The Use of Interactive Tangibles to Connect Clinicians and Patients with Chronic Pain

Piano Endo
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Introduction

The International Association for the Study of Pain (IASP) defines pain as “an unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage.” [1] One way to categorize pain is the duration of the symptoms. On one end of the spectrum, there is acute pain (AP) which is sudden, often provoked by an illness or injury, and dissipates once the cause is resolved. At the other extreme, there is chronic pain (CP) that persists and/or recurs beyond three to six months. [2] Pain can transition from AP to CP, and emerging neuroscience points to the shift in the drivers of pain from their recent finding; there is a correlation between the intensity of chronic back pain and the increased activities in the ventromedial prefrontal cortex (vmPFC), the area of brain that has less relation with pain experience. This correlation suggests that the brain can link actions and experiences with pain through associative learning. The patients can thus feel pain even in the absence of any stimulus. [3] This explains the increasing popularity of the biopsychosocial model accounting for social and psychological factors despite the traditional assumption that there is a linear relationship between tissue damage and pain symptoms. [4] However, systematic issues have barred integrative pain care principles from being widely operationalized. The patient-clinician relationship (PCR) can be a promising aspect for implementing the biopsychosocial model of pain as well as creating impactful patient engagement and tackling disparities in healthcare. We hypothesize that patients can improve PCR by candidly reflecting on the clinical sessions. The research aims to identify the effectiveness of therapeutic tangibles, toys, and interactive interfaces in lowering the psychological barriers for effective communication between patients and healthcare providers.

Scholarly Review

Crossmodal correspondences (CCs), the associations between the sensory in different modalities, is a topic with increasing interest in the field of Human Computer Interaction. Lin et al. explores the way CCs can contribute to the design of interactive multisensory experiences, specifically among “haptic experiences of 3D printed tangible objects, visual colour, and emotions” (2) [5]. In this research, 30 participants touched 18 tangibles with “varying degrees of angularity (round/spikey) and complexity (low/medium/high number of protruding points)” and matched each of them with colors and emotions (2). Lin et al. discovered an association between color and haptic experience as well as between emotion and haptic experience. Round objects with low/medium complexity had an association with blue while the participants tended to associate spiky objects with medium/high complexity with red. In addition, the participants associated round objects with higher levels of brightness and spiky objects with darker shades. In terms of emotion-touch association, the experiment revealed less pleasure in spiky

objects and higher ratings of pleasure in objects with low complexity. Spiky objects and higher/medium complexity gave a sense of excitement to the participants. The participants also noted that spiky objects gave them an impression of lack of control. Based on these findings, we can better design the interactive tangibles in our research by assigning low angularity and low complexity as well as high brightness and blue-ish hue. We can assume that such a combination of color, complexity and angularity can create calm, pleasant feelings in the patients with chronic pain.

Completed Tasks and Future Scopes

For this project, we recruited patients with a chronic pain diagnosis from a clinician. The recruitment process was through flyers at DHMC, Dartmouth College, and local clinics, in addition to online platforms. The patients will have therapeutic tangibles with an embedded sound recorder that enables them to verbally reflect on their visit. We will conduct interviews before and after the patients interact with the therapeutic tangibles to collect data for further qualitative and quantitative analysis.

The production of therapeutic tangibles start from designing and casting. The casting steps begin with creating a cast for therapeutic tangibles using a 3D modeling tool Fusion360. Then, we will pour Ecoflex, the platinum-catalyzed silicones, and create an interactive tangible. We searched for creative pigment options and ordered thermochromic pigments. A sound recorder will be inside the therapeutic tangible to catch the patients' reflection on their medical visit experience.

After the qualitative and quantitative analysis on the interviews with the patients, we will hold an exhibition in the Engineering and Computer Science Center at Dartmouth College. The exhibition aims to increase awareness on CP and the patients' experience. The theme of the exhibition will be resonance - hoping to suggest and/or remind of images, memories and emotions of the fights the patients with CP put up. We will display the interactive tangibles with a recorded voice inside in addition to a private space where the visitors can listen to them.

By the end of my stay at Dartmouth, I had conducted one interview with a patient with CP, created a prototype for the interactive tangible and explored different styles of exhibition. Although there was not much of a result during my participation in the research, I am looking forward to hearing the progress from the team.

Reference

[1] https://www.iasp-pain.org/resources/terminology/?ItemNumber=1698%20&%20navItemNumber=576

[2] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4450869/

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[4] https://www.proquest.com/docview/1041810547?accountid=10422

[5] https://dl.acm.org/doi/pdf/10.1145/3411764.3445373?casa_token=k7RHS41WBmwAAAAA:9ejJ1-xAuOADJXvZPXvtMJemZepqBczClH-4SnmOenGxJjvV-jXkzxzd0lAN3I_aEIU7gmi0bDFW

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Piano Endo ◦ Shirin Amouei ◦ Grace Chen ◦ Andrea Robang ◦ Elizabeth Murnane
Department of Engineering, Guarini School of Graduate and Advanced Studies at Dartmouth, Hanover, NH 03755

Chronic Pain (CP)

a type of pain that

→ persists beyond three to six months [1]

→ seen in 20% of adults in the US [2]

A Shift in Views on CP

biomedical model

↓

biopsychosocial model [3]

Patient Clinician Relationship (PCR)

a promising area for

→ implementing the biopsychosocial model of pain

→ creating impactful patient engagement

Hypothesis

more willing to reflect on the quality of their visit experience

=

more engaged in their own care

↓

better clinical outcome

Research Goal

interactive tangibles

×

opportunity to reflect on their medical visit experience

1 Interview 1 (Pre-Tangibles)

2 Creating a Cast for Interactive Tangibles

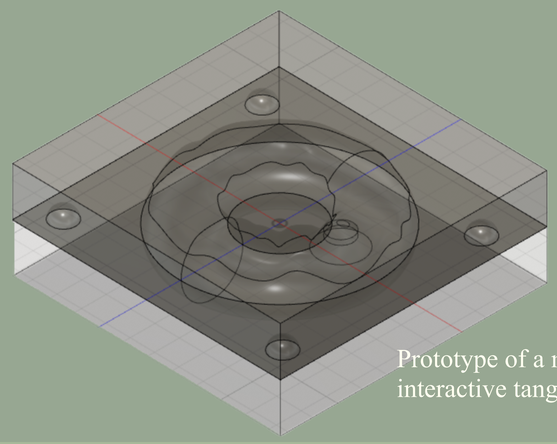
3 Creating Interactive Tangibles + Voice Recorder

4 Interview 2 (Post-Tangibles)

5 Exhibition "*Resonance*"

6 Interview Analysis

Prototype of interactive tangibles made with Ecoflex



Prototype of a mold for interactive tangible

Reference

[1] Treede et al. (2015) A Classification of Pain for *ICD-11*. Pain, 156 (6):1003-1007.
[2] Dalhamer et al. (2018) Prevalence of Chronic Pain and High-Impact Chronic Pain Among Adults - United States, 2016. Morbidity and Mortality Weekly Report, 67 (36):1001-1006.
[3] Engel, George L. (2012) The Need for a New Medical Model: a Challenge for Biomedicine. Psychodynamic Psychiatry, 40 (3):377-396.