PTSD and a new way to fight it

By

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PTSD Research

• PTSD is severe anxiety caused due to the experience of or exposure to a traumatic situation

• People with PTSD may have depression or another type of anxiety before developing PTSD
PTSD – Undiagnosed

- Mental health stigma prevents people from getting anxiety diagnosis
- 20 soldiers commit suicide because of PTSD
Primary Gap In Research

- 200 documents/articles reviewed
- Primary gap - No continuous detection & monitoring of PTSD symptoms
Gaps In Research

• Five gaps across all domains
• U.S. Military has advance, inclusive, and effective PTSD resilience training compared to other domains
Three Studies

<table>
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<tr>
<th>Study 1</th>
<th>Study 2</th>
<th>Study 3</th>
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<tr>
<td>Validate people’s willingness to fight anxiety</td>
<td>Collect data to detect anxiety</td>
<td>User testing - Detect, Alert and Distract anxiety to stop its progression</td>
</tr>
<tr>
<td>Realistic effects of diet, sleep, and environment collectively</td>
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</tbody>
</table>
Study 1 - Background

• No study conducted on the collective effect of diet, sleep and environment on people who have PTSD or any other anxiety

• Test people’s willingness to empower themselves to combat their anxiety

• Validate the need for an engineering solution which may detect anxiety and help monitor it
Study 1 – Root Cause Analysis

Chemicals
- Light food
- Sugar free food
- Junk/Processed food
- Dyes in food

Drinks
- Caffeinated
- Juices
- Energy
- Diet

Nutrients
- Bad Carbohydrates
  - Lack of Tryptophan
  - Lack of Magnesium
  - Lack of Antioxidants
  - Lack of vitamin B
  - Lack of Omega 3

Lack of Help
- No treatment
- No Diagnosis
- Self-Diagnosis
- No Help

Environment
- PFOA in nonstick cookware
  - Lack of safe family
  - Upbringing
- BPA in plastic
  - Child Abuse
- Endure stress
- Lot of caffeine
- Worries
- Fear

Lack of Sleep
Study 1 - Design and Participants

Design:
Survey with 53 questions on symptoms, diet, sleep, environment, quality of life, & empowerment

Participants:
General Anxiety Disorder (GAD) - 19
Specific Phobia (SP) - 6
Social Anxiety Disorder (SAD) - 15
Panic Disorder (PD) - 16
Post-Traumatic Stress Disorder (PTSD) - 5
Obsessive Compulsive Disorder (OCD) - 3
Study 1 – Top Ten Anxiety Symptoms Reported

- Confused thoughts: 37.50%
- Headaches: 42.19%
- Uneasiness: 46.88%
- Self-conscious: 48.44%
- Excessive worry: 53.13%
- Anxiousness: 53.13%
- Nervousness: 60.94%
- Overwhelmed: 62.50%
- Elevated heart rate: 78.13%
- Self-doubt: 87.00%
Study 1 – Results on Distraction Strategies

DISTRACTION STRATEGIES TO CONTROL ANXIETY

- Listen to music: 16%
- Increase time with friends/family: 11%
- Increase sleep time: 10%
- Physical Exercise/Yoga: 10%
- Other: 10%
- Mindfulness training: 2%
- Change in diet to Mindfulness training: 2%
- Counseling: 3%
- Meditation: 3%
- Write journal
- Strengthen faith: 6%
- Practice relaxation: 6%
- Play video games: 8%
- Breathing exercise: 9%
- Practice relaxation: 6%
Study 1 - Results On Quality Of Life

97% Develop negative attitude
89% Symptoms affect their life
81% Try to change negative thoughts & attitude
78% Have negative thoughts & emotions
72% Living with fear or skepticism
Positive responses are significantly higher than the negative responses (t statistics = -2.948, df = 197.3, p = 0.004)

<table>
<thead>
<tr>
<th>Positive Responses</th>
<th>Negative Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy diet</td>
<td>Unhealthy diet</td>
</tr>
<tr>
<td>≥ 8 hours of sleep</td>
<td>&lt; 8 hours of sleep</td>
</tr>
<tr>
<td>Less consumption or interaction with harmful chemicals</td>
<td>More consumption or interaction with harmful chemicals</td>
</tr>
</tbody>
</table>
Study 1 - Result

Healthy diet + good sleep + less harmful substances \[= \textit{no anxiety}\]
Chemicals In Diet and Environment

• Chemicals used in cereals, processed food, red dyes, sugar-free foods, nonstick cookware, plastic products, sales receipts, fertilizers, pesticides, insecticides, cleaning products, fabric making, and several other products lower mental health.
FDA Chemical Allowance Limits In Products

• FDA’s approach to setting harmful chemical allowance limits on the individual products is not good enough.

• FDA needs to analyze the total impact of the chemicals in the products based on the daily consumption or interaction of several products containing harmful chemicals.

• The combined effect of the chemicals in the diet and environment is causing a major negative impact on mental health, and it reduces people’s ability to be mentally resilient.
Study 1 - Results On Empowerment

91% does not take any medication or supplements

92% show a willingness to empower themselves to fight anxiety

Need an engineering solution that detects anxiety and allows people to monitor and control it as it occurs.
Prototype Engineering Solution - Planning

- Measurements
  - HRV, brainwaves
  - Wearables
    - Polar H10
    - Muse band

- BlueTooth Integration
  - Hired Experienced Android Developer

- Mobile platform
  - Android system compatible with wearables
  - PI Android app testing experience

- Cost
  - Hardware
  - Software Application

- Risk

Sensors
Prototype Engineering Solution - Development

• Agile Development
  • Major sprints
    • Creation of SW app framework
    • Integrating Android tablet with Polar H10 and receiving R-R interval to calculate HRV
    • Integrating Android tablet with Muse band and receiving brain waves scores
    • Capturing and storing baseline values
    • Capturing/analyzing/storing experiment values
    • Detecting anxiety and generating alert
Prototype Engineering Solution – Measurements

HRV Values

<table>
<thead>
<tr>
<th>Meta-analysis performed</th>
<th>No. of data sets</th>
<th>Number of anxious participants</th>
<th>Number of control participants</th>
<th>Comparison of anxious and control participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>All disorders</td>
<td></td>
<td></td>
<td></td>
<td>Effect size (95% CI) SE of summary effect size p value</td>
</tr>
<tr>
<td>Time domain HRV</td>
<td>20</td>
<td>1615</td>
<td>1402</td>
<td>-0.70 (-1.45 to -0.06) 0.38 0.07</td>
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<tr>
<td>HF HRV</td>
<td>34</td>
<td>915</td>
<td>1559</td>
<td>-0.29 (-0.41 to -0.17) 0.09 0.001</td>
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<tr>
<td>LF HRV</td>
<td>22</td>
<td>715</td>
<td>1115</td>
<td>-0.08 (-0.31 to 0.15) 0.09 0.49</td>
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<tr>
<td>Panic disorder</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Time domain HRV</td>
<td>8</td>
<td>264</td>
<td>243</td>
<td>-0.41 (-0.68 to -0.15) 0.13 0.002</td>
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<tr>
<td>HF HRV</td>
<td>16</td>
<td>437</td>
<td>520</td>
<td>-0.22 (-0.42 to -0.02) 0.18 0.039</td>
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<tr>
<td>LF HRV</td>
<td>12</td>
<td>360</td>
<td>425</td>
<td>-0.11 (-0.47 to 0.25) 0.18 0.544</td>
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<tr>
<td>Post traumatic stress disorder</td>
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<td></td>
<td></td>
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<tr>
<td>Time domain HRV</td>
<td>4</td>
<td>96</td>
<td>78</td>
<td>-0.63 (-1.00 to -0.26) 0.16 0.001</td>
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<tr>
<td>HF HRV</td>
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<td>192</td>
<td>525</td>
<td>-0.29 (-0.58 to -0.001) 0.18 0.049</td>
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<tr>
<td>LF HRV</td>
<td>6</td>
<td>183</td>
<td>515</td>
<td>-0.04 (-0.51 to 0.42) 0.24 0.854</td>
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<tr>
<td>Generalized anxiety disorder</td>
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<td></td>
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<tr>
<td>Time domain HRV</td>
<td>3</td>
<td>65</td>
<td>68</td>
<td>-0.55 (-0.98 to -0.12) 0.18 0.001</td>
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<tr>
<td>HF HRV</td>
<td>3</td>
<td>68</td>
<td>90</td>
<td>-0.50 (-0.87 to -0.25) 0.18 0.001</td>
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<tr>
<td>LF HRV</td>
<td>1</td>
<td>16</td>
<td>19</td>
<td>0.50 (-0.16 to 1.16) 0.34 0.140</td>
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<tr>
<td>Obsessive–compulsive disorder</td>
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<tr>
<td>HF HRV</td>
<td>2</td>
<td>40</td>
<td>63</td>
<td>-0.29 (-0.84 to 0.28) 0.29 0.329</td>
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<tr>
<td>LF HRV</td>
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<td>26</td>
<td>24</td>
<td>-0.08 (-0.63 to 0.47) 0.28 0.773</td>
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<td>Social anxiety disorder</td>
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<tr>
<td>Time domain HRV</td>
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<td>53</td>
<td>58</td>
<td>-0.40 (-0.78 to -0.02) 0.22 0.039</td>
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<tr>
<td>HF HRV</td>
<td>3</td>
<td>30</td>
<td>109</td>
<td>-0.47 (-0.74 to -0.20) 0.14 0.050</td>
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<tr>
<td>LF HRV</td>
<td>1</td>
<td>53</td>
<td>53</td>
<td>-0.25 (-0.63 to 0.13) 0.19 0.205</td>
</tr>
<tr>
<td>Specific phobia</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time domain HRV</td>
<td>1</td>
<td>61</td>
<td>58</td>
<td>-0.28 (-0.74 to -0.02) 0.18 0.037</td>
</tr>
<tr>
<td>HF HRV</td>
<td>1</td>
<td>61</td>
<td>58</td>
<td>-0.05 (-0.41 to 0.31) 0.18 0.784</td>
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<tr>
<td>LF HRV</td>
<td>1</td>
<td>61</td>
<td>58</td>
<td>-0.05 (-0.41 to 0.31) 0.18 0.782</td>
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<tr>
<td>Mixed anxiety</td>
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<tr>
<td>Time domain HRV</td>
<td>3</td>
<td>1086</td>
<td>905</td>
<td>-1.52 (-4.13 to 1.08) 1.33 0.251</td>
</tr>
</tbody>
</table>

Brainwave Values

- Alpha waves represent meditative state
- Beta waves represent active state

During anxiety:
- Alpha waves decreases & Beta waves increases
Prototype Engineering Solution - Architecture
Prototype Engineering Solution – System Reqs

• Integration of Polar – H10
  • Establish BlueTooth Connection
  • Receive real-time R-R interval data
  • Derive HRV values from R-R interval
  • Continuously display HRV values in DADA App

• Integration of Muse band SDK
  • Establish BlueTooth Connection
  • Receive EEG data for alpha and beta brainwaves
  • Continuously display brainwave values in DADA App
Prototype Engineering Solution – System Reqs

• Display all measurements simultaneously
• Store all measurements separately
• Capture baseline and store baseline values
• During the experiment, compare HRV and brainwaves values to its baseline values in real-time and store all measurements
• Generate an alert if symptoms are detected and store the instances data in the App
Prototype Engineering Solution – SW Application
Study 2 – Anxiety detection algorithm

- Objective – Collect data to generate anxiety detection algorithm
- Data
  - Brainwaves alpha scores, beta scores
  - HRV (derived)
- Participants
  - People with speech anxiety
- Experiment
  - Baseline data
  - Introduce stressor to cause anxiety and collect data
- Methodology
  - Capture Baseline data
  - Start Experiment
  - Introduce stressor to cause anxiety
Study 3 – Detect, Alert & Distract (DADA) Model

• Objective
  • Detect anxiety and distract it to lower its effects and stop its progression. Improve the quality of life.

• Participants
  • People with speech anxiety

• User testing DADA Model
  • Detect anxiety
  • Alert user
  • Provide distraction strategies to stop anxiety
Study 3 – DADA Benefit

**Actions**
- Act when alerted
- Use distraction strategy for 5-10 minutes

**Results**
- Lower effects of anxiety
- Stop the progression of anxiety

**Impact**
- Improved task performance
- Improved quality of life
- Increased mission readiness
Conclusion

• Managing diet, sleep and environment alone cannot help solve the anxiety problem
• An engineering solution that detects anxiety is an absolute need
• Monitoring and controlling the anxiety as it flares up is like putting a bandage on a cut as soon as it occurs and prevent its progression
Discussion

• Integrating two wearables:
  • Challenge integrating two BlueTooth devices
  • Challenge receiving data from two wearables simultaneously
  • Lack of proper support from the wearable manufacturers during the development

• Proper placement of the wearables is required to reduce noise in data or loss of data
Discussion

• Limited participant’s motion to reduce noise in the data
• Need to create anxiety detection algorithm to detect different types of anxiety
Questions