Piloting The Mechanisms of Latent Inhibition to Prevent Dental Fear

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Introduction

In the United States, dental fear and anxiety are prevalent issues that impact the oral health of 40-50 million Americans[1]. Moreover, Hispanic and African American populations are disproportionally impacted by poor oral health[2,3], with dental fear as a common reason for avoiding dental visits in these populations[4]. A major etiological factor for dental fear is direct associated conditioning[1] but natural history studies suggest that pre-exposure to dental stimuli prior to a fear conditioning event can result in latent inhibition (LI), the retardation of associative conditioning as the result of prior learning[5,6]. These findings suggest pre-exposure to dental stimuli as a method by which the development of dental fear and phobia could be prevented. However, the casual effect of LI on dental fear has not been established using experimental methods.

Hall and Rodriguez[7] have proposed a model of LI which starts with the well-established finding that a novel stimulus garners significant attention because of its potential to serve as a signal of a relevant event[8]. Over time, prediction errors are predicted to decrease because of this learning, resulting in a decrease in attention as the lack of relevance of the stimulus is learned. If a pre-exposed stimulus is later paired with a relevant outcome unconditioned stimulus (UCS), this lack of attention renders the stimulus less available to enter an association with the UCS, retarding learning. Changes in prediction errors and ensuing decreased attention to the pre-exposed stimulus may be the mechanisms through which pre-exposure results in the LI effect.

Hypothesis

1(a). Preexposure to a stimulus will lead to diminished prediction errors in the outcome of the pre-exposed stimulus and diminished attention to the target stimulus and (b) to decreases in fear acquisition, recall and retention.
2. Examine whether individual ethnic differences could account for disparities observed in oral health and dental fear.

Acknowledgements

NIH National Institute of Dental and Craniofacial Research

BMC

Methods

Virtual Reality

Thirty healthy male and female volunteers aged 6-31 years enrolled across two sites: University of Texas Rio Grande and University of Toledo.

Participants completed conditioning tasks to assess pain sensitivity via a cold pressor test and dental startle task (air puff stimulation) through custom polyvinylsiloxane mouthpieces and fear of pain questionnaire in one appointment for the pilot study.

Current data collection will include 2 visits including an experimental task presented in virtual reality (VR) to test for pre-exposure and approach/avoidance behavior.

The reliable execution of study procedures across two sites may be of issue, but the study intervention is automated using an identical VR program, the concerns are greatly minimized.
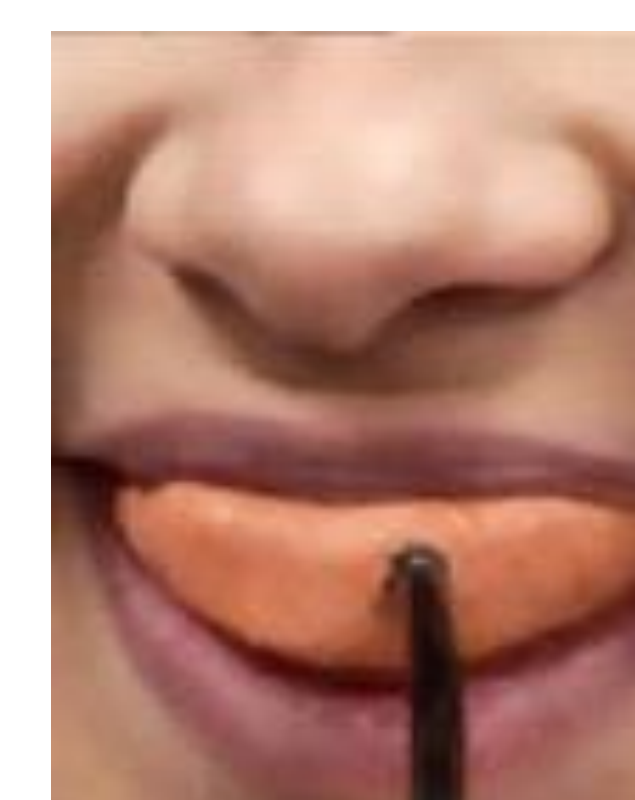
Equipment
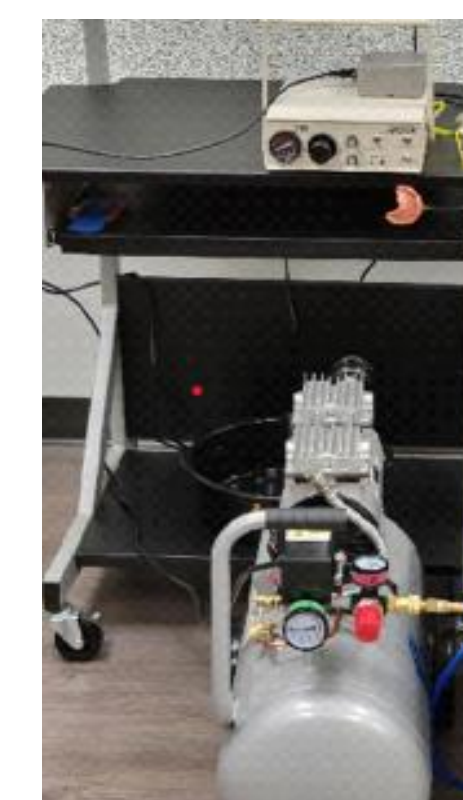
HTC Vive Pro headset with programming done in Vizard

Dental Startle: 100ms 60 psi air puff delivered via a fitted mouthpiece

3M™ STD Vinyl Polysiloxane Express Putty Mouthpiece

California Air Tools 8010 Steel Tank Air Compressor via an AIRSTIM device

Purpose

The purpose of this pilot study was to formulate a protocol for a randomized control trial identifying mechanism(s) underlying LI of dental fear and examine whether individual differences could account for disparities observed in oral health and dental fear. This study aims to determine if pre-exposure retards conditioning to a noxious oral stimulus and impedes recall and retention of this learning via decreased prediction errors and attention.

Results
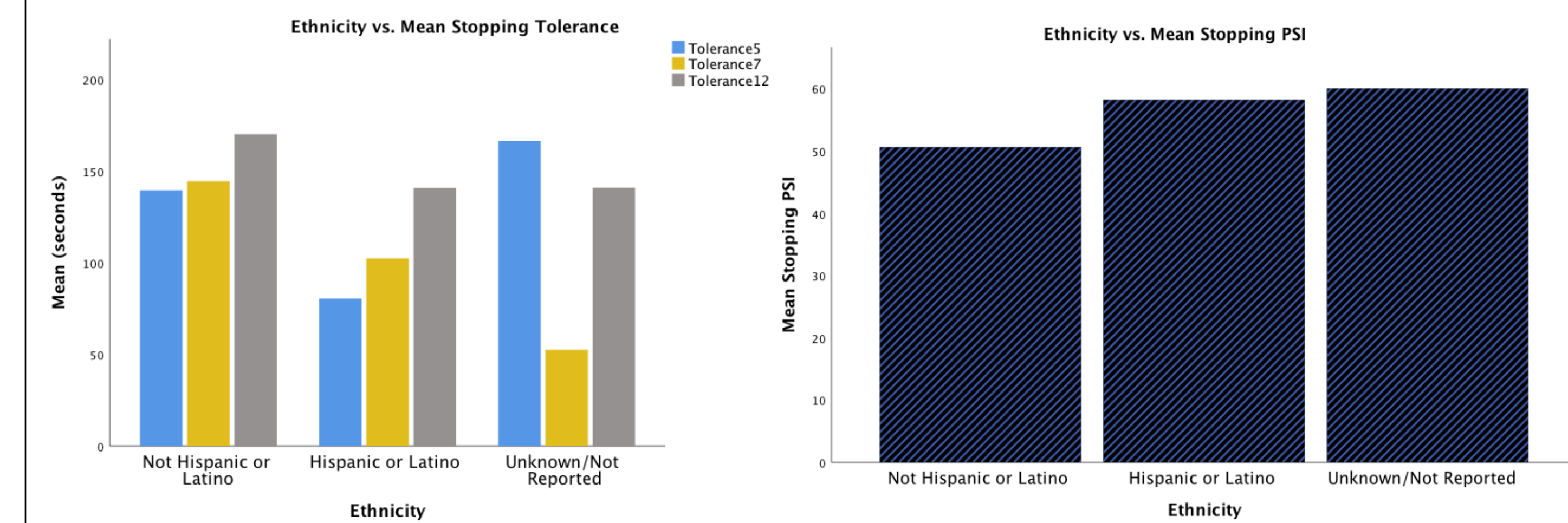
Descriptive statistical analyses determined the upward limits for the startle task (mean=54 psi and maximum=60 psi).
The cold pressor task revealed 12° C having the largest mean of 157.53s (5° C 119.7s, 7° C 123.0s).
Differences between ethnicity and cold test were not significant (5° C F=.885 P=.424, 7° C F=.791 P=.463, 12° C F=.245, P=.785).
Self-reported ethnicity revealed 37% Hispanic or Latinos, 57% not Hispanic or Latino and 7% unknown or not reported to be not significant.
Differences between ethnicity and stopping psi for the startle task were not significant (F=1.143 P=.334).

Discussion

The protocol of the study will test hypotheses regarding the mechanisms through which pre-exposure interventions result in LI of conditioning to a noxious oral stimulus. The ability of a relevant individual difference variable, pain sensitivity, to predict the magnitude of LI via engagement of the hypothesized mechanisms will be tested. Results could be used to design prevention programs for dental phobia and to predict for whom these programs will be most effective.
Participant ratings could facilitate or interfere with the learning taking place in the conditioning task and/or the physiological assessment of fear learning. Detailed standard operating procedures and training will be used to maximize fidelity.

Conclusion

This study helped determine the protocol for the formal study to test hypotheses regarding the mechanisms through which pre-exposure interventions result in LI of conditioning to a noxious oral stimulus. The pilot study showed no statistical significance regarding ethnicity. More participants (≥100 people) will be required for a more robust analysis. Current studies are underway to test hypotheses listed above.