Virtual Reality and Its Potential for Stress Therapy

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ABSTRACT: VR technology is the combination of AI technology, multimedia technology, computer networks technology, computer graphics technology and designed into a new HCI technology through which users can experience and interact with 3D environment using visual, auditory, haptic, taste, and so on interactions, similar to real-world experience. This paper explored the virtual reality and its potentials for stress therapies. Implications and future researches were also discussed

INTRODUCTION

The utilization of Virtual reality has been successfully adopted and implemented in several domains to serve different purposes. Its applications can be seen in medicine and healthcare industries (Schijven & Jakimowicz, 2003; Dunkin et al., 2007); its applications can also be seen in education and training (Makransky & Lilleholt, 2018); VR application can also be seen in engineering and automobile industries (Berg & Vance, 2017). VR applications can also be seen in scientific discovery(Johnston et al., 2017); one of the most successful applications of VR applications can be mostly seen in the gaming and entertainment industry (Zyda, 2005). Another successful domain in which VR has been applied in healthcare as can be seen in the treatment of phobia through exposure therapy (VRET – Virtual Reality Exposure Therapy) and other domains of therapy and rehabilitation (Brinkman, 2012; Opriş et al., 2012; Parsons, 2015; Rizzo et al., 2015). VR offers a range of benefits which includes suspension of disbelief, involvement and engagement in a virtual environment, peripheral awareness, immersion, and presence. All of which enables the user to be immersed into a virtual world, giving them or a realistic feeling of "being there" in a place different from the user's original physical present location (Diemer, Alpers, Peperkorn, Shiban, & Mühlberger, 2015; Murray, Neumann, Moffitt, & Thomas, 2015; Wu, Wang, Zhao, & Wu, 2015).

VIRTUAL REALITY & MODALITIES

Touch (haptics), sight (visual) and sound (aural) provides the best options for developing VR systems which is testament to the fact that majority of the works and resources in this domain, focused on exploring these three alternative modalities which limit our focus to these three key elements of VR: haptics, aural and visual modalities. VR is dependent profoundly upon visual display and presentation, and therefore, it does not come as a surprise that vision and visual interactivity is the most useful of the senses, and a very valuable modality for understanding space. Invariably, one cannot truly experience VR without any sort of visual interaction. As we well know, geographic representations for instance, are usually majorly visual in nature; making people's ability to see inevitable in order to access and understand them. Therefore, visually impaired users possess very limited or no access to them and navigating the virtual environments they represent as explained by Jacobson, Kitchin and Golledge, (2002). The author added that the multi-modality is aimed at augmenting visual representations and does not seek to cater for users that are visually challenged. The visual Interactive nature of VR provides numerous advantages to what most users consider an adventure in an unknown territory like immersion, sense of

presence, suspension of disbelief, involvement and engagement, and peripheral awareness.

Visual Modality – Background and significance.

The potential and possibility to exploit the power of visualization and visual interaction, further motivated (Dayang R. Awang et al., 2011) into developing a VR application that enables the user to choose desired image from a selection of virtual world of images to utilize and explore the location in the course of the therapy, integrating visual and aural interactivity, instead of just using their imagination to imagine being at the location. Especially with the advent of "social interfaces" which involves computer generated characters that tries to interact with users in natural ways (Turk, 1996).The author in his study explored the utilization of fast, simple computer vision for the optimization and enhancement of visual interaction in social user interfaces (Turk, 1996).

Aural Modality – Background and significance.

Aural interaction alone in HCI provides a host of immeasurable advantages especially in disability or for visually impaired users. Aural interactivity carries with it the sense of presence or activity, giving one the sense of being in the company of someone, something or an activity. For instance, exploring an environment in a virtual world, walking down a street or using a character to walk down a street, the activities of other characters can be inferred from the sounds they are making: blacksmiths are pounding hammers on anvils; passing cars generate positional engine noise, and so on. There is a sense of on-going activities despite not being able to visualize the character or the activity. Aural interactions be it through music or other means makes a person to feel less alone (i.e., connected with something/someone else) or remind the person that an on-going activity is still going on (continuity), albeit been distracted momentarily by something or someone else (Parker & Heerema, 2008). The author also highlighted that aural interaction is known to carry more emotional content than any other modality that is to say that, sounds trigger feelings and memories. It is said by psychologists that humans learn first by seeing, next by hearing. However, the sense of hearing connects to the limbic system, where memories can be recalled using sounds like music and voices, and loud and sudden sounds cause an immediate startle reflex in fear(Brown, Martinez, & Parsons, 2004; Parker & Heerema, 2008; Winer, 2006), like the rumbling and growling sounds of a wild animal would trigger a fearful emotional response. Hence, it is certain that certain sounds would affect us at a profound emotional level which designers usually utilize to provide an interesting emotional experience in Virtual Reality.

Auditory, health, and well-being

Auditory has been instrumental in several domains for several purposes even in rehabilitation and stress relief which can be seen in how people use music in their everyday lives. Music for most people is more likely to be an element of comfort, source of inspiration, distress, expression of feelings, positive distraction, entertainment or company (Buchanan, 2013), i.e., performing a different task with music alongside as companion (for instance, dressing up for work, driving to or from work, some use music during physical exercise) rather than being the primary focus. In fact, in the extensive practice of music therapy in medicine and health care in the treatment of ailments like Alzheimer's disease and cancer, and as a positive stimulus in relaxation, pain, anxiety and stress relief (Daniel, 2016; Powell, 2016; Tam, Lo, & Hui, 2016; Trapp, Engel, Hajak, Lautenbacher, & Gallhofer, 2016).

Haptic Modality - Background and Significance

The terminology "*haptics*" or "touch" is a proliferating term in HCI with the growing use of touch in computing. And therefore lots of terms with diverse meanings are still being used across literatures to refer to haptic interactivity, limiting the consensus and common understanding in the research domain. In remedying that, the author put forward this set of

haptic related definitions as shown in the Table 1.

Table 1: Haptic Definitions *(Oakley, McGee, Brewster, & Gray, 2000)*

Term	Definition
Haptic	Relating to the sense touch.
Proprioceptive	Sensory information about the state of the body (including cutaneous, Kinesthetic, and Vestibular sensations).
Vestibular	The perception of head position, acceleration and deceleration.
Kinesthetic	The feeling of motion, through the sensations originating in muscles, tendons and joints.
Cutaneous	Pertaining to the skin itself or the skin as a sense organ. Includes sensation of pressure, temperature and pain.
Tactile	Pertaining to the cutaneous sense but more frequently the sensation of pressure rather than temperature and pain.
Force Feedback	Relating to the mechanical production of information sensed by the human kinaesthetic system.

Role of Haptic Interactivity

Haptic interactivity through touch provides direct contact with other persons or an object which relies on active exploration (Klatzky & Reed, 2016)could have various benefits, interpretations and outcomes depending on the context, situation, person, area being touched and so on. Meanings such as: support, appreciation, inclusion, sexual interest or intent, affection, playful affection, playful aggression, compliance, attention-getting, announcing a response, greetings, and departure.

Multimodal Interactivity

Multimodal interaction is the equipping of users with multiple choice of modalities to interact with a system that reacts and interprets to users' inputs from more than one modal and interaction channel(Dumas, Ingold, & Lalanne, 2009; Dumas, Lalanne, & Oviatt, 2009; Sarter, 2002), be it through aural, gestural, gaze, facial expression, body movement, and touch. Jacobson, Kitchin and Golledge(Jacobson, Kitchin, & Golledge, 2002) also added that multimodal interaction in VR consist of interaction through several interactive input and display devices like keyboards, joystick, mouse, monitor, alongside other peripheral devices for speech recognition, eye gaze tracking, gesture tracking, data gloves, tactile feedback from surface textures, head mounted displays, force feedbacks, etc. Reeves et al (2004) explained that the two main aims of multi-modal interactions are to achieve an interaction closely similar or identical to the natural human-human interaction style, and to increase the interaction's robustness through the use of redundant complementary information.

Virtual Reality and Stress Therapy

Virtual Reality Stress Therapy (VRST) application's or technologies are applications or technologies that permits users to enter, explore and interact with computer-generated environments with the use of the multi-sensory modalities such as sight, sound, and touch enabling them to combat stress.

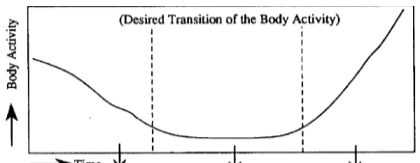
Stress according to the Oxford dictionary is "a state of an affair involving demand on physical or mental energy" which can upset the normal psychological and physiological performance of a person. This drops the mental and physical activity of the person and is a major factor of issues such as; hypertension, insomnia, onset of malignancy, depression, digestive disorders, diabetes, herpes lead from various problems like irritability, quickness to anger, lack of concentration, decrease in mental and physical activity, eye fatigue, stiff shoulders, drowsiness, neck ache, back ache, discursiveness and lack proper judgment (Nakajima et al., 1994; Bagheri-Nesami et al., 2014).

Pressure, frustration and conflicts are the most common sources of stress. In situations when a person is stressed, the brain prepares the body for defence "The fight or flight response" through the release of stress hormones (cortisone and adrenaline) which raises the blood pressure and prepares the body to respond to the situation (Grewal & Shekar, 2008; Sahai, 1996), with a good defensive response, the stress hormones in the blood are used to up reducing the effect of stress and anxiety symptoms. But with a poor defensive response, when the body fails to counter the challenging stressful situation, the hormones and chemicals remain unreleased in

the bloodstream for a long period of time which ends up resulting to stress-related physical symptoms like unfocused anxiety, dizziness, rapid heartbeats, tensed muscles (Life Positive Foundation, 2012).

The stress response is activated by the sympathetic nervous system, and all stress therapies target the initiation of the parasympathetic nervous system which is concerned with recuperation, stress relief and relaxation, allowing the body to attain the state of "Homeostasis", and lessening the body from the likelihood of stress related health issues (Song & Song, 2005).

One of the applications of VRST can be seen in the VR Relax-Refresh system applying virtual reality technology for body massage by Nakajima et al., (1994). The VR Relax-Refresh system consist of a massage lounger that vibrates and massages (for body stimulation), a head mounted-display (HMD, for visual stimulation), a standard VCR (sound/aural stimulation), and an interface circuit that gears the massage chair and generates stereographic images. These three multi-modalities were put together by the designers to deliver body massage and sleep inducer via virtual space. By sitting on the lounger and putting on the head-mounted-display, the user goes through 3 stages this includes; the sleep-encourage stage, the sleep stage and the refresh stage as shown in Figure 1. Relieving the user of stress as the system puts the user to sleep with a varying degree of interaction and refreshing the user after some time duration.



Stimulations \ Stages	Sleep Encourage Stage	Sleep Stage	Refresh Stage
Visual Stimulation	Relaxing Images (mono)	Darkness	Refresh Images (stereo)
Aural Stimulation	Relaxing Music with body vibration	Quiet Music with Small Vibration	Loud Music
Body Stimulation	Soft Massage	None	Strong Massage

Figure 1: The experience story of the VR relax/refresh system (*Nakajima, Nomura, Fukusima, & Ojika, 1994*)

Another successful domain in which VR has been applied in health care as can be seen in the treatment of phobia through exposure therapy (VRET – Virtual Reality Exposure Therapy) and other domains of therapy and rehabilitation (Brinkman, 2012; Hooplot, 2005; Morina, Ijntema, Meyerbröker, & Emmelkamp, 2015; Opriş et al., 2012; Parsons, 2015; Rizzo et al., 2015). In VRET, multimodal interactivity is utilized to enhance the anxiety-producing stimuli to increase or decrease the effect on the patient while therapeutically combating the patients' worst fear. These stimuli are usually generated as a result of the patients strong, irrational fear for certain condition or situation such as fear of heights, fear of flying, agoraphobia, fear of spider, fear of driving, fear of public speaking and so on. VRET allows the therapist to regulate the induced anxiety in adjusting the multi-modal parameters of the virtual environment in the increment or decrement of the fear factor to match the users' level of tolerance. This, in turn, enhances the patients' immersion and sense of presence (Brinkman, 2012; Opriş et al., 2012; Parsons, 2015; Rizzo et al., 2015). The sense of presence or immersion is relatively essential in this form of therapy as it intensifies the patient's phobic responses. The authors indicated that VR environments can create a range of phobic symptoms, and the incorporation of sound and touch such as a furry spider greatly intensified the experience.

The stimuli in VRET are usually generated as a result of the patients strong, irrational fear for certain condition or situation such as fear of heights, fear of flying, agoraphobia, fear of spider, fear of driving, fear of public speaking and so on (Parsons, 2015). These stimuli were traditionally generated by in vivo exposure which involves directly facing a feared object, situation, or activity in real life or by having the patient imagine the stimulus in imagino therapy Bruce and Regenbrecht (2009). VRET allows another option of this exposure therapy which can be safer, less embarrassing and a lot more effective as compared to the realism of in imagino therapy and In vivo. In simulating and multimodal interactivity using VR, allows extra advantage of interactively. Identifying and

simulating the visual, aural, haptic and other modal aspect of the therapy not only enhances the sense of presence but also increases sense of realism, which allows the regulation of the induced anxiety in adjusting the parameters of the virtual environment by increasing or decreasing the fear factor to match the users' level of tolerance. The sense of immersion or presence is relatively essential in this form of therapy as it intensifies the patient's phobic responses, which indicated that VR scenes can produce a variety of phobic symptoms, and the incorporation of sound and touch such as a furry spider greatly intensified the experience.

Music therapy and guided image therapy are two applications where the aural and visual modality are utilized to produce positive stimulus to patients/users, inducing relaxation, pain relief, anxiety and stress relief (D R Awang et al., 2011; Barrera, Rykov, & Doyle, 2002; Buchanan, 2013; Daniel, 2016; Tam et al., 2016). The Bonny method of guided of Guided Imagery and Music (GIM) has been used in the inpatient psychiatric setting in the treatment of patients with post-traumatic stress disorder (PTSD) (Patterson & Nanni, 2015; Rizzo et al., 2015). This method allows access to the patients'/users' subconscious feelings, images, and memories and fosters empowerment and reconnection through self-understanding and an alliance with the therapist.

Foot reflexology is another therapy that has been tested and proven effective in countless studies for relaxation, stress relief, enhanced alertness, potential diagnostic tool, and as a complementary treatment tool which has(Choi & Lee, 2015; Hudson, Davidson, & Whiteley, 2015). Patients overall experience of the therapy was compared to using reflexology artifacts to conduct the therapy(Okere, Sulaiman, Rambli, & Foong, 2015), and revealed opportunities for VR. The potential application of VR in foot reflexology therapy was explored by (Okere, Sulaiman, Awang, & Foong, 2014a, 2014c; Okere, Sulaiman, & Foong, 2013; Okere, Sulaiman, Rohaya, Rambli, & Foong, 2014), and the requirements for application in VR was outlined by (Okere, Sulaiman, Awang, & Foong, 2014b; Okere, Sulaiman, Rambli, & Foong, 2016; Sulaiman, Okere, Awang, & Mean, 2016).

CONCLUSION AND FUTURE WORKS

Stress can seriously affect performance negatively, and also affect people's cognitive and emotional processes (Maples-Keller, Yasinski, Manjin, & Rothbaum, 2017). Therefore, knowing how to manage stress is very significant as it can have affect people's overall performance, as well as their emotional and physical health (Shiban, Peperkorn, Alpers, Pauli, & Mühlberger, 2016). Virtual reality allows clinicians to engage patients using multimodal interactivity tailored and customized for a specific purpose to combat stress or phobic symptoms, matching users' requirements or endurance threshold to the therapist's rehabilitation or recovery scheme. This may traditionally be too expensive or not feasible like where patients have to imagine these phobic stimuli in their minds during therapy, or using in vivo therapy or imagino therapy (Maples-Keller et al., 2017). Future research should also see other therapies like acupuncture, lomi-lomi, body massage, and so on, exploit the potentials and opportunities of VR for relaxation, stress relief and other complementary therapy purposes, by identifying and simulating the haptic, visual, and other interactions in the therapy.

REFERENCES

Awang, D. R., Suziah, S., Halabt, H., Abas, S., Peteras, B., & Mohd, Y. N. (2011). VReST: An image-based virtual reality stress therapy web application. In *in IT in Medicine and Education (ITME), 2011 International Symposium on* (pp. 733–737).

Awang, D. R., Suziah, S., Halabt, H., Abas, S., Peteras, B., Mohd, Y. N., … Mohd, Y. N. (2011). VReST: An image-based virtual reality stress therapy web application. In *in IT in Medicine and Education (ITME), 2011 International Symposium on* (Vol. 2, pp. 733–737). http://doi.org/10.1109/ITiME.2011.6132104

Barrera, M., Rykov, M., & Doyle, S. (2002). The effects of interactive music therapy on

hospitalized children with cancer: A pilot study. *Psycho-Oncology*, *11*, 379–388.

Berg, L. P., & Vance, J. M. (2017). Industry use of virtual reality in product design and manufacturing: a survey. *Virtual Reality*, *21*(1), 1–17. http://doi.org/10.1007/s10055-016-0293-9

Brinkman, W. (2012). A Virtual Reality Dialogue System for The Treatment of Social Phobia. *Environments*, 1099–1102. http://doi.org/10.1145/2212776.2212395

Brown, S., Martinez, M. J., & Parsons, L. M. (2004). Passive music listening spontaneously engages limbic and paralimbic systems. *Neuroreport*, *15*(13), 2033–2037.

Buchanan, J. (2013). *Tune In: A Music Therapy Approach to Life.: Use Music Intentionally to Curb Stress, Boost Morale, and Restore Health*. Hugo House Publishers, Ltd.

Choi, M. S., & Lee, E. J. (2015). Effects of Foot-Reflexology Massage on Fatigue, Stress and Postpartum Depression in Postpartum Women. *Journal of Korean Academy of Nursing*, *45*(4), 587–594.

Daniel, E. (2016). Music used as anti-anxiety intervention for patients during outpatient procedures: A review of the literature. *Complementary Therapies in Clinical Practice*, *22*, 21–23.

Diemer, J., Alpers, G. W., Peperkorn, H. M., Shiban, Y., & Mühlberger, A. (2015). The impact of perception and presence on emotional reactions: a review of research in virtual reality. *Frontiers in Psychology*, *6*(January), 1–9. http://doi.org/10.3389/fpsyg.2015.00026

Dumas, B., Ingold, R., & Lalanne, D. (2009). Benchmarking fusion engines of multimodal interactive systems. In *In Proceedings of the 2009 international conference on Multimodal interfaces*, (pp. 169–176). ACM.

Dumas, B., Lalanne, D., & Oviatt, S. (2009). Multimodal interfaces: A survey of principles, models and frameworks. In *in Human Machine Interaction Anonymous.* (pp. 3–26). Springer Berlin Heidelberg.

Hooplot, F. S. (2005). Design and evaluation of a new system for VRET for agoraphobia, (September), 1–71.

Hudson, B. F., Davidson, J., & Whiteley, M. S. (2015). The impact of hand reflexology on pain, anxiety and satisfaction during minimally invasive surgery under local anaesthetic: A randomised controlled trial. *International Journal of Nursing Studies.*, *52*(12), 1789–1797. http://doi.org/S0020-7489(15)00231-X

Jacobson, D., Kitchin, R., & Golledge, R. (2002). Multimodal virtual reality for presenting geographic information. *Virtual Reality in Geography*, 1–20. http://doi.org/10.4324/9780203305850

Johnston, A. P. R., Rae, J., Ariotti, N., Bailey, B., Lija, A., Webb, R., … Parton, R. G. (2017). Journey to the centre of the cell: Virtual reality immersion into scientific data. *Traffic*, (October), 1–6. http://doi.org/10.1111/tra.12538

Klatzky, R., & Reed, C. L. (2016). Haptic Exploration. In. In *Scholarpedia of Touch* (pp. 177–183). Atlantis Press.

Makransky, G., & Lilleholt, L. (2018). A Structural Equation Modeling Investigation of the Emotional Value of Immersive Virtual Reality in Education. *Educational Technology Research and Development*, 1–24. http://doi.org/10.1007/s11423-018-9581-2

Maples-Keller, J. L., Yasinski, C., Manjin, N., & Rothbaum, B. O. (2017). Virtual Reality-Enhanced Extinction of Phobias and Post-Traumatic Stress. *Neurotherapeutics*, *14*(3), 554–563. http://doi.org/10.1007/s13311-017-0534-y

Morina, N., Ijntema, H., Meyerbröker, K., & Emmelkamp, P. M. G. (2015). Can virtual reality exposure therapy gains be generalized to real-life? A meta-analysis of studies applying behavioral assessments. *Behaviour Research and Therapy*, *74*(NOVEMBER), 18–24. http://doi.org/10.1016/j.brat.2015.08.010

Murray, E. G., Neumann, D. L., Moffitt, R. L., & Thomas, P. R. (2015). The Effects of the Presence of Others during a Rowing Exercise in a Virtual Reality Environment. *Psychology of Sport and Exercise*, *22*, 328–336. http://doi.org/10.1016/j.psychsport.2015.09.007

Nakajima, R., Nomura, J., Fukusima, S., & Ojika, T. (1994). A Relax-Refresh System

Applying Virtual Reality. In *In Robot and Human Communication, 1994. RO-MAN'94 Nagoya, Proceedings., 3rd IEEE International Workshop on* (pp. 145–150). IEEE. http://doi.org/10.1109/ROMAN.1994.365940

Oakley, I., McGee, M. R., Brewster, S. A., & Gray, P. D. G. (2000). Putting the feel in 'look and feel. In *Proceedings of the SIGCHI conference on Human Factors in Computing Systems* (pp. 415–422). Hague, Netherlands. http://doi.org/10.1145/332040.332467

Okere, H. C., Sulaiman, S., Awang, D. R., & Foong, O. (2014a). Haptic Exploratory Interactions in Foot Reflexology Practice from the Practitioners Perspectives. In *Proceedings of the 2014 fifth International Conference on Intelligent Systems, Modelling & Simulation (ISMS), 2014 5th International Conference on* (pp. 496–501). IEEE.

Okere, H. C., Sulaiman, S., Awang, D. R., & Foong, O. (2014b). Using AHP approach to determine the hierarchy of multi-modal interactive importance in foot reflexology practice. In *User Science and Engineering (i-USEr), 2014 3rd International Conference on* (pp. 158–163). IEEE Computer Society.

Okere, H. C., Sulaiman, S., & Foong, O. (2013). An Exploratory Study on the Prospect of Virtual Reality's Key Multi-sensory Elements in Traditional Foot Reflexology. In *Proceedings of the 2013 1st International Conference on Artificial Intelligence, Modelling and Simulation (AIMS 2013)* (pp. 137–142). IEEE Computer Society.

Okere, H. C., Sulaiman, S., Rambli, D. R., & Foong, O. (2016). A Multimodal Interaction Design Guidelines for VR Foot Reflexology Therapy Application. *International Journal of Operations Research and Information Systems (IJORIS)*, *7*(3), 74–91. http://doi.org/doi:10.4018/IJORIS.2016070105

Okere, H. C., Sulaiman, S., Rambli, D. R., & Foong, O. M. (2015). An exploratory study on the user experience of foot reflexology therapy using reflexology artifacts. In *Proceedings of The 23rd Scientific Conference Of Microscopy Society Malaysia (SCMSM 2014) (Vol. 1669, p. 020074)*. AIP Publishing.

Okere, H. C., Sulaiman, S., Rohaya, D., Rambli, A., & Foong, O. (2014). Multimodal Interactions in Traditional Foot Reflexology. In *Computer and Information Sciences (ICCOINS), 2014 International Conference on* (pp. 1–6). IEEE.

Okere, H. C., Sulaiman, Awang, D. R. R., & Foong, O. (2014c). Visual and Aural Modal Interactions in Traditional Foot Reflexology Practice. *Australian Journal of Basic and Applied Sciences*, *8*(5), 508–514. Retrieved from http://ajbasweb.com/old/ajbas/2014/Special 2/508-514.pdf

Opriş, D., Pintea, S., García-Palacios, A., Botella, C., Szamosközi, Ş., & David, D. (2012). Virtual reality exposure therapy in anxiety disorders: a quantitative meta-analysis. *Depression and Anxiety*, *29*(2), 85–93. http://doi.org/10.1002/da.20910

Parker, J. R., & Heerema, J. (2008). Audio interaction in computer mediated games. *International Journal of Computer Games Technology*, *2008*, 1.

Parsons, T. D. (2015). Virtual Reality Exposure Therapy for Anxiety and Specific Phobias. *Encyclopedia of Information Science and Technology*, 288–296. http://doi.org/10.4018/978-1-4666-5888-2.ch636

Patterson, J., & Nanni, N. (2015). Virtual Reality Exposure Therapy (Vret) for Combat- Related Posttraumatic Stress Disorder (Ptsd), 1–8.

Powell, S. K. (2016). Ode to Healing Music in Health Care. *Professional Case Management*, *21*(1), 1–2.

Rizzo, A., Cukor, J., Gerardi, M., Alley, S., Reist, C., Roy, M., … Difede, J. (2015). Virtual reality exposure for PTSD due to military combat and terrorist attacks. *Journal of Contemporary Psychotherapy*, (MAY 2015), 1–10. http://doi.org/10.1007/s10879-015-9306-3

Sarter, N. B. (2002). Multimodal information presentation in support of human-automation communication and coordination. *Advances in Human Performance and Cognitive Engineering Research*, *2*, 13–36.

Shiban, Y., Peperkorn, H., Alpers, G. W., Pauli, P., & Mühlberger, A. (2016). Influence of

perceptual cues and conceptual information on the activation and reduction of claustrophobic fear. *Journal of Behavior Therapy and Experimental Psychiatry*, *51*, 19–26. http://doi.org/10.1016/J.JBTEP.2015.11.002

Sulaiman, S., Okere, H. C., Awang, D. R. R., & Mean, F. O. (2016). Expert review of the multimodal interaction model for Foot Reflexology VRST application. *2016 3rd International Conference on Computer and Information Sciences, ICCOINS 2016 - Proceedings*, 530–535. http://doi.org/10.1109/ICCOINS.2016.7783271

Tam, W. W. S., Lo, K. K. H., & Hui, D. S. C. (2016). The effect of music during bronchoscopy: A meta-analysis. *Heart & Lung: The Journal of Acute and Critical Care*. http://doi.org/10.1016/j.hrtlng.2015.12.004

Trapp, W., Engel, S., Hajak, G., Lautenbacher, S., & Gallhofer, B. (2016). Cognitive remediation for depressed inpatients: Results of a pilot randomized controlled trial. *Australian and New Zealand Journal of Psychiatry*, *50*(1), 46–55.

Winer, J. A. (2006). Decoding the auditory corticofugal systems. *Hearing Research*, *212*(1), 1–8.

Wu, F., Wang, J., Zhao, Y., & Wu, S. (2015). Improve the immersion of equipped with virtual maintenance training system to more close to the equipment maintenance training environment, (Etmhs), 338–342.