feared factor until patient begins to understand that nothing fearful results from such encounter[3]. The long-term effectiveness of such treatment is evident even from earlier studies[4].

Virtual reality is well-known for its highly immersive digital 3D environment. The realistic graphics in VR gives a real sense of presence that arouses genuine emotions from user, causing them to respond as if it were real. Recreating situations and managing stimuli in this controlled environment is more cost-effective than collecting and arranging physical objects for the vivo procedure[5]. This is why the use of VR as an exposure medium became a point of interest for authors in psychology, leading them to explore this alternative treatment known as virtual reality exposure therapy (VRET). Studies demonstrated that the use of virtual reality systems in the therapeutic setting yields a promising outcome [6][7]. This is true across different phobias. In terms of attribution, a recently conducted meta-



analytic examination indicated that virtual reality exposure and in vivo exposure therapy show similar rates of attrition[8].

While VRET is generally found useful for treating different kinds of phobia, the focus of this study is on the efficacy of VR in reducing public speaking anxiety. There is a rising demand for a good public speaking skill in the business industry, especially so that in business, marketing, sales pitches and advertisement would require such skill. One of the greatest hindrance to a persuasive speech is simply the fear of speaking in front of an audience. In vivo therapy for this scenario could be difficult to manage since it would involve a good number of people to serve as an audience. Studies were conducted to test the effect of VRET to public speaking with varying results. This paper digs into the undertakings of studies within the last 10 years with the goal of gaining enlightenment on the efficacy of virtual reality in reducing public speaking anxiety through a systematic review guided by Khan's Five Steps in Conducting a Systematic Review[9]. Speakers who wish to overcome this fear can gain insight from this paper and evaluate whether resorting to this treatment is worth the investment.

## 2. Methodology

Online library PLOS ONE, ScienceDirect, and search engine Google Scholar was used to collect papers for this review. For PLOS ONE, a search for the keywords "virtual reality for public speaking", with specified filters (Article type: journal article; Where my keywords appear: title; Publication Date: January 2009 to September 2019), yielded one result. Similar search settings in ScienceDirect resulted to a list of 8 papers, while in Google Scholar, 34 results. A quick scan through the list showed a couple of duplicate studies and three were written in foreign language. First screening process was then performed to remove these duplicate papers and those written in foreign language. Second screening process selected only those in line with the context of this review, and with consideration of the exclusion criteria (type of research: systematic review, commentary, developmental). Final list of papers were summarized according to methods and outcomes.

## 3. Findings

Out of 24 studies filtered from the first screening process, 10 were excluded. Two were out of context such that one tested the effect of stereoscopic viewing on presence, anxiety and cyber-sickness in VR, and the other is on the effect of level presence but not comparing it to a control group. Two did not measure PSA, and the rest of the excluded papers were about the design and development of VR software or framework for public speaking. Test procedures to prove their usability or efficacy were not discussed in the manuscript. The final list of reviewed papers are listed in Table 1.

### 3.1. Methods

The total number of participants in all the reviewed papers is 630. There were 54% students, 34% are of recorded public anxiety level and the rest (12%) are randomly selected, of ages 18 through 60. Among the diverse scales utilized in measuring public speaking anxiety level were Liebowitz Social Anxiety Scale (LSAS) [10][11][12], Self-Statements during Public Speaking (SSPS) [13], Attitude Towards Public Speaking (ATPS)[14], Personal Report of Confidence as a Speaker (PRCS) [13][15], and Personal Report of Public Speaking Anxiety (PRPSA) [16], Personal Report of Communication Apprehension (PRCA)[17], and Public Speaking Anxiety Scale (PSAS)[18]. A study also utilized heart beat rate and skin conductance meter [14] for objectivity. Fifty seven percent (57%) of these papers compared VRET to either a cognitive behaviour therapy (CBT) treatment [10][19][11] or a control group [20][14][13][21] – those who did not receive any treatment at all.

### 3.2. Outcomes

Virtual reality is able to elicit public speaking distress and exposure to it is found to cause distress habituation [15]. This makes it a useful tool in coping with fear [14][12][22][23] as compared to mere visualization [17] or imagination technique [20]. These reports come from studies whose participants engaged with VR once, yet with promising outcome. There is one study that reported no improvement

on PSA after immersing in VR [15]. Authors of such study highlighted, however, that participants only had one session in VR. They were instructed to complete a 5-minute mock public speaking task to a virtual audience while wearing 3D glasses. The control group delivered their speech to the researcher.

**Table 1.** Final list of reviewed papers

No	Title	Year	Participants				VR Session	PSA Scale	Reference
			VR	CBT/CT	Control	Total			
1	Virtual Reality Cognitive Behavior Therapy for Public Speaking Anxiety: A Randomized Clinical Trial	2009	28	30	30	88	7	LSAS; SSPS	[10]
2	The effectiveness of 3-D video virtual reality for the treatment of fear of public speaking	2010	20			20	6	SPSS	[24]
3	Virtual reality exposure versus Cognitive Restructuring for Treatment of Public Speaking Anxiety: A Pilot Study	2011	20	28	30	78	7	LSAS	[11]
4	Virtual Reality Therapy: A Means of Reducing Public Speaking Anxiety	2011	40	40	40	120	1	PRCA	[17]
5	The use of doppelgangers in virtual reality to treat public speaking anxiety: a gender comparison	2014	21		20	41	1	PRCA	[20]
6	Virtual reality therapy: an effective treatment for the fear of public speaking	2015	7		7	14	5	ATPS	[14]
7	The effect of virtual reality exposure on fear of public speaking using cloud-based software	2016	65		33	98	6	PRCS	[13]
8	Beat the Fear of Public Speaking: Mobile 360° Video Virtual Reality Exposure Training in Home Environment Reduces Public Speaking Anxiety	2017	35			35	4		[25]
9	Overcoming public speaking anxiety of software engineers using virtual reality exposure therapy	2017	6			6	1	LSAS	[12]
10	Therapist-led and at-home one-session Virtual Reality exposure therapy for public speaking anxiety using consumer hardware and software, with online maintenance: A randomized controlled trial	2017	25		25	50	4	PSAS	[18]
11	Public speaking anxiety decreases within repeated virtual reality training sessions	2018	19			19	1	PRCS-2; Heartrate	[15]
12	Behavioural therapy and virtual reality exposure for public speaking anxiety	2019	6			6	6	SSPS	[22]
13	A pilot of acceptance and commitment therapy for public speaking anxiety delivered with group videoconferencing and virtual reality	2019	15			15	6	Not indicated	[23]
14	The effects of immersion and presence in a virtual reality public speaking task	2017	20		20	40	1	PRPSA	[16]

After completing the task participants then completed the PRPSA. Findings revealed no improvement to PSA after participating in such task and increased immersion did not significantly reduce fear of public speaking within one session. Nevertheless, all the other reviewed papers came to a unanimous conclusion that VRET was successful in reducing PSA among participants, even equal to CBT[11][19], and decrement was strongest in participants with initially high speaking anxiety baseline levels[25]. Additionally, Lister's study reported an increase in confidence and positive self-statements [13]. Finally, the level of presence in VR did not have significant effect on the PSA level of participants. Simple consumer VR hardware [18] and VR 3D video displayed using a standard CRT television[24] successfully triggered fear response and was used for the treatment.

### 3.3. Extracted Pre- and Post-treatment PSA levels

In this section, the mean PSA level of participants in the reviewed papers are presented. The attempt to gather all participants' mean PSA levels on pre- and post-treatment was only successful in five papers shown in Table 2. This is because three of the other papers were abstract-only and the rest with full paper did not indicate numeric data. Instead, they presented data in graphs without specified value.

To highlight the changes on the PSA level of participants, the difference between pre- and post-treatment was computed. The percentage value of decrease is also presented. The percentage of decrease in the PSA level of participants ranged from 7.8% up to 54.7%, with mean value of 29.2 %. Those who had the highest record of pre-treatment PSA level (65)[12] showed a decrease of 46.2%; while those who had the least (14.55) [24] only had 15.7% decrease. These data support the findings of Stupar-Rutenfrans' study where VRET is found more effective when aimed at reducing high-state anxiety levels[25].

**Table 2.** Extracted PSA levels before and after treatment

Title	PSA Level		Difference	Percentage of decrease
	Pre-treatment	Post-treatment		
Virtual Reality Cognitive Behavior Therapy for Public Speaking Anxiety: A Randomized Clinical Trial	19.39	8.79	10.6	54.7
The effectiveness of 3-D video virtual reality for the treatment of fear of public speaking	14.55	12.27	2.28	15.7
Virtual reality exposure versus Cognitive Restructuring for Treatment of Public Speaking Anxiety: A Pilot Study	30.8	28.4	2.4	7.8
Virtual Reality Therapy: A Means of Reducing Public Speaking Anxiety	16.7	13.1	3.6	21.6
Overcoming public speaking anxiety of software engineers using virtual reality exposure therapy	65	35	30	46.2
			<b>Mean =</b>	<b>29.2</b>

### 3.4. Limitations of the reviewed studies

While the findings of the reviewed papers yielded a strong evidence to support the efficacy of VR in reducing PSA, some limitations in the undertakings were found. First, majority of the measurement tool utilized was self-report. Only 1 out of 14 studies utilized technical measures (heart rate and skin conductance) in addition to self-report scale for testing the effect of VRET to fear of public speaking. Self-report can be biased in this aspect since subjects are expecting to improve in their anxiety level after the treatment. Second, there is lack of comparison between VRET and control group. Out of the 14 studies, only 8 compared VRET to a comparison group. Findings would have been more robust if a control groups were included for comparison.

## 4. Conclusion

Having positive reports from 13 out of 14 reviewed studies, and with the support of T-test analysis, this paper finds VR as an effective tool in reducing PSA. The tool is then recommended to speakers as an alternative treatment for PSA since it is portable, manageability, cost-efficient, and more convenient to use anywhere at any time. A close look at the single study that reported no significant effect of VRET to PSA leads this paper to suggest that the efficacy of virtual reality as a tool for reducing PSA is highly dependent on the length of time user is exposed to such medium. While a specific number of sessions cannot be recommended due to lack of studies in this aspect, users are advised to undergo VRET as needed for habituation. Findings of this review call for authors to further their research and explore other features of VR that could complement its ability to elicit real-life emotions (through sense of presence) and make it more useful not only in reducing PSA but also in enhancing public speaking skills.

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