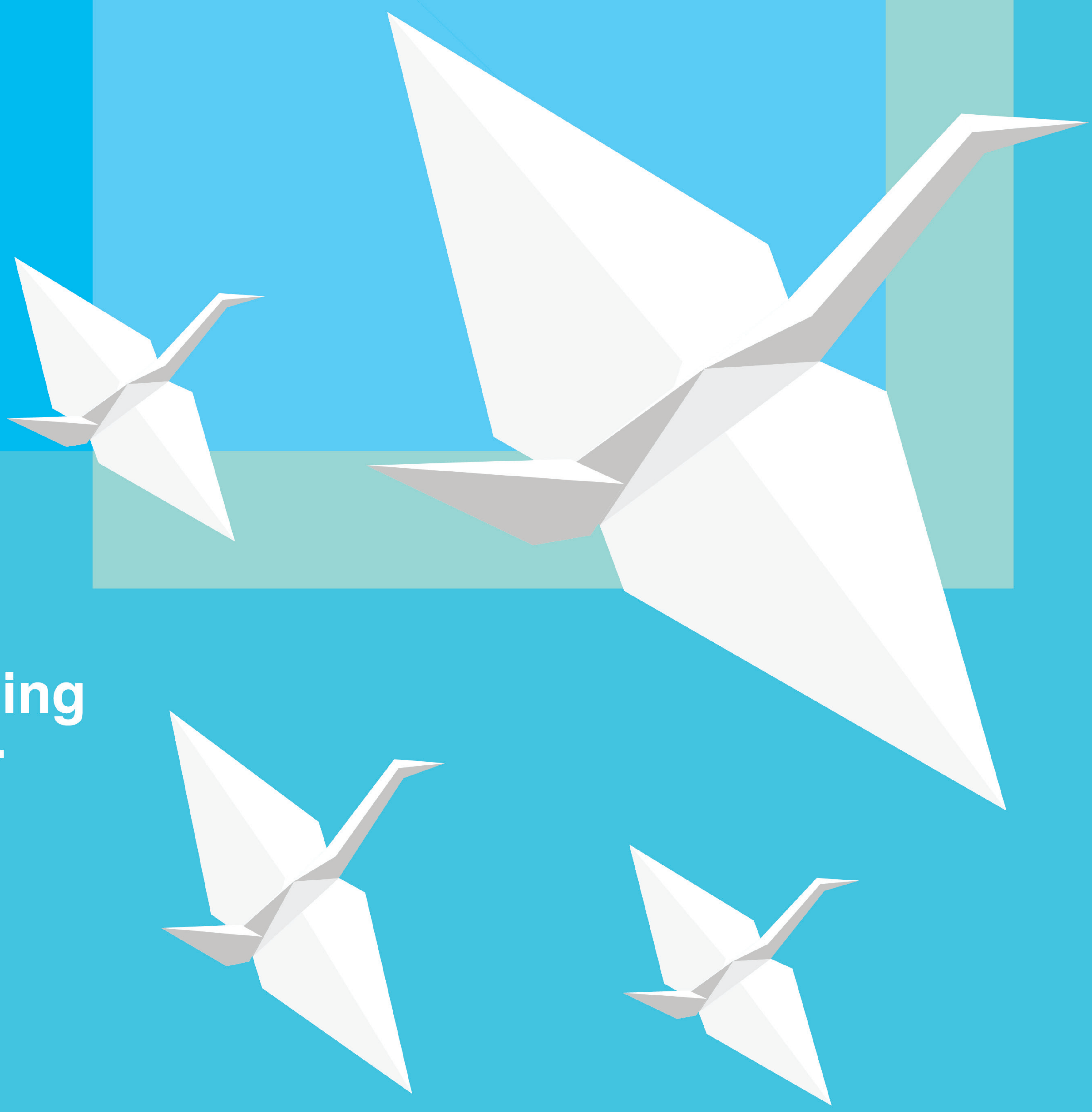
human centered design



A User-Centric Approach to Designing Learning Models for Crafting Origami

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performance m
performance metrics
usability testing
interaction design
design

Introduction to Empathy

By applying an empathetic system of understanding with human centered design, a designer's research measures how users are able to fold origami via the assigned methods of interaction. Through this level of empathy, the adaptation of our instructional learning models to a prototype application can translate into a better graphical experience; one that is modeled around the user.

Thus, demonstrating how a focus in human centered design successfully allows designers to design and better understand the desired experiences and needs of their users.

Project Details

Date: 2018 Spring & 2018 Fall

Location: Cal Poly Pomona, Art Department

Audience: Participants who wish to learn new methods of folding origami or those participants who have never folded before.

Project Goal: To better understand learning models in UI/UX design and practice a human centered design methodology.

Mediums: Phone Prototype Application, Origami Paper, Video, Animation

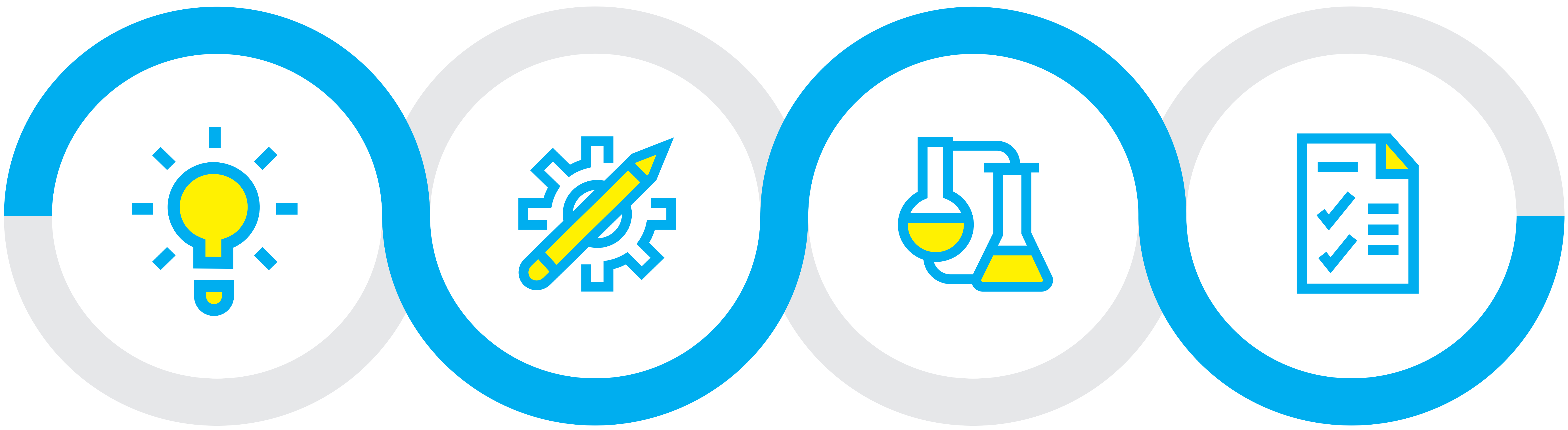
Tools: Emotiv EEG & Emotiv Software, Adobe XD, p5.js, Sonification Sandbox Beta

Methods of User Testing

Methods for user testing were grouped into two testing phases. Participation in prior origami folding was void until Phase Two of user testing.

Phase One of testing was designed to understand what instructional model for learning origami was preferred amongst users. User testing consisted of another instructional static based app, video, and printed directions.

Phase Two of testing focused on understanding how users utilize and comprehend the application that was designed from our user feedback. Data collection and inferences were generated from recored times, performance metrics, multi-channel electroencephalogram headsets, SUS questions, and exit interviews.



Learning Models

- Testing begins to determine which **medium of instruction** is best for folding origami.
- We test with application, video, and printed directions.
- We infer that learners primarily engage with graphic instructions over text.

Design Prototype

- We designed a prototype application that pertained to the **visual learning model**.
- We then refined our series of instructions to fit a much smaller range of steps and directions for our users.

Test Prototype

- Next, we tested our prototype application on **5 subjects**.
- Subjects wore multi-channel electroencephalogram headsets.
- Data was collected and scored through **SUS Questions** and **Exit Questions**.

Data & Refinement

- After testing, we review and calculate time based efficiency models, success rates, & efficiency models.
- Review **biofeedback** and exit interview comments.
- Refine the application prototype for presentation.

Qualitative System Question Results

Based on qualitative feedback from exit interview questions, we found that users of the prototype application design did not read text based instructions and instead chose to focus on the animations of those instructions. If a user was stuck, they would prefer to rewatch the animation of the folding before having to read the instructions.

Common User Comments

A majority of the users stated that they would prefer to have less words and better quality animations that did not go too fast. Users suggested that there should be more **media controls integrated into the animation**; features relating to video scrubbing and playback as well as **audio instructions**.

> “I had to wait for the animation to start over in order to fold.”

System Usability Scale Results

SUS testing was administered to understand what components of the application prototype were most successful. The SUS testing showed that most 1st time users of origami folding performed and felt more confident with the app than users who had folded elsewhere prior.

SUS Questions: User #3

Please answer these questions by checking which box that you agree with the most.

SUS Score: 60

24*2.5 = 60

Questions	Strongly Agree	Strongly Disagree
I would like to use this app frequently.	X	
I found the animations unnecessarily complex.		X
I thought the instructions were easy to understand.	X	
I think that I would need the support of another person to be able to use these instructions.		X
I found the instructions and the animations to be well integrated together.	X	
I thought there was too much inconsistency in this app.		X
I would share this tool with my peers and family.	X	
I would use this app again and want to fold other origami with it.	X	
I felt confident after using the app instructions to fold my origami.	X	
I found the technology distracting when learning how to fold the origami.		X

Craftwork

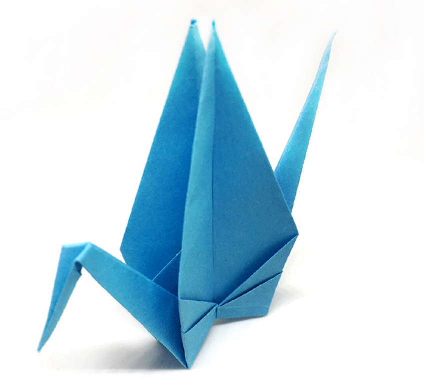
Craftwork for user testing was graded on a scale of **“complete”**, **“partial”**, and **“incomplete”**. Of the five final users, three of the participants craft was scored as “complete”, one participant was scored “partially complete”, and one participant scored “incomplete”.

User #1

- **Craft:** Complete
- **SUS: 30%**
- **1st Time**

User #2

- **Craft:** Complete
- **SUS: 60%**
- **1st Time**



User #3

- **Craft:** Complete
- **SUS: 60%**
- Not 1st Time

User #4

- **Craft:** Partial
- **SUS: 40%**
- **1st Time**

User #5

- **Craft:** Incomplete
- **SUS: 50%**
- Not 1st Time

Quantitative Results

Quantitative data was calculated with:

1. Time Based Efficiency models
2. Overall Relative Frequency
3. Effectiveness
4. Simplified Success Rate
5. Completion Rate
6. SUS Scoring

Sample of Equations.

$$Overall\ Relative\ Efficiency = \frac{\sum_{j=1}^{R}\sum_{i=1}^{N} n_{ij}t_{ij}}{\sum_{j=1}^{R}\sum_{i=1}^{N} t_{ij}} \times 100\%$$

$$Time\ Based\ Efficiency = \frac{\sum_{j=1}^{R}\sum_{i=1}^{N} \frac{n_{ij}}{t_{ij}}}{NR}$$

$$Effectiveness = \frac{\text{Number of tasks completed successfully}}{\text{Total number of tasks undertaken}} \times 100\%$$

Recorded User Data

Performance Metrics

Model(s)	Score(s)
Overall Relative Efficiency	82%
Effectiveness	60%
Simplified Success Rate	70%
Full Completion Rate (Excluding Incomplete)	60%

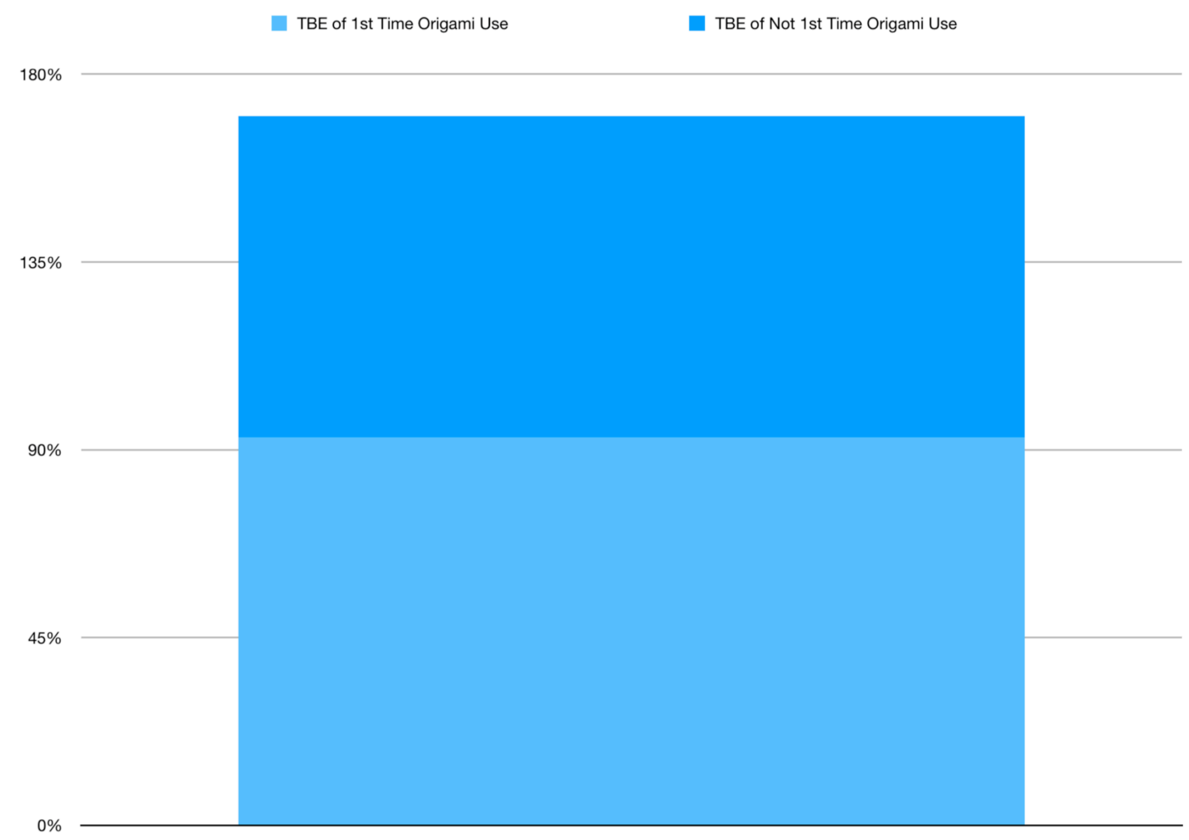
Time Based Efficiency

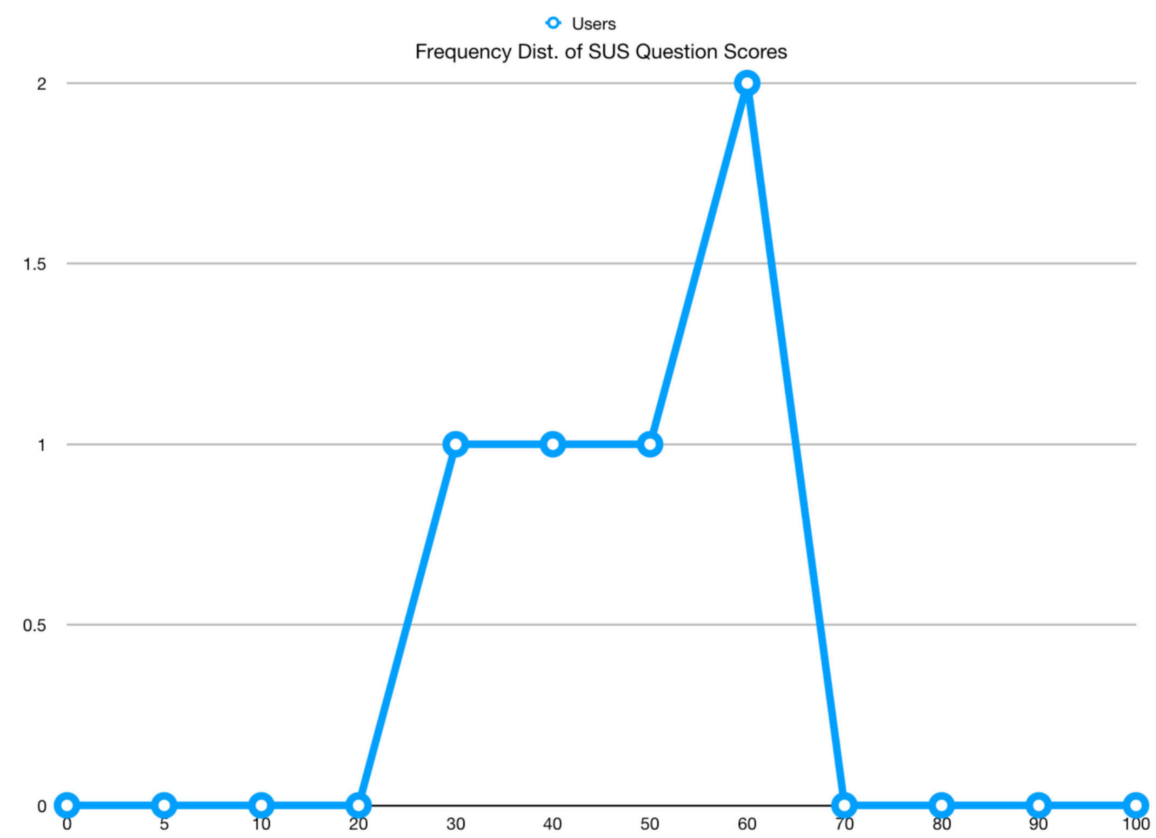
Model(s)	Score(s)	Score(s) 100%	Score(s) 1000%
Overall TBE	0.0866 goals/minute	8.66%	86%
TBE 1st Time	0.093 goals/minute	9.3%	93%
TBE Non 1st Time	0.077 goals/minute	7.7%	77%

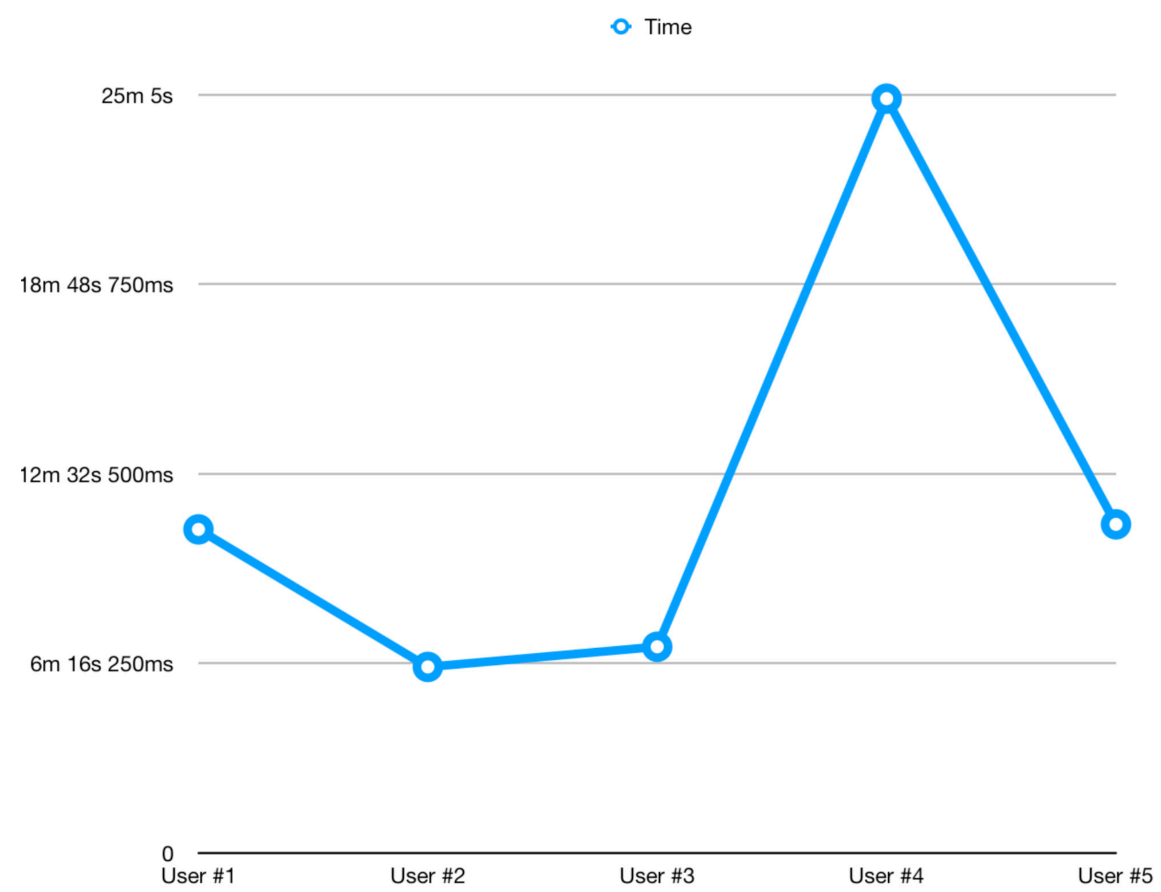
User Metrics

User	Time	Craft	SUS	1st Time?
User #1	10m 42s	100%	30%	Yes
User #2	6m 9s	100%	60%	Yes
User #3	6m 49s	100%	60%	No
User #4	24m 57s	50%	40%	Yes
User #5	10m 52s	0%	50%	No

Quantitative Visualizations







From our quantitative data, we found that **1st time folders of origami had a higher Time Based Efficiency score** than users who had learned to fold origami elsewhere; users who first learned from our app also said to have a more enjoyable and **confident experience** when using the prototype than folders who learned elsewhere.

EEG
Data

EEG headsets were worn by participants to better analyze and monitor their performance metrics. Below is a sample of each user's metrics at the middle of their folding time.

User #1

Stress	37
Engagement	66
Interest	53
Excitement	15
Focus	28
Relaxation	48

User #2

Stress	17
Engagement	17
Interest	46
Excitement	11
Focus	9
Relaxation	12

User #3

Stress	24
Engagement	36
Interest	49
Excitement	43
Focus	35
Relaxation	23

User #4

Stress	41
Engagement	53
Interest	52
Excitement	69
Focus	50
Relaxation	37

User #5

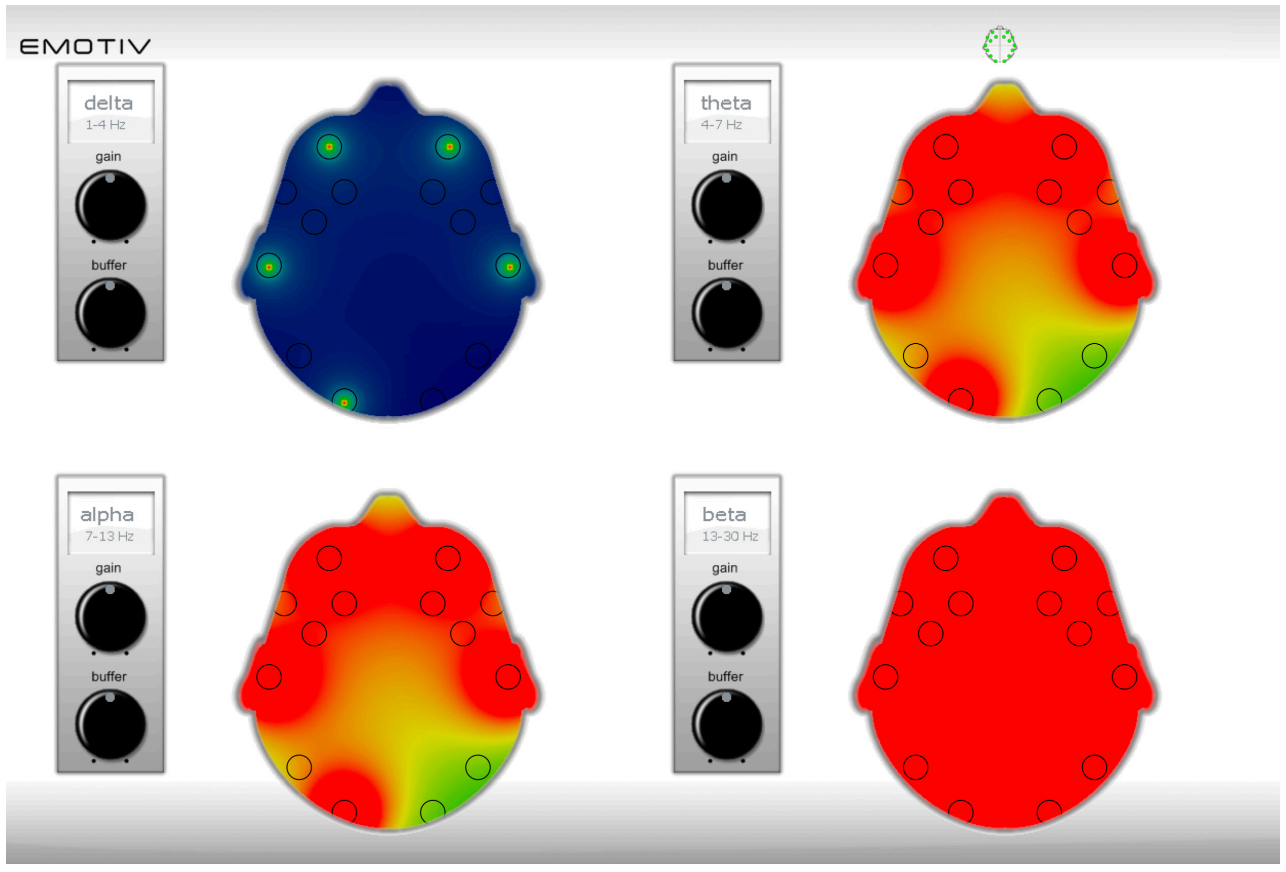
Stress	38
Engagement	50
Interest	58
Excitement	26
Focus	30
Relaxation	40

Inference
of Data

Based off of observations and our recorded user performance metrics, we found that most users kept **engaged** when using our design. Users were also highly **interested** in their work and **focused** during folding of origami.

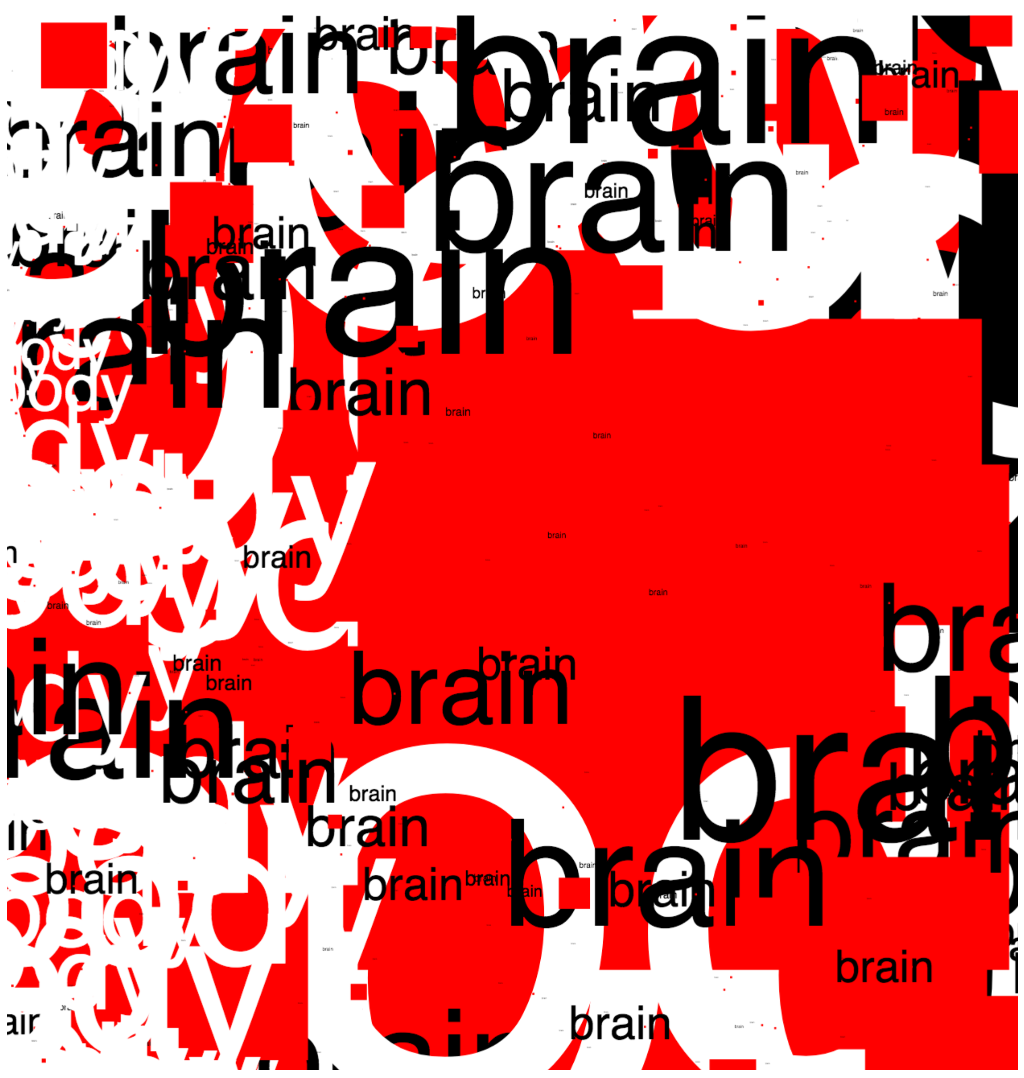
EEG
Heat-map

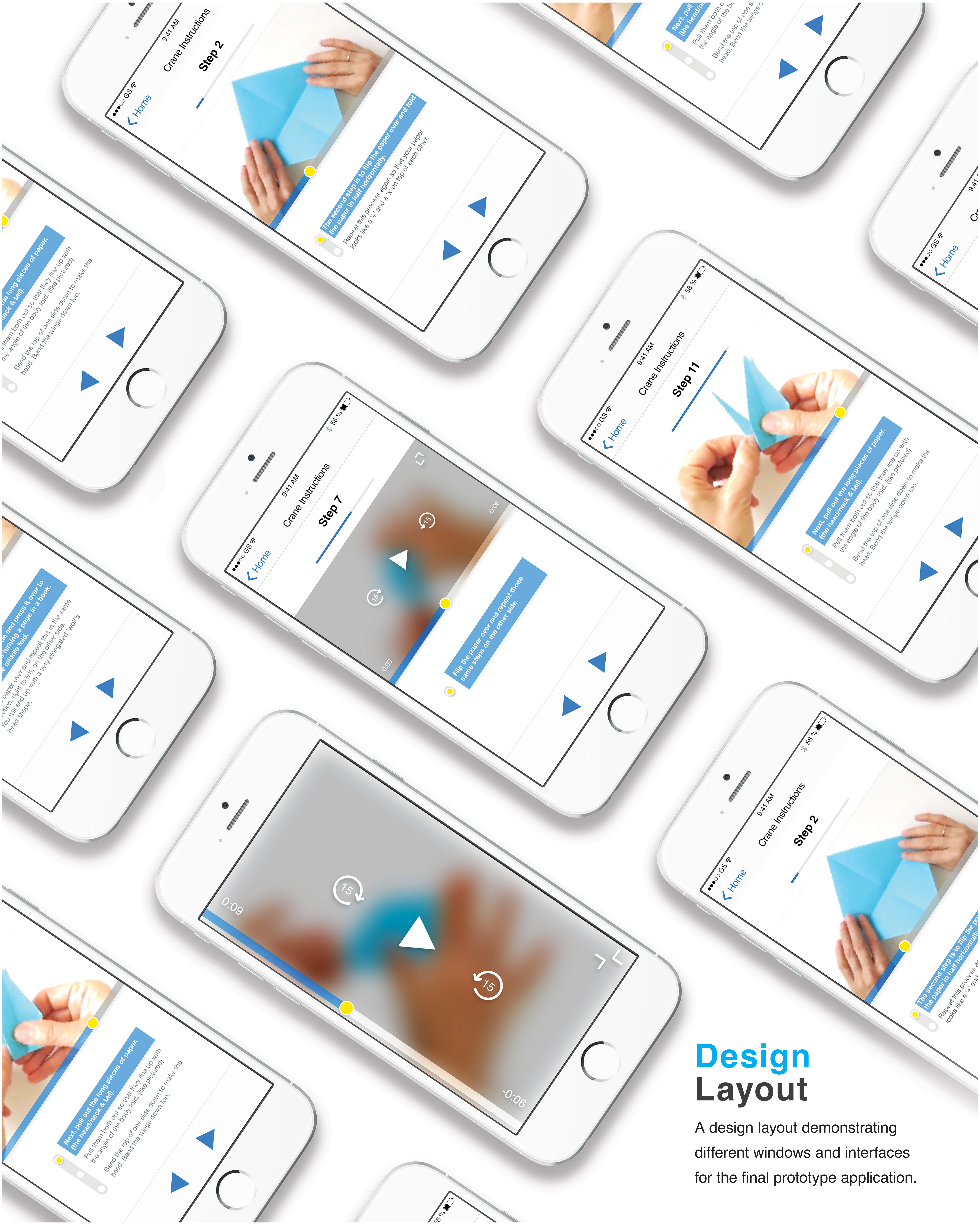
A heat-map of each user was also recorded. Activity tracked areas of activity with each wavelength that was produced by brain. Wavelengths monitored were: Delta, Theta, Alpha, and Beta. Below is a sample.



Raw EEG
Data Abstraction

Raw EEG data was exported to Sonification Sandbox and mapped in p5.js. Together, mapping sound and color to produce a layer of artistic abstraction and visualization of shape, color, and sound of users brain data.



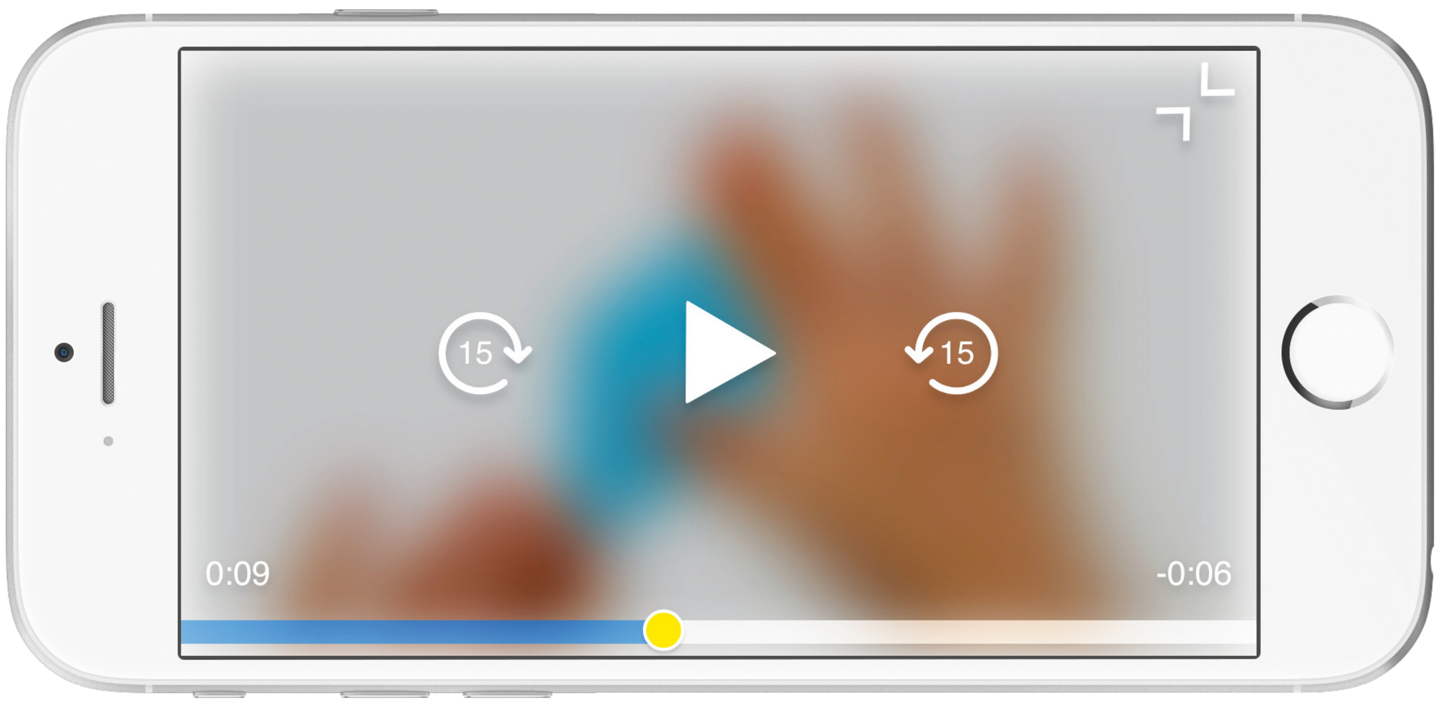


Design Layout

A design layout demonstrating different windows and interfaces for the final prototype application.

Application
Prototype UI

Based off of our testing, we determined that the best adaptation of user learning models was the video medium. Users tended to use visuals and were often lost in the text. To accommodate, we designed the app around video, adding playback features, highlighting steps, and adding video scrubbing to the interface.



Color
System

Through testing and user input, we selected our final color system to establish our applications color system Colors were chosen and assigned in a manner to assist the user in visualization and navigation of directions.

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Interface
Features