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November 2, 2015

To the Nord Evaluation Committee:

We (Amy Przeworski, PI - Dept. of Psychological Sciences and Marc Buchner, Co-PI - Elec. Engr. & Comp. Sci.) propose a study to compare the use of an augmented reality device (HoloLens) and a virtual reality device (Oculus Rift) to generate stimuli in facing fears.

Background and significance - Specific phobias are psychological disorders characterized by excessive and irrational fear of a specific stimulus. Common specific phobias include phobias of bees, dogs, spiders, snakes, heights, blood, injections, and flying. These are among the most common psychological disorders, with approximately 12.5% of adults suffering from a specific phobia at some point during their lifetime. Specific phobias are often chronic and the avoidance of feared situations can interfere in work and leisure activities.

Specific phobias are most commonly treated using individual therapy. In vivo exposure therapy, the form of therapy with the most evidence-base, involves gradually facing one's fears. During this therapy, clients are asked to remain in the presence of a fear-inducing stimulus until their anxiety peaks and passes, a process that occurs naturally due to parasympathetic nervous system activation. Clients in exposure therapy initially face fears of stimuli that are the least anxiety-provoking and gradually they work their way up to the most anxiety-provoking stimuli. For example, an individual with a dog phobia may initially be put in the room with a small dog in a cage. The client will face this fear repeatedly, allowing the anxiety to peak and pass until eventually the individual's anxiety barely increases in response to this stimulus. Subsequent exposure exercises may include having this same dog on a leash across the room, moving the dog closer to the client, eventually having the client touch the dog, removing the dog from the leash and having it sit on the client's lap and then doing this same process with larger dogs which induce more anxiety. Eventually the client would be asked to go to places where dogs are routinely present, such as a barbecue or park.

Although in vivo exposure therapy is effective, it requires therapists to have access to a variety of stimuli and to tailor those stimuli to the client. Therapists may require access to numerous well-trained dogs, snakes, spiders, and other insects of varying sizes. Similarly, challenges are posed when a client has fears of bridges, heights, or flying. In response to these challenges, researchers and therapists have used virtual environments to simulate necessary stimuli.

In virtual reality therapy, a client wears a headset including screens on which a virtual environment is projected. As the client turns his/her head, the scene adjusts. Clients may also wear a glove with sensors on it that indicate the position of each of the individuals' fingers and palm in space and which project a hand in the virtual environment that matches the position of the client's hand. This allows clients to interact with stimuli in the virtual world and increases the client's sense of immersion. Studies have shown that virtual reality therapy is as efficacious as in vivo therapy for specific phobias and superior to wait list control conditions. However, it is possible that new technology that relies on holograms may increase client immersion even more.

In 2015, Case Western Reserve partnered with Microsoft in connection with the HoloLens, the first fully un-tethered hologram-based augmented reality (AR) hardware human interface on the market. The HoloLens allows virtual holograms to integrate with the real (visible) world through spatial mapping. In comparison, totally immersive Virtual Reality (VR) approaches such as the new Oculus Rift can provide a complete immersive experience in a fully artificially created virtual world. The Unity software game engine, however, can be used, to create the VR or AR environments that are used in these state-of-the-art technologies.

The use of HoloLens technology in therapy has yet to be examined. AR may increase client immersion through clients being able to interact with the hologram in the real world. For example, hologram spiders would be able to crawl across the walls of the office and the desk that is directly in front of the client. Thus having hologram spiders interact with the real environment may increase client immersion. Similarly, clients can impact holograms. For example, a client could push a hologram spider away on the table or swat away a hologram bee. This may more closely simulate reality than a virtual environment but would provide similar benefits to virtual reality therapy in terms of convenience and the ability to tailor the stimuli to the unique fears of the client. The purpose of the proposed project is to (a) create hologram stimuli that may be used in therapy or exposure exercises, (b) test the efficacy of these stimuli in inducing anxiety, increasing immersion and believability and (c) compare the efficacy of virtual reality and augmented reality approaches.

Bee swarms and various sized spider clusters will be created for both the HoloLens augmented reality technology and the Oculus Rift virtual reality interface. It is hypothesized that augmented reality stimuli will induce greater distress in participants with fears of bees or spiders and be perceived as more realistic than the virtual reality stimuli.

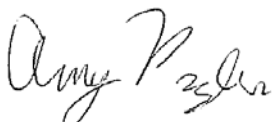
Methods - Participants with elevations in fear of bees and spiders will be recruited. Participants will first complete a telephone screen to identify whether they have elevated bee or spider fears. Participants will complete questionnaires measuring anxiety and specific phobia symptoms and a diagnostic interview administered by psychology graduate students. Participants will then use the HoloLens and Virtual Reality technology to interact with the stimuli. They will also provide ratings of their distress levels in response to the stimuli and the degree to which the stimuli appeared real.

Educational Benefits for Students - Engineering undergraduate students who are involved in the project will have the opportunity to program stimuli to be used with the HoloLens hardware and virtual reality equipment. HoloLens has not yet gone to market; therefore, students will truly be on the cutting edge of technology. Engineering students will also learn about therapy for specific phobias and have the opportunity to participate in a multidisciplinary team composed of faculty and students from computer science and engineering and psychology. Such translational teams are the wave of the future and will provide engineering students with a unique opportunity to learn about the application of technology in the social sciences.

Psychology undergraduate students will run participants through the study and have the unique opportunity to use the cutting edge HoloLens technology in a social science application. This would be the first study testing the application of this technology in such an application. Additionally, students will learn about the use of virtual reality in interventions for specific phobias. Psychology graduate students will also be trained to reliably conduct diagnostic interviews with participants to determine whether they have a specific phobia.

Thank you for the consideration of our project.

Sincerely,



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Associate Dean of Engineering



Lee Thompson
Professor and Chair
Department of Psychological Sciences

Budget

The applicant, Dr. Amy Przeworski, has not previously received Nord Grant funds.

Engineering undergraduate programmer:

(\$16/hr @ 7 hrs/week @ 16 weeks + \$16/hr @ 8 hrs/week @ 16 weeks) \$3840

The student will be recruited from Computer Science and Computer Engineering students that have taken EECS 290 – Introduction to Computer Gaming. As a result the student will have considerable expertise in Unity Game Engine Programming and virtual world creation. Programming of the HoloLens and Oculus Rift units will be aided by staff in the Interactive Commons Visualization facility currently being constructed in Thwing. The programmer is anticipated to work for 10 hours per week during the first (Spring) semester and for 10 hours per week during the second (Summer) semester.

2 Oculus Rift Virtual Reality Units and software (estimated cost) \$1600

Oculus Rift VR units will be available commercially in 1Q-2016. However a substantial amount of the programming and virtual world creation for these will use the programming and virtual world creation done for the HoloLens units.

Recruitment and compensation and of approximately 60 individuals with bee/spider phobias \$1500

Funds are needed to advertise for the recruitment of 60 individuals (compensated at \$25 each e.g. with a gift card). Although individuals from the general college-age population can be used to study the general issue of anxiety creation, examining the issue in the context of phobias requires more specialized recruiting. This is important to be able to refer to the extended data for larger-scale proposals at various funding agencies.

Total \$6940