

**GOOD HEALTH WALES 2017**

ARTS FOR HEALTH AND WELLBEING SYMPOSIUM

**IECHYD DA CYMRU 2017**

SYMPOSIWM Y CELFYDDYDAU AR GYFER IECHYD A LLES

**DESIGN *for* HEALTH**

Dr Sean Jenkins

Matthew Bellis

School of Design & Applied Arts



**Swansea**  
**College of Art**  
Founded 1853

# Swansea College of Art : Partnerships with Healthcare

Founded 1853



# : Academic & Technical Expertise

capture

- **User Centered Design Research**
- **3D Scanning & IRT**

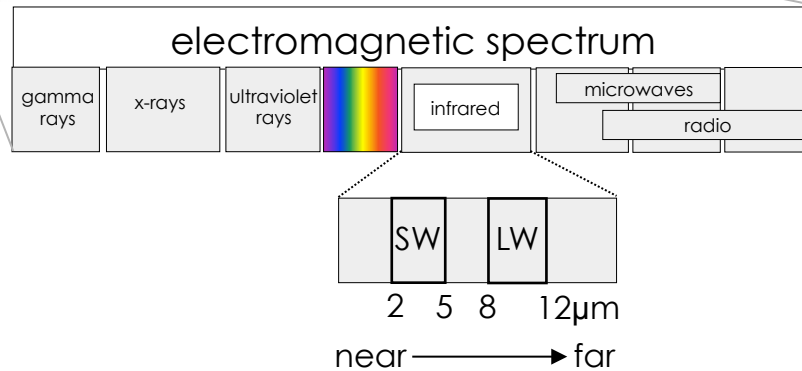
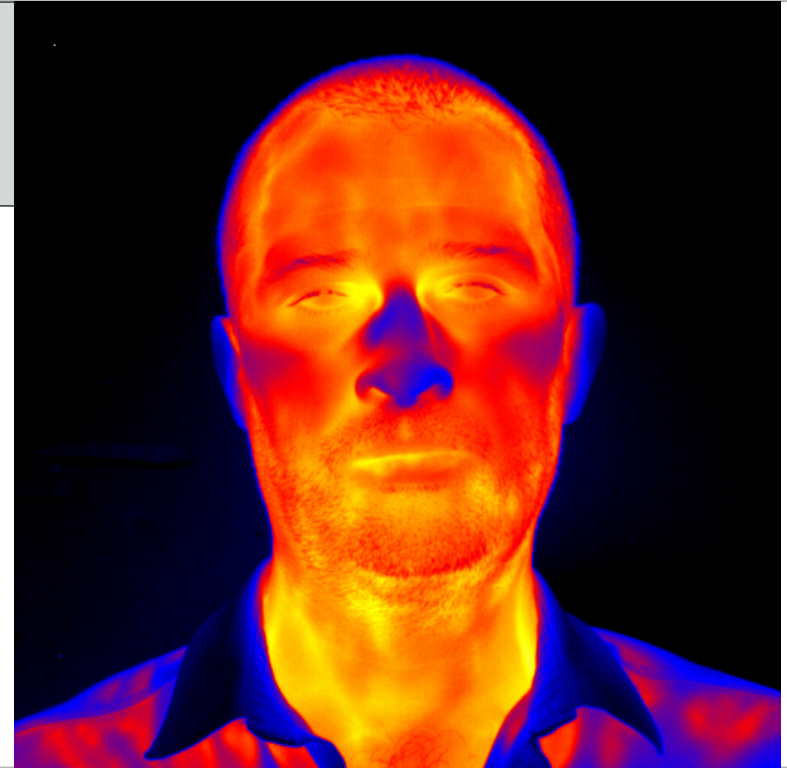
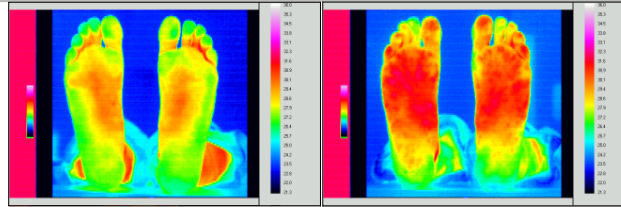
convert

- **3D Computer Aided Design**
- **Simulation, Analysis & Testing**

create

- **Product Design Innovation**
- **Product Prototyping**

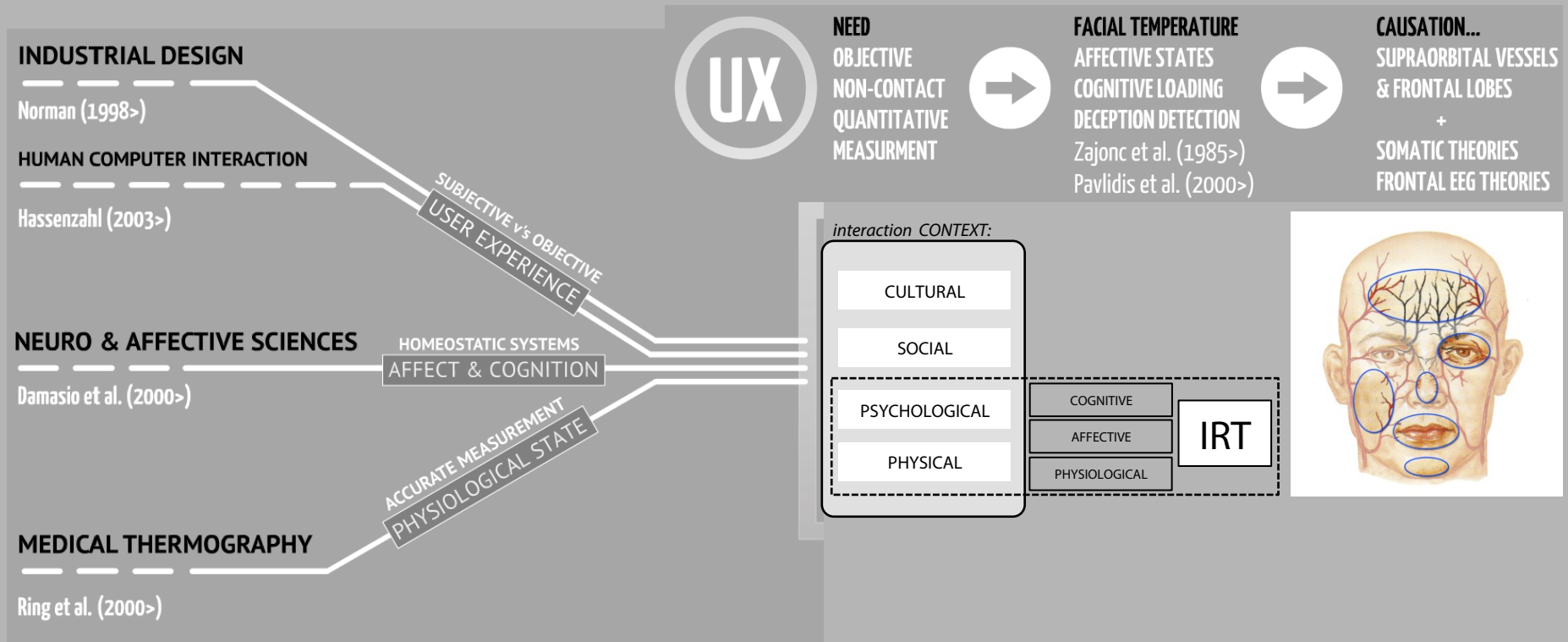
# Infrared Thermography



a technique used to visualise and measure **infrared radiant energy**



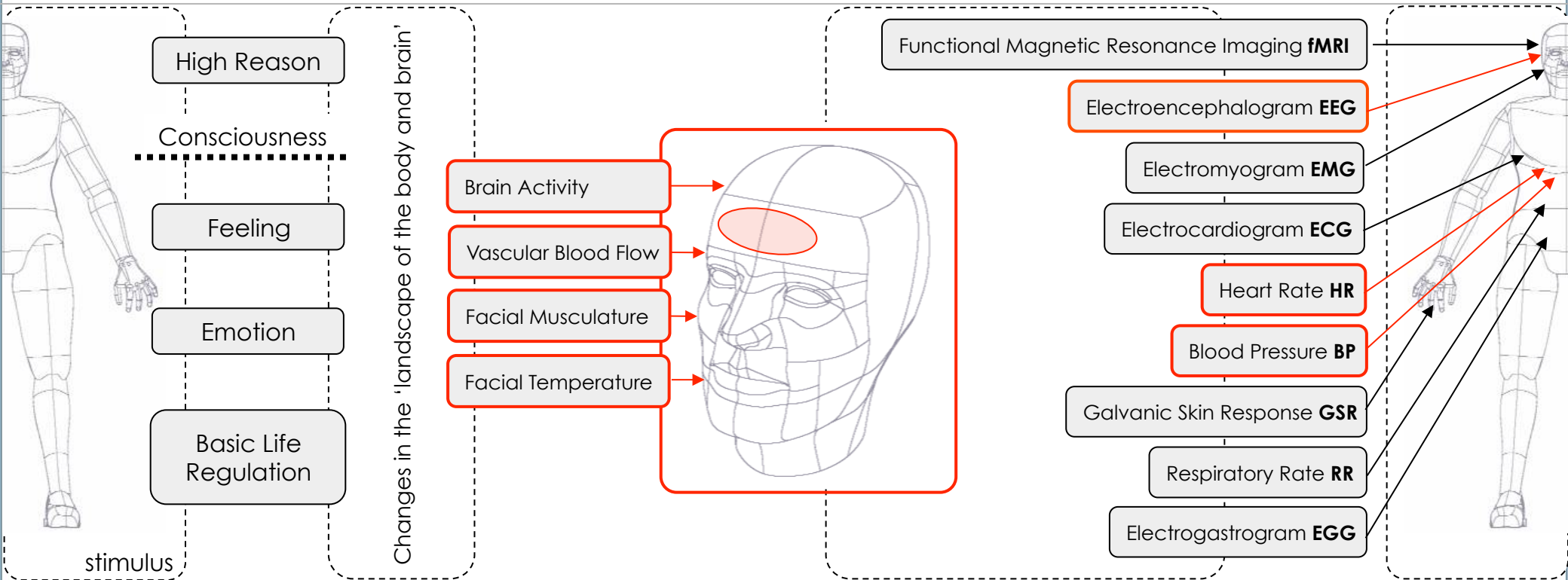
# Thermographic Measurement of UX



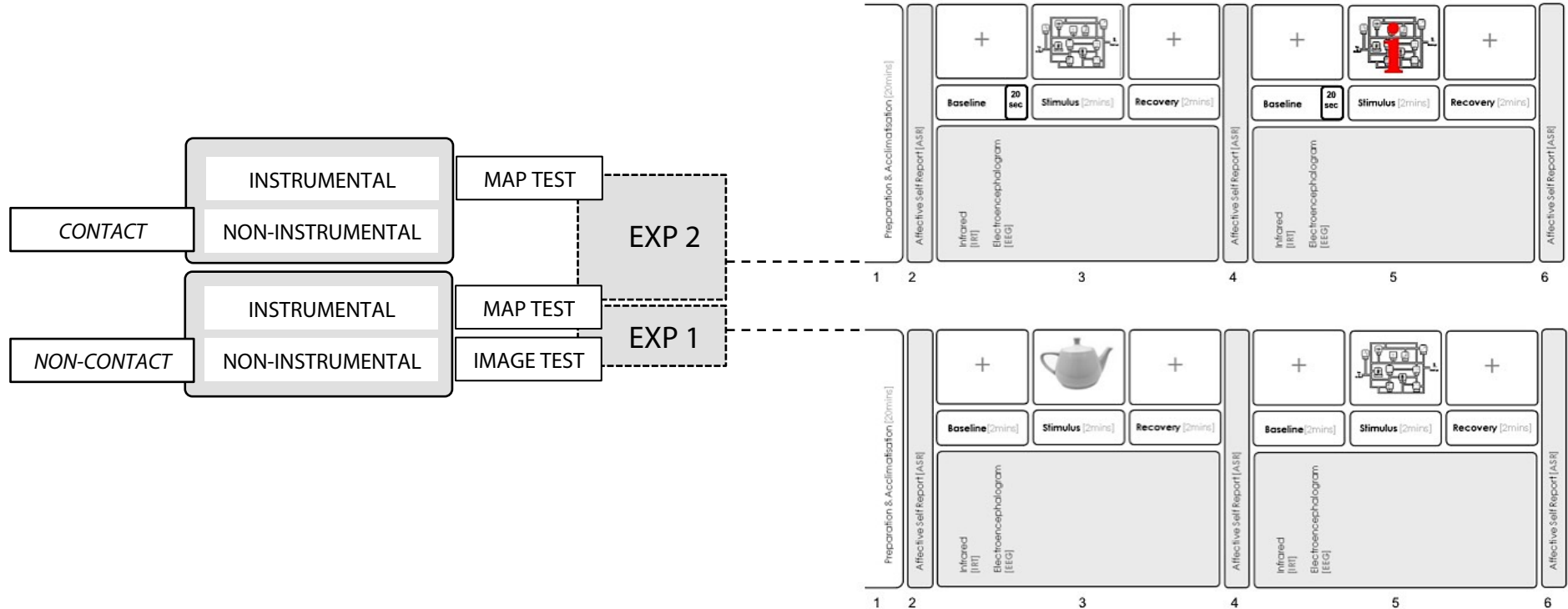
**“...emotions are part of the mechanism of homeostatic regulation”**

*Damasio (2000)*

# Measures of Cognition and Affect



# Empirical model of Product Interaction

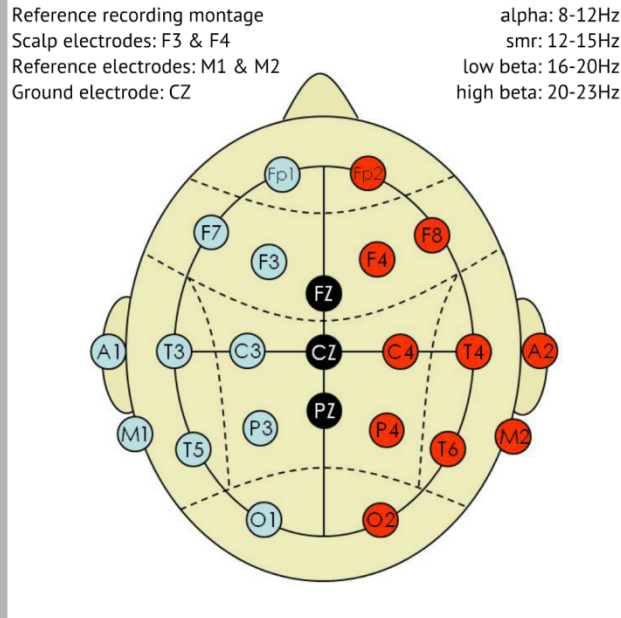


# Between Methods Triangulation



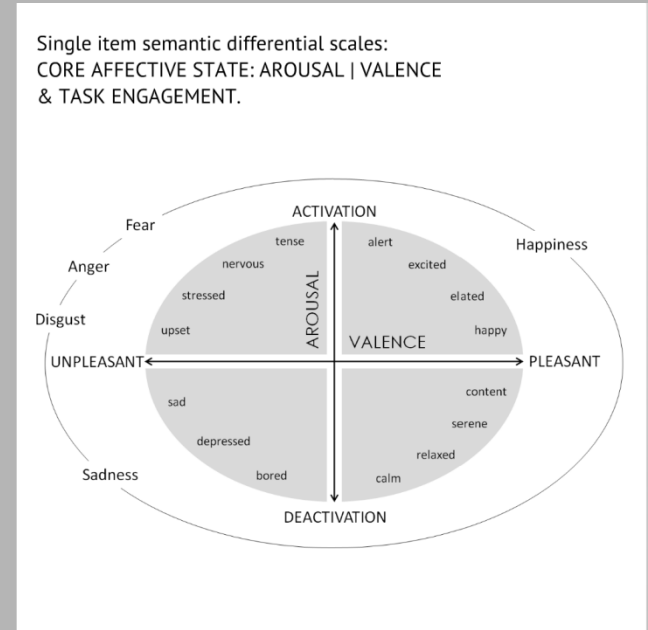
Infrared Thermography [IRT]

Non-contact objective measure



Electroencephalogram [EEG]

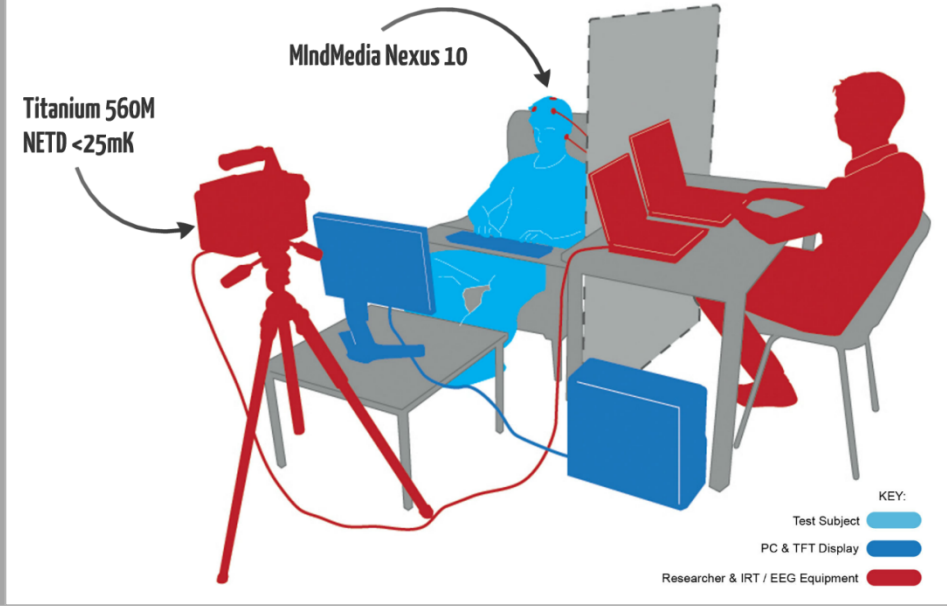
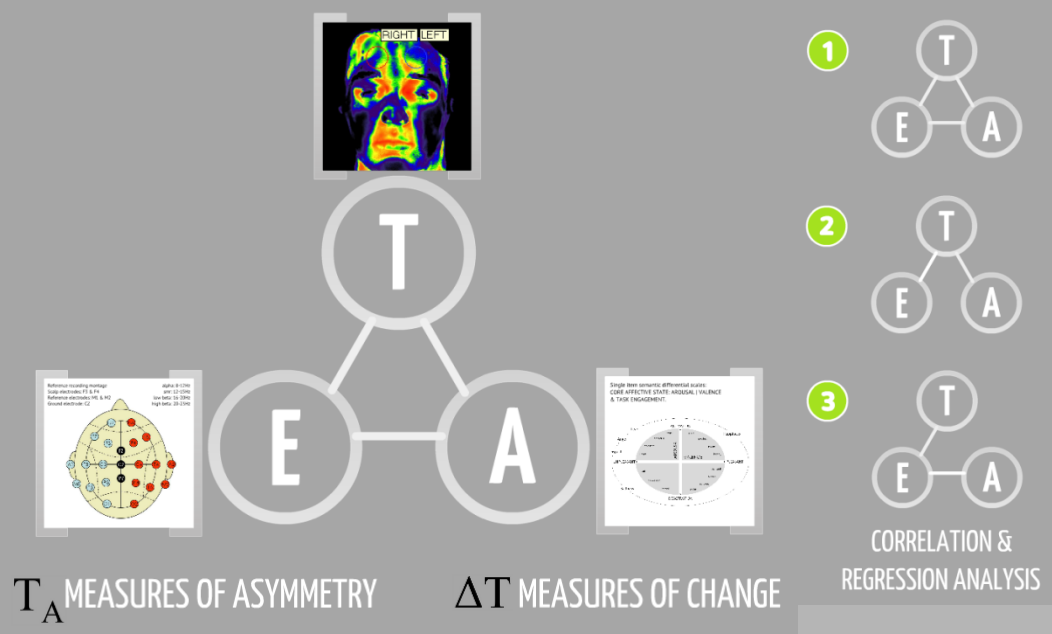
Contact objective measure



Affective Self Report [ASR]

Subjective measure

# Between Methods Triangulation



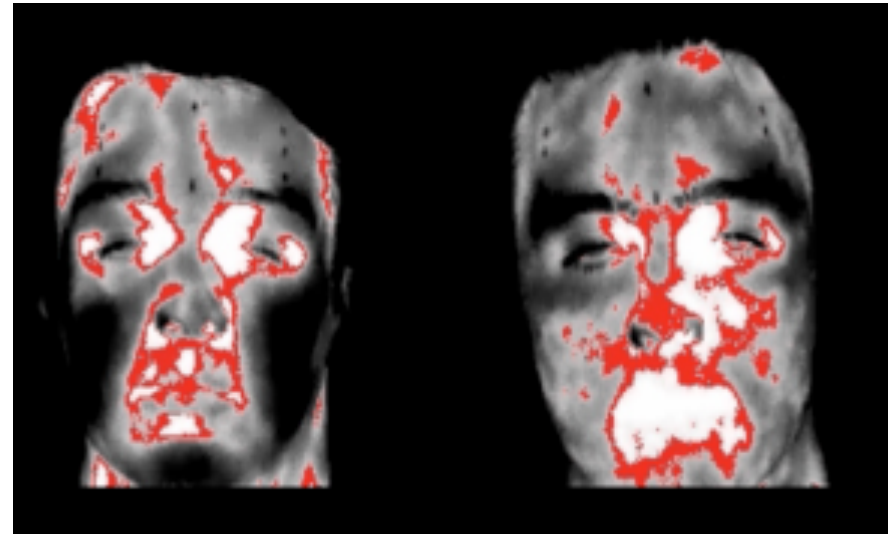
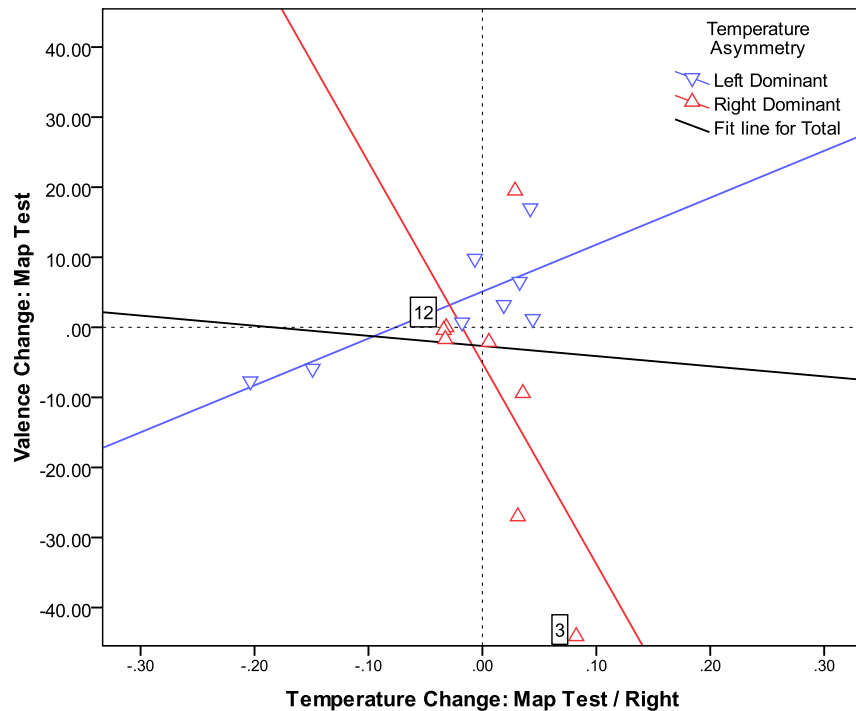
# Motion Compensation and Analysis

The screenshot displays the MotionByInterpolation software interface, which is used for motion compensation and analysis. The interface is divided into several panels:

- Display Panel (Left):** Shows a grayscale image of a human face with blue motion vectors overlaid. A list of frame numbers (9459 to 7418) is visible on the right side of this panel.
- Position mark tracking Panel (Top Left):** Includes buttons for "Position mark tracking", "Motion compensation", and "Calculate stress".
- Temperature Analysis Panel (Top Right):** Displays a thermal map of the face with "RIGHT" and "LEFT" labels. A color scale on the right indicates temperature from 33.99 to 38.00 °C. Below the map is a graph showing temperature trends over time (frames 0 to 720) for both sides.
- Stress Measurement Panel (Bottom Left):** Contains controls for "Displacement size" (7 px), "Size" (5 px), "Spatial resolution" (7), and "Deformation" (0.99999). It also includes "Physical units" settings for "Emissivity" (0.98), "Material" (Steel), and "Km" (3.14e-006).
- Player Panel (Bottom):** Shows a video player with a timeline and playback controls. The current frame is 448/720, and the time is 11:16:43.362.



# Thermographic Measurement of UX



**SUBJECT 3**  
High arousal  
High engagement  
Negative valence

**SUBJECT 12**  
Low arousal  
Low engagement  
Positive valence

*Jenkins, Brown & Rutterford (2009)*

# Thermographic Measurement of UX

Baseline (trait) asymmetry °C = LEFT | RIGHT Dominant

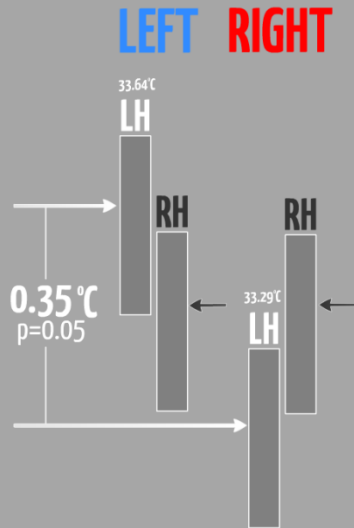
N=33 >

LEFT

N=20

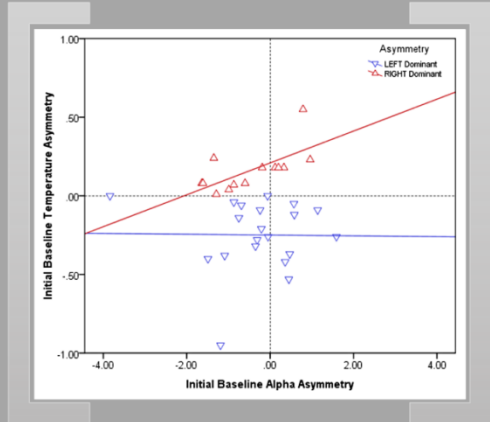
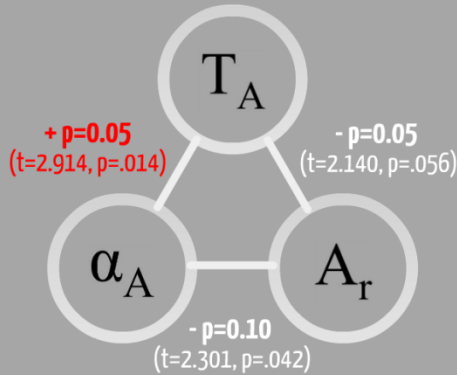
RIGHT

N=13

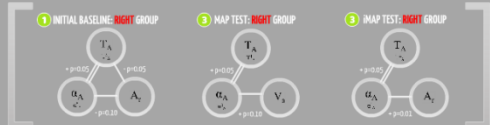


CORRELATIONS WITH TEMPERATURE ASYMMETRY (NB: Regression analysis indicates strong linear relationship)

1 INITIAL BASELINE: RIGHT GROUP



- Hemispherical differences of both groups significant throughout experiment ( $p=0.01$ )
- Right Dominant group had significantly higher baseline self reported arousal ( $p=0.05$ )
- Positive correlation between temperature and alpha asymmetry.
- Negative correlation between physiological measures of asymmetry and arousal.

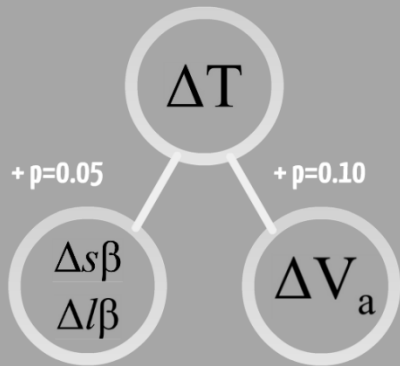


Jenkins & Brown (2014)

# Thermographic Measurement of UX

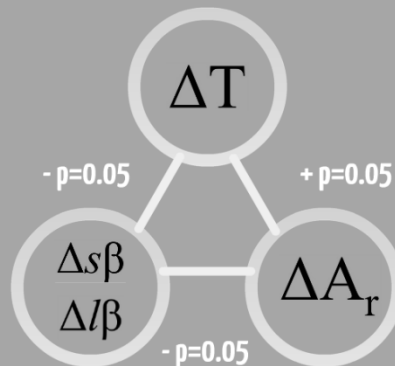
## CORRELATIONS WITH TEMPERATURE CHANGE (NB: Regression analysis indicates strong linear relationship)

2 MAP: **RIGHT** GROUP | RIGHT HEMISPHERE



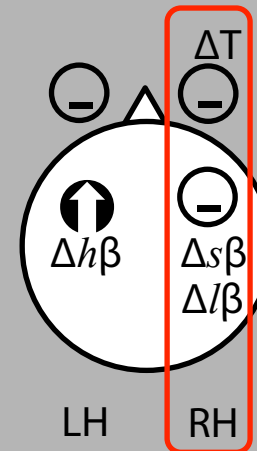
- Positive correlation between changes in temperature and beta frequencies
- Positive correlation between temperature and arousal

1 iMAP: **RIGHT** GROUP | LEFT HEMISPHERE



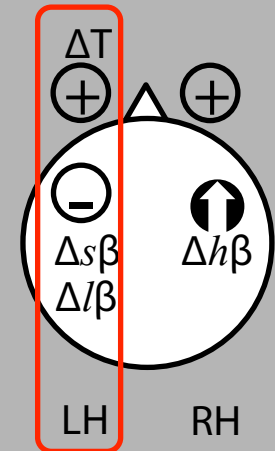
- Negative correlation between changes in temperature and beta frequencies.
- Positive correlation between changes in temperature and arousal.

MAP



Increased arousal  
Positive task response

iMAP



Decreased arousal  
Negative task response

# Thermographic Measurement of UX



Tonic Supraorbital Temperature Asymmetry = **LEFT** | **RIGHT** Dominant 'TYPES'  
Indicates that population samples are more complex than previously considered...



Temperature asymmetry is an index of underlying trait frontal EEG activation and autonomic balance which appears to moderate cognitive and affective reactivity to stimuli...

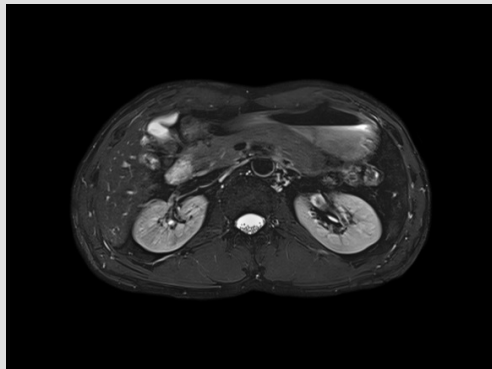


Tonic trait influences nature of response to the level of interaction and the effectiveness of measurement



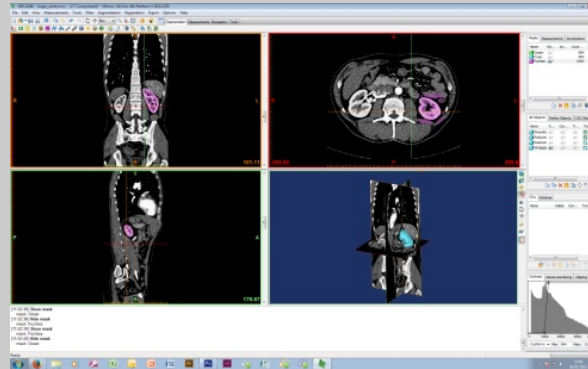
# Capture | Convert | Create

## capture



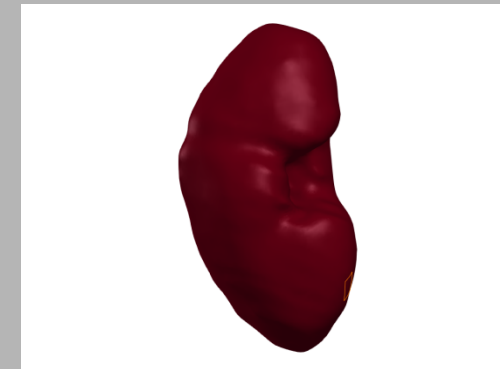
Magnetic Resonance Imaging  
Structured Light Scanning  
Photogrammetry & IRT

## convert



Materialise Mimics  
Solidworks /  
Autodesk Fusion 360

## create

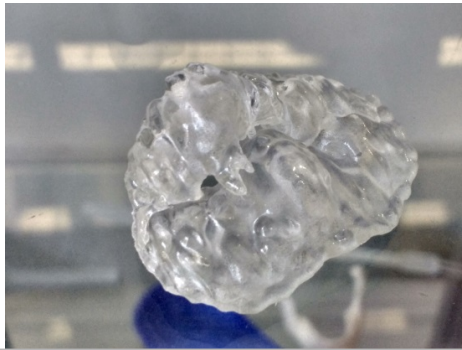
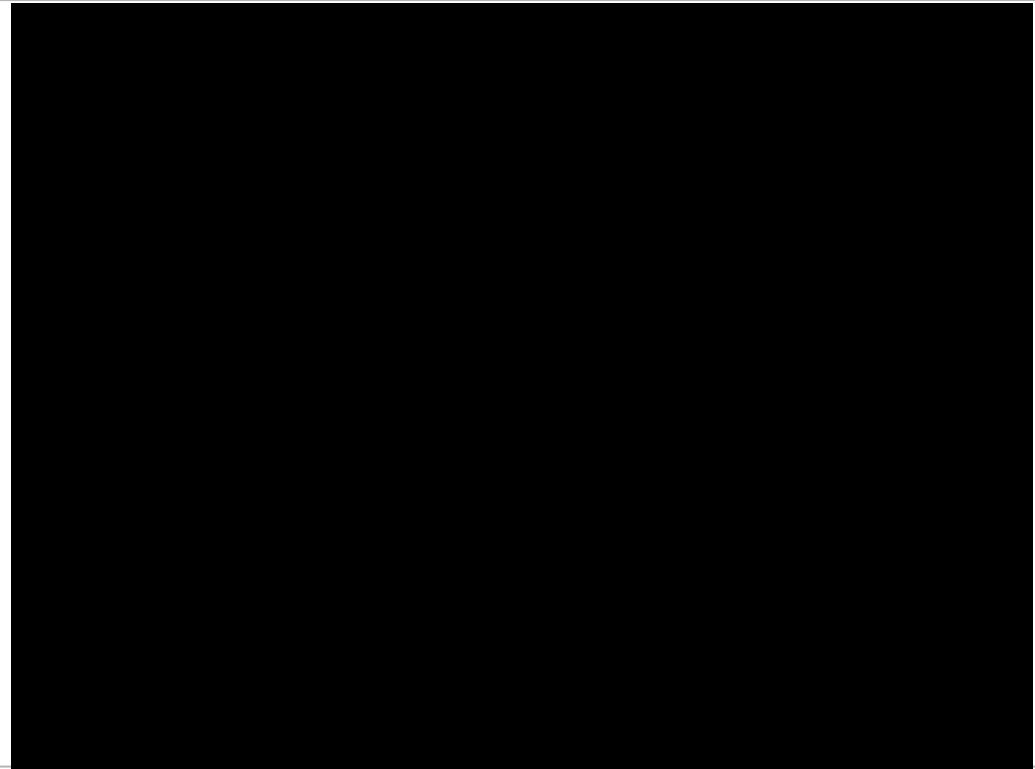
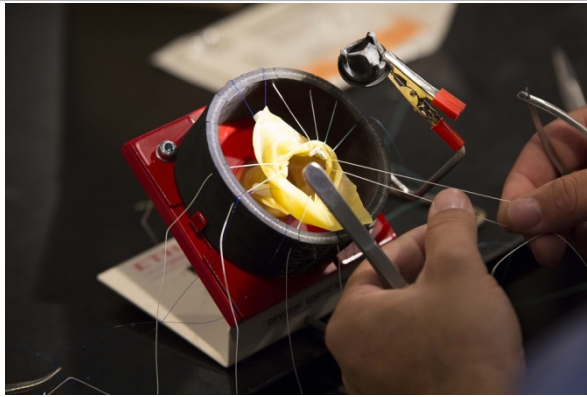


Selective Laser Sintering  
Multijet Printing  
Fused Deposition Modelling

**“all healthy bodies are alike, each unhealthy body is unhealthy in its own way”**

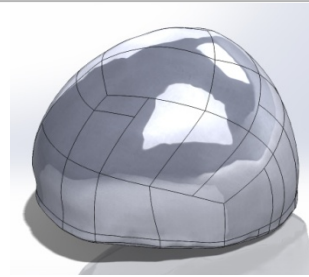
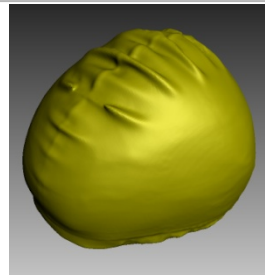
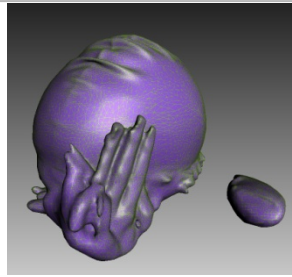
*Lieberman D. E. 2013*

# Heart Surgery Training Aid





# Bespoke Riding Helmet

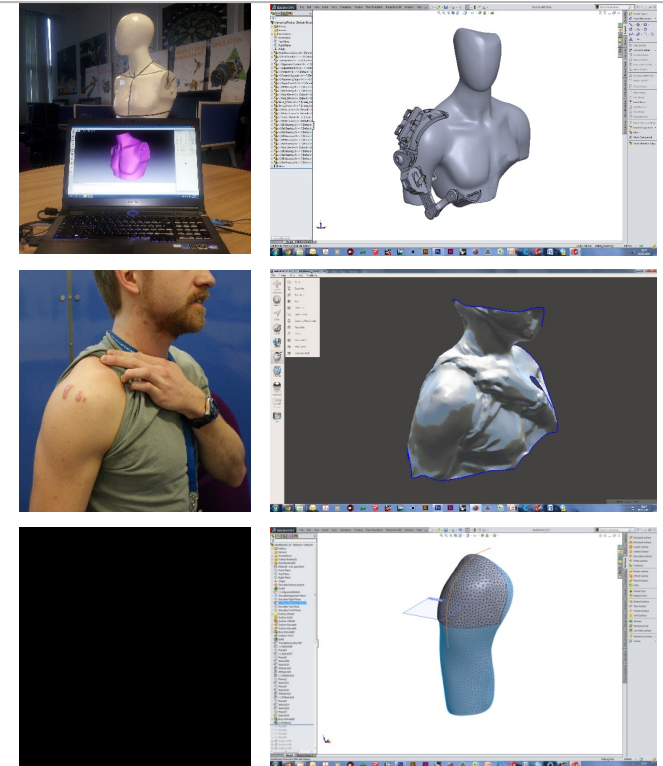


# Collaboration with :





# Collaboration with :



# Respiratory healthcare + design research



GIG  
CYMRU  
NHS  
WALES

Bwrdd Iechyd Prifysgol  
Hywel Dda  
University Health Board

Prince Philip Hospital, Clinical Research Centre



Prifysgol Cymru  
Y Drindod Dewi Sant  
University of Wales  
Trinity Saint David

School of Design & Applied Arts

Swansea  
College of Art  
Founded 1853

re: **DRAW**  
RESPIRATORY DESIGN RESEARCH WALES



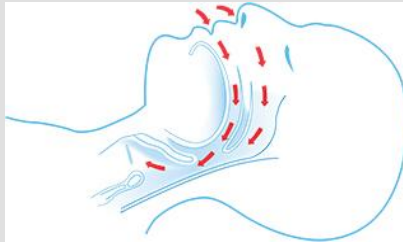
Prifysgol Cymru  
Y Drindod Dewi Sant  
University of Wales  
Trinity Saint David

Swansea  
College of Art  
Founded 1853

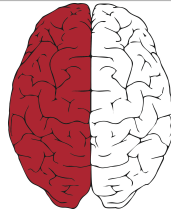
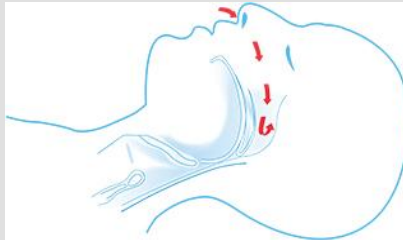
*Trawsnewid Addysg; Trawsnewid Bywydau  
Transforming Education; Transforming Lives*

# Obstructive Sleep Apnoea

Regular Breathing



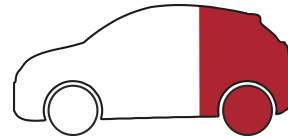
Cessation Breathing



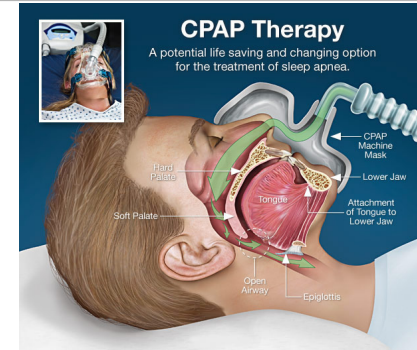
49%



46%



31%



RAND

EUROPE

**200,000 work days lost = £40 billion UK Economy (1.86% GDP)**

# Obstructive Sleep Apnoea

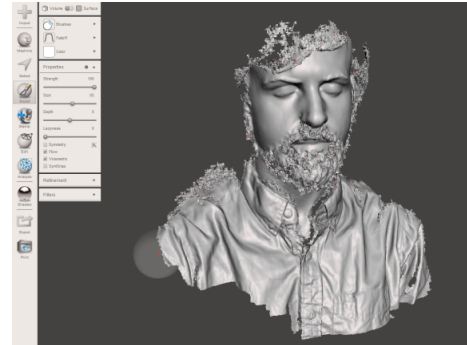
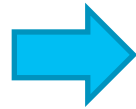
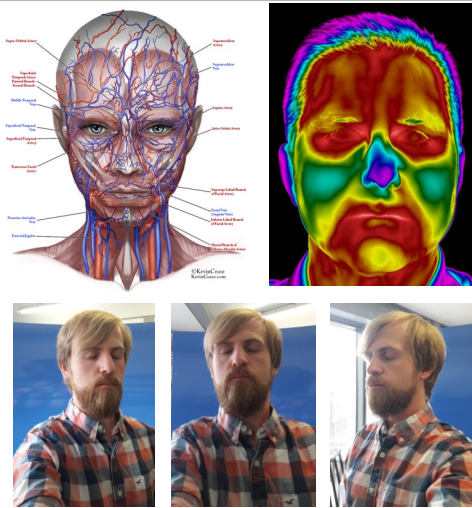


Problems with current treatment:

- **30% non-compliance**
- **Human – Mask Interface**
- **Mask leaks**
- **Dry eyes, nose and mouth**
- **Pressure Ulcers and Abrasions**
- **Awakenings**
- **Claustrophobia and Anxiety**
- **20 masks for 7 billion people**

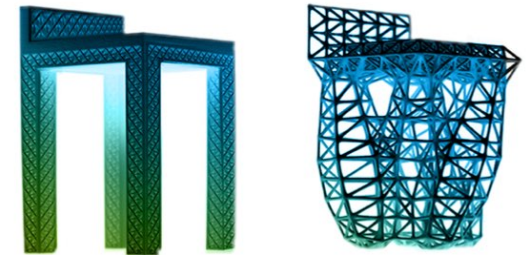
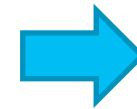
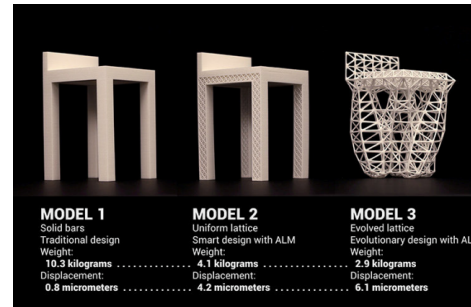


# User Informed Generative Design



FROM  
20 SIZES FOR  
7 BILLION PEOPLE

TO  
7 BILLION SIZES  
FOR  
7 BILLION PEOPLE





**THANK YOU**

Dr Sean Jenkins

[sean.jenkins@uwtsd.ac.uk](mailto:sean.jenkins@uwtsd.ac.uk)

Matthew Bellis

[matthew.bellis@uwtsd.ac.uk](mailto:matthew.bellis@uwtsd.ac.uk)



**Swansea**  
**College of Art**  
Founded 1853