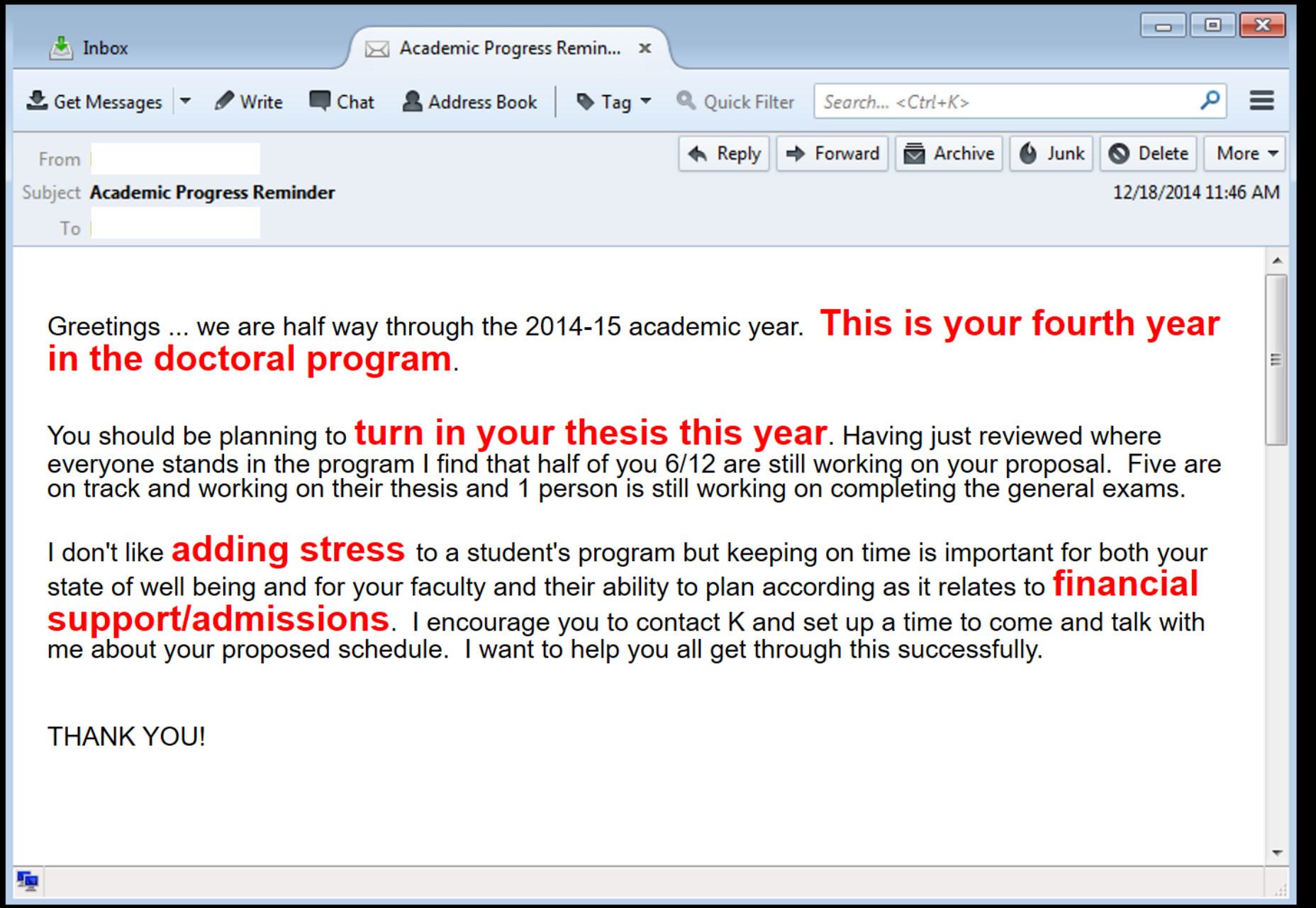
Emotion AI and Future Health

Javier Hernandez, Ph.D.

Research Scientist, Massachusetts Institute of Technology www.javierhr.com
Founder & CEO, Global Vitals LLC www.globalvitals.com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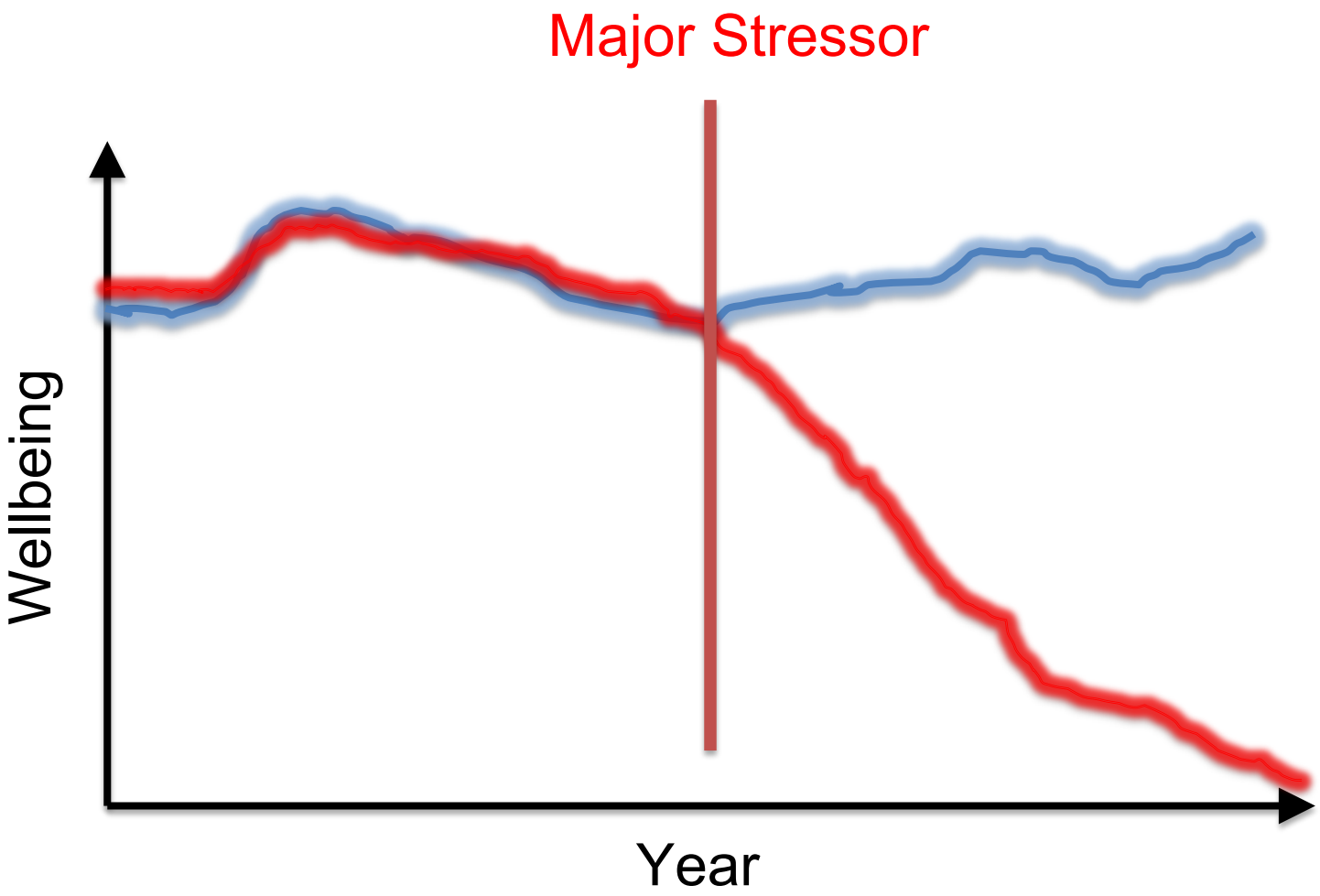
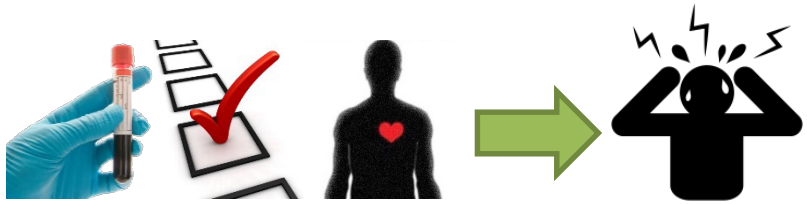
12/18/2014 11:46 AM
Greetings ... we are half way through the 2014-15 academic year. This is your fourth year in the doctoral program.
You should be planning to turn in your thesis this year. Having just reviewed where everyone stands in the program I find that half of you 6/12 are still working on your proposal. Five are on track and working on their thesis and 1 person is still working on completing the general exams.
I don't like adding stress to a student's program but keeping on time is important for both your state of well being and for your faculty and their ability to plan according as it relates to financial support/admissions. I encourage you to contact K and set up a time to come and talk with me about your proposed schedule. I want to help you all get through this successfully.
THANK YOU!

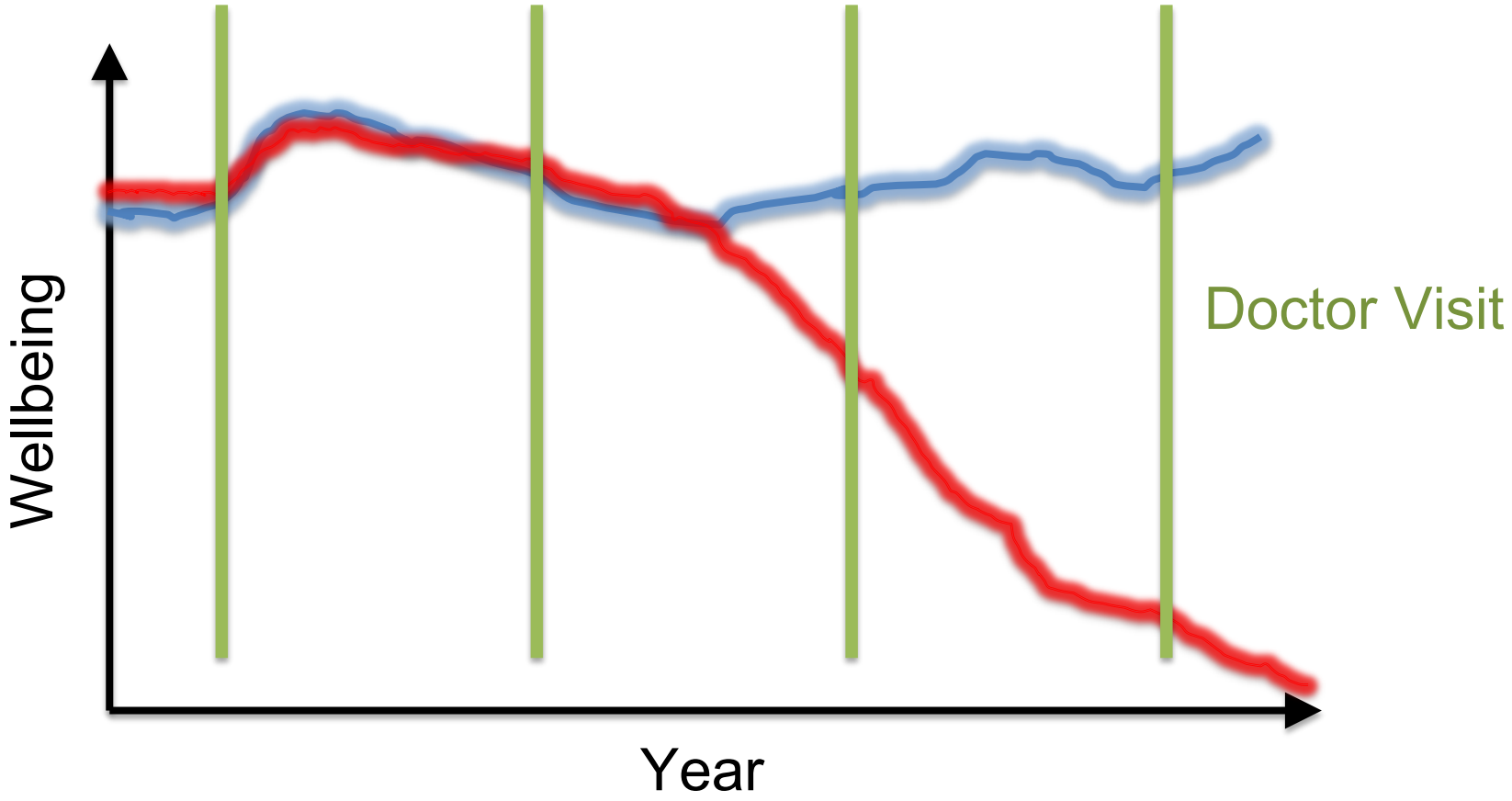

MCMXVII
MASSACHVSETTS INSTITVTE OF TECHNOLOGY

1 in 4 Americans experience **mental health** problems in a given year

NIMH Statistics

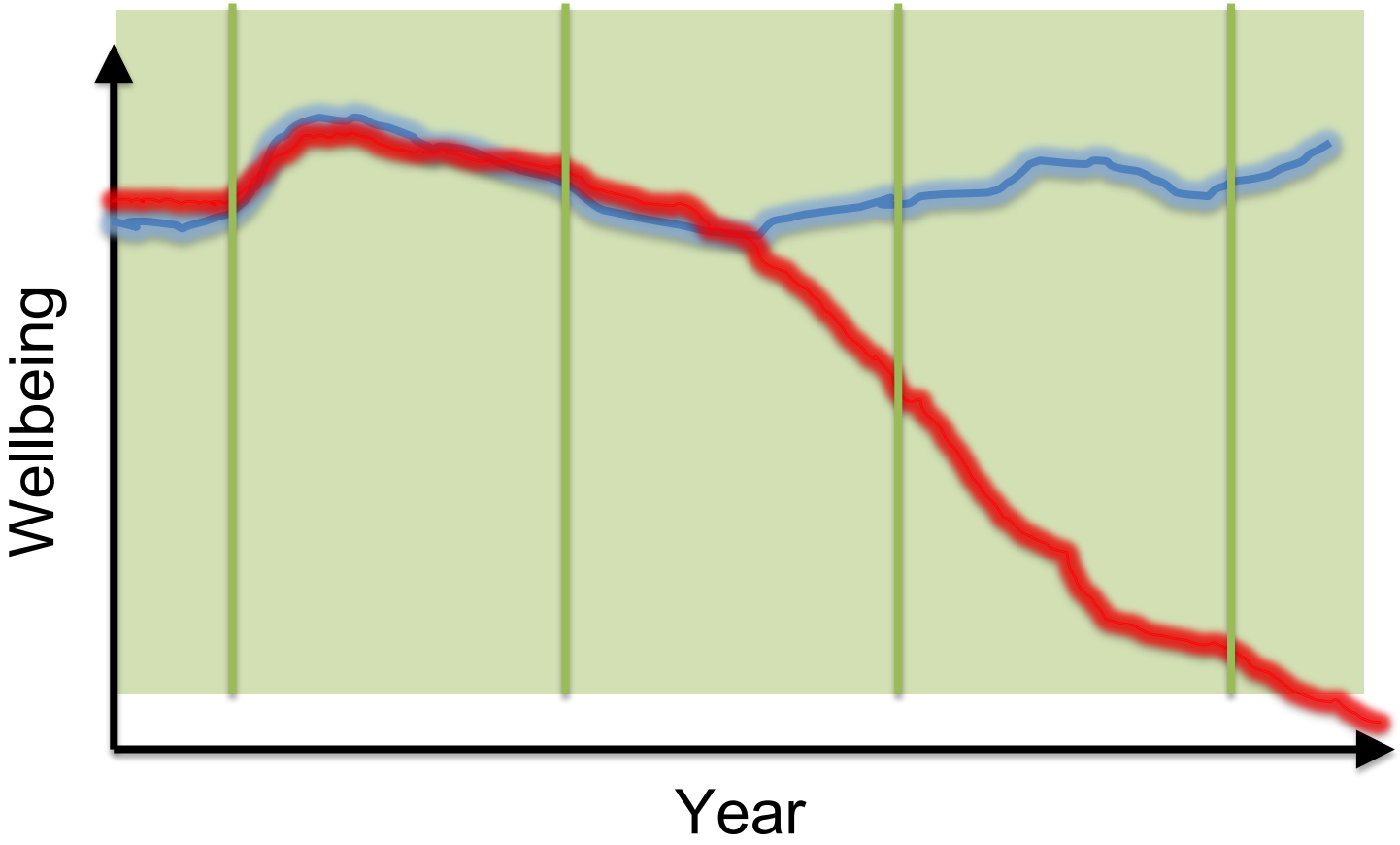

Major Stressor
Wellbeing
Year





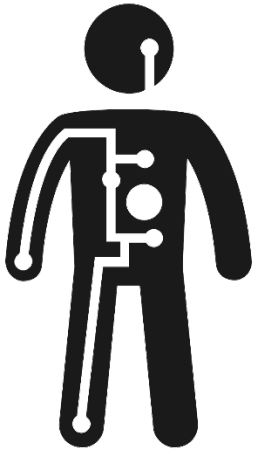
Infrequent assessments

in response to problems

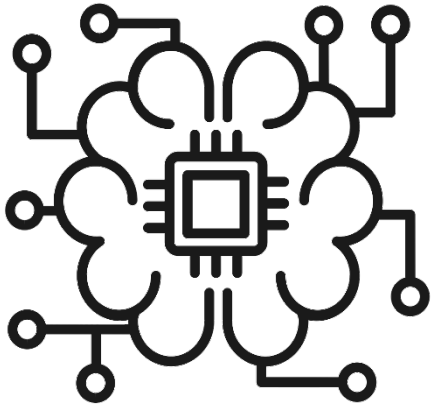


Continuous assessments

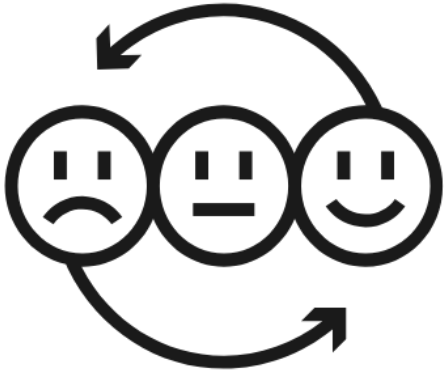
in prevention to problems



Comfortable
Sensing

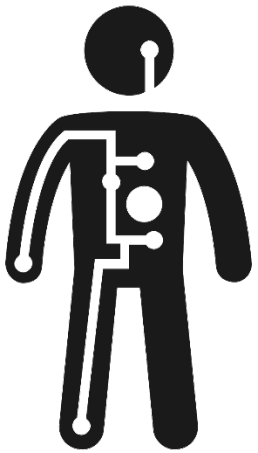


Intelligent
Modelling

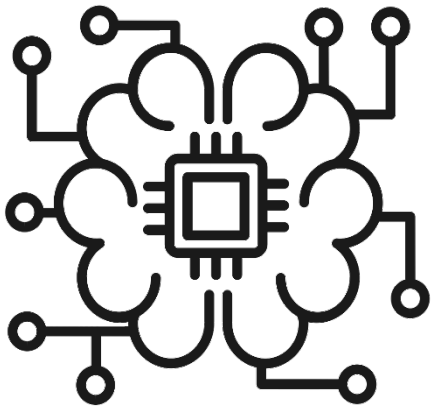


Effective
Intervention

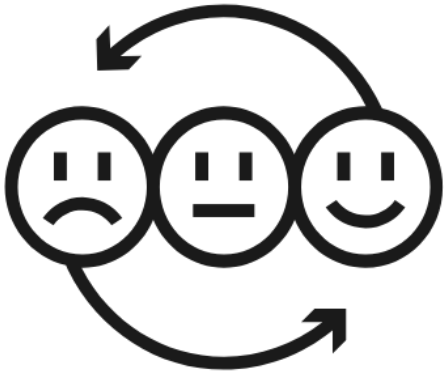
To Promote Emotional Wellbeing



Comfortable Sensing

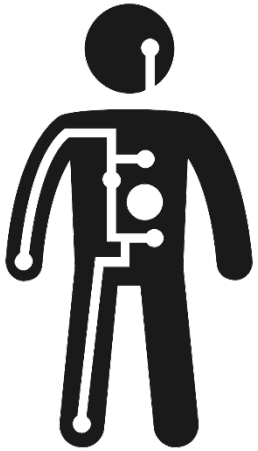


Intelligent Modelling

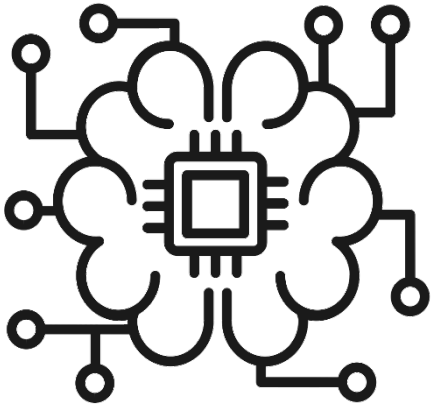


Effective Intervention

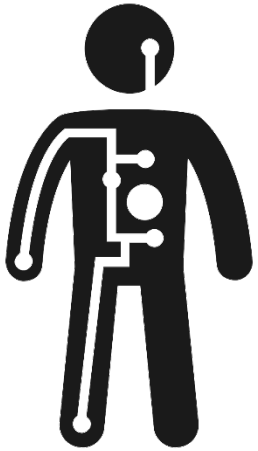
To Promote Emotional Wellbeing



Comfortable
Sensing



Intelligent
Modelling



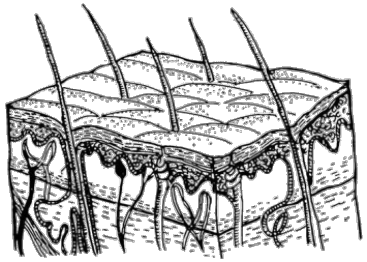
Comfortable
Sensing

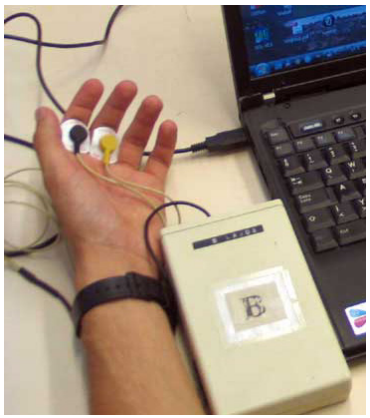
Intelligent
Modelling

Comfortable
Sensing

Intelligent
Modelling

Electrodermal Activity (aka GSR)





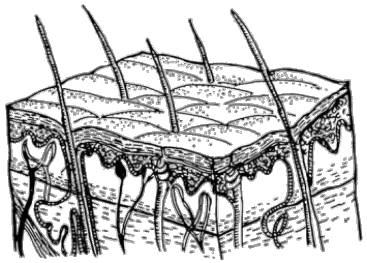
Skin Conductance
Wires
Fingers

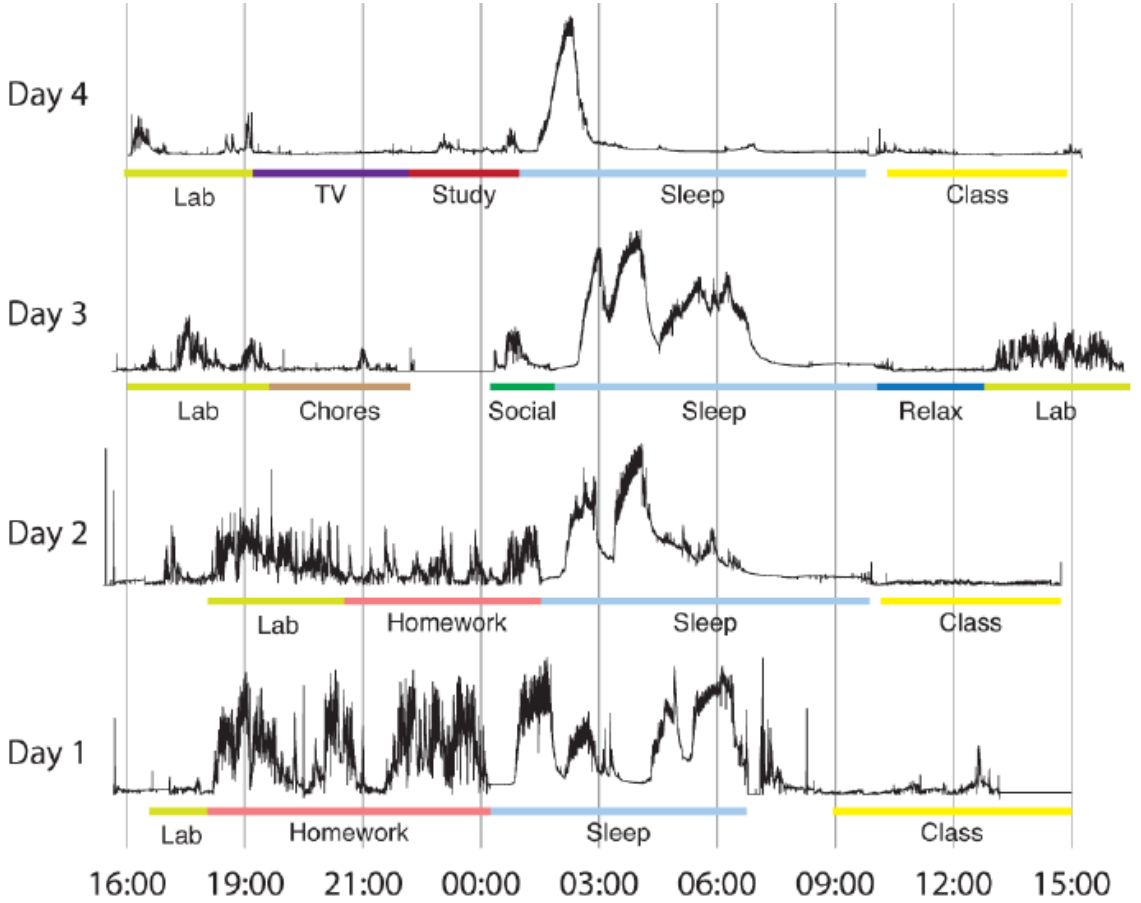
Affective Computing group
Wireless
Wrist/ankle

Spin-off Companies
Wireless
Commercial sensors

affectiva® EMPATICA

Electrodermal Activity (aka GSR)

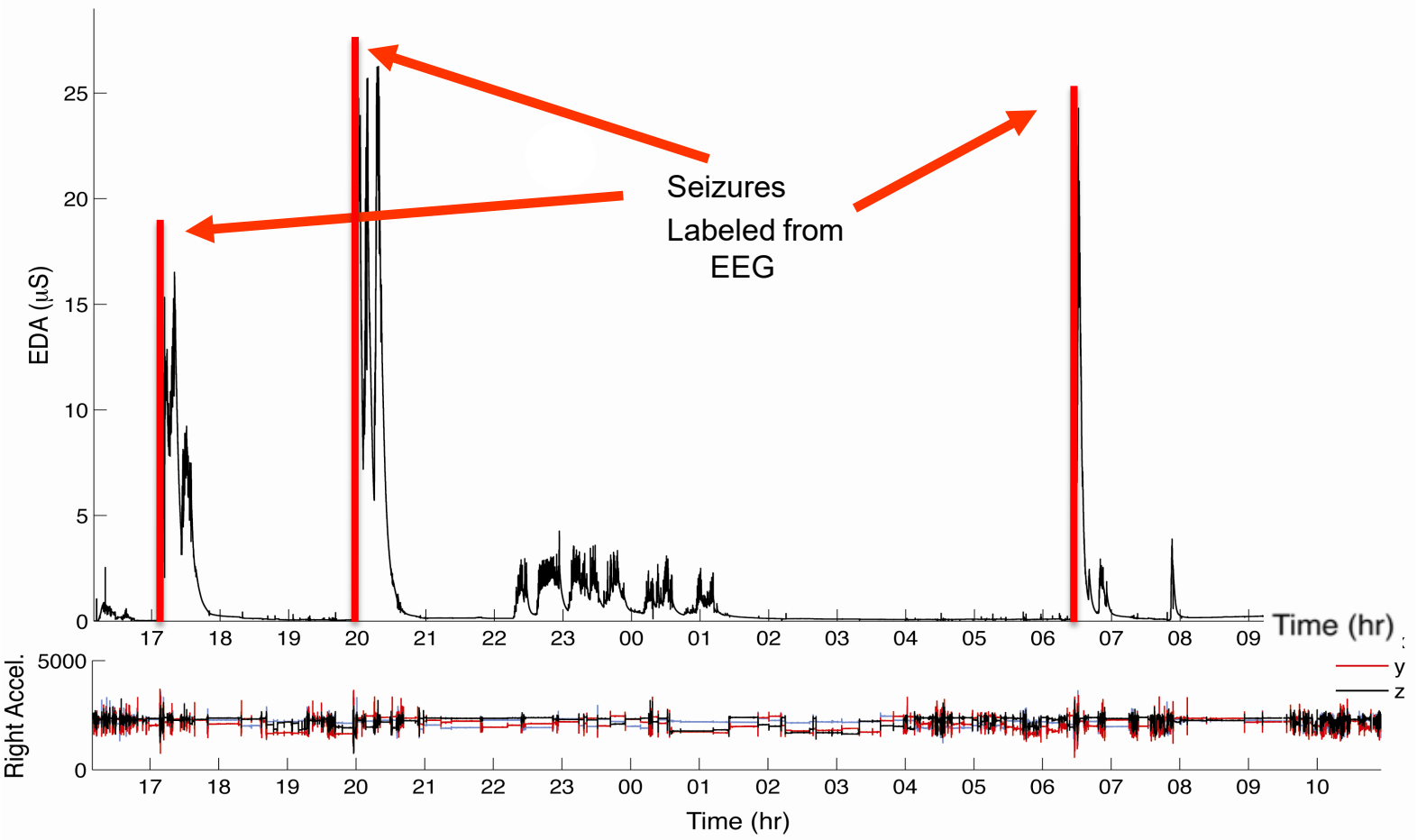




Poh, M.Z., Swenson, N.C., Picard, R.W., "Comfortable Sensor Wristband for Ambulatory Assessment of Electrodermal Activity," Ambulatory Assessment, 2009.

Sano A., Picard R.W., "Recognition of Sleep Dependent Memory Consolidation with Multi-modal Sensor Data", The 10th Annual Body Sensor Networks, 2013.

Electrodermal Activity (aka GSR)



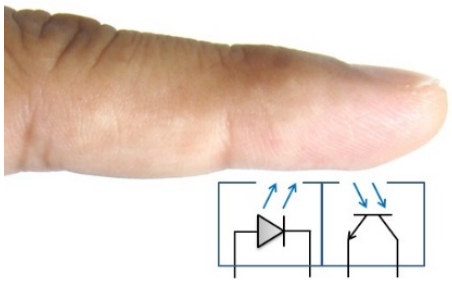
Poh, M.Z., Loddenkemper, T., Reinsberger, C., Swenson, N.C., Goyal, S., Sabtala, M.C., Madsen, J.R., and Picard, R.W. "Convulsive Seizure Detection Using A Wrist-worn Electrodermal Activity and Accelerometry Biosensor," Epilepsia 2012

Electrodermal Activity (aka GSR)

www.empatica.com

Photoplethysmography

J. Allen, “Photoplethysmography and its application in clinical physiological measurement.,” Physiol. Meas., vol. 28, no. 3, pp. R1–R39, 2007.



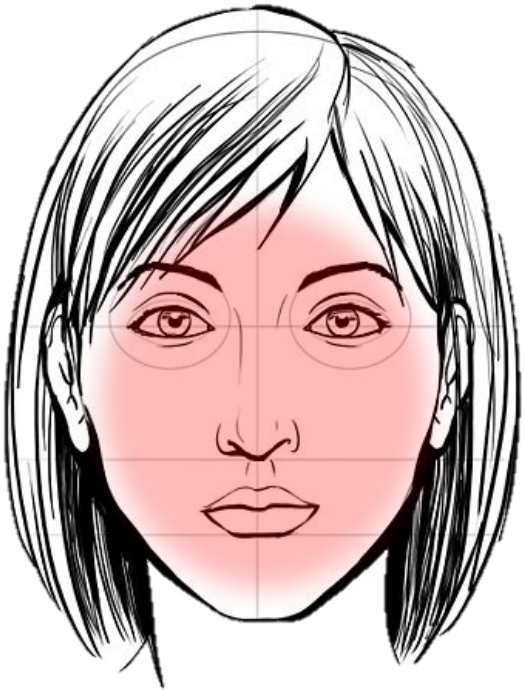
Blood Volume Pulse (BVP)

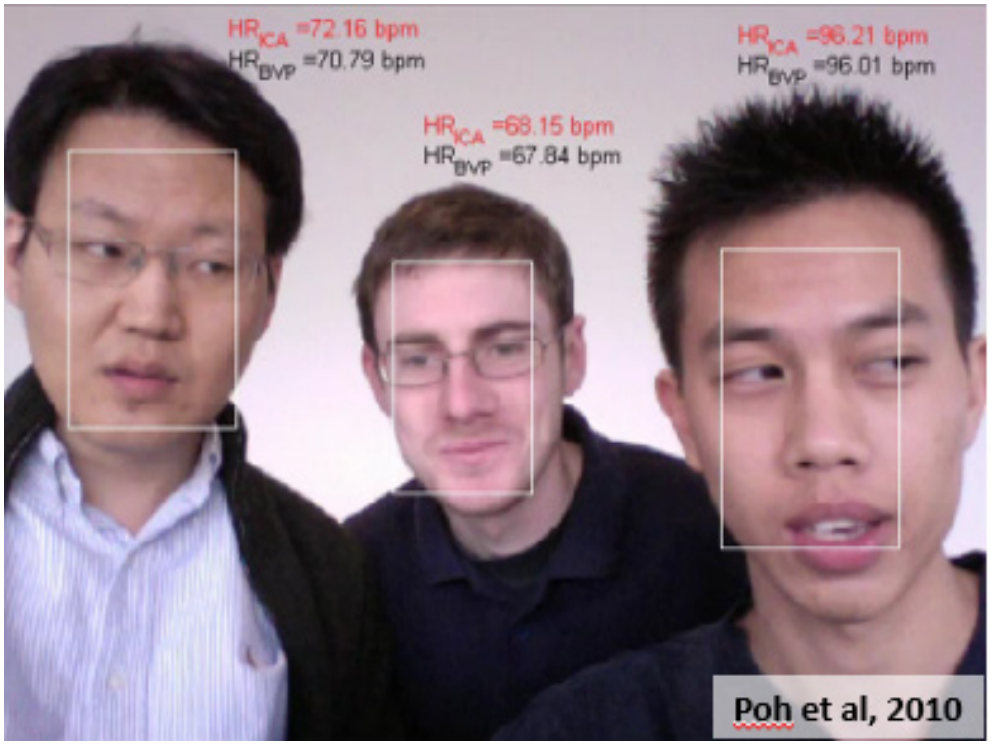
Apple Watch

Skin occlusion

Band tightness

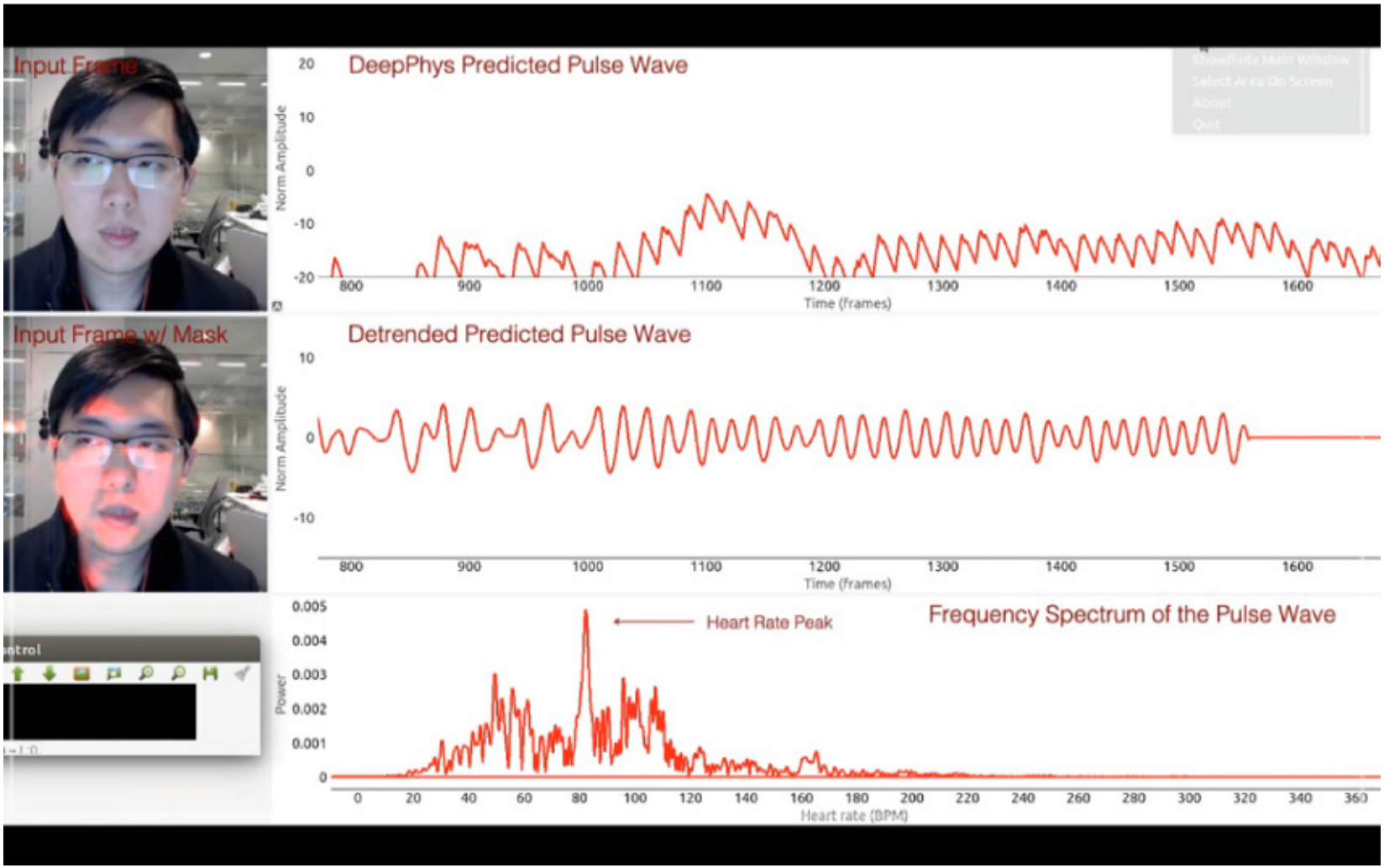
Remote Photoplethysmography





cardiio

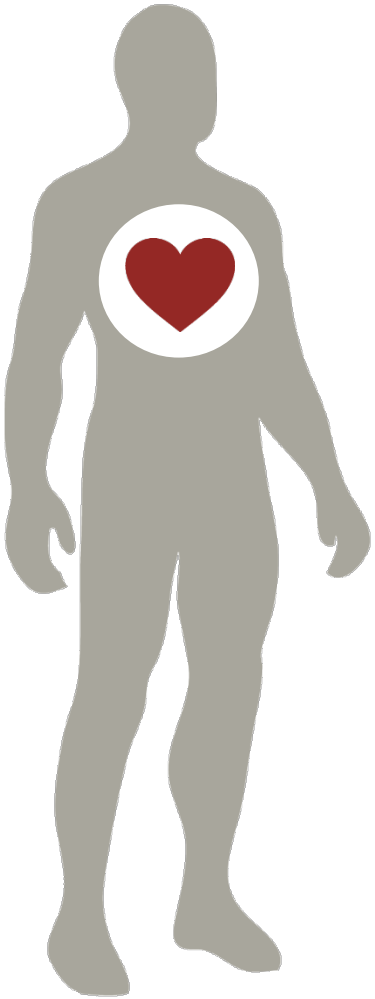
Remote Photoplethysmography

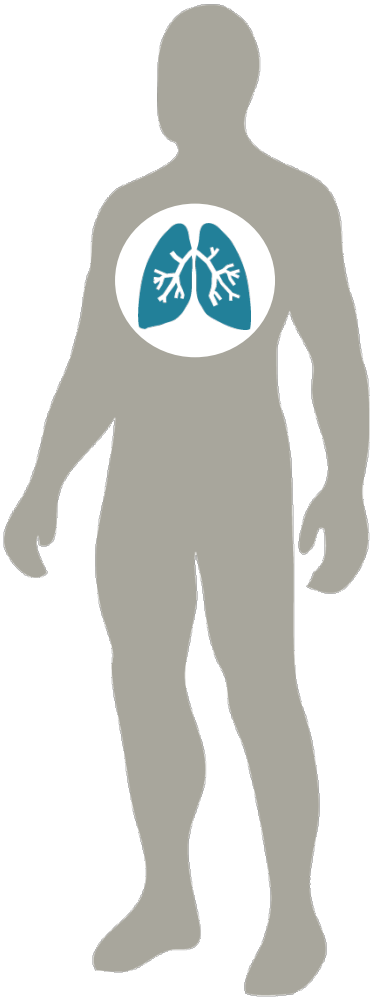


Chen W. and McDuff D. "DeepPhys: Video-Based Physiological Measurement Using Convolutional Attention Networks" In European Conference on Computer Vision (ECCV), 2018

Main contact: Weixuan 'Vincent' Chen <cvx@mit.edu>

Cardio-respiratory Body Vibrations





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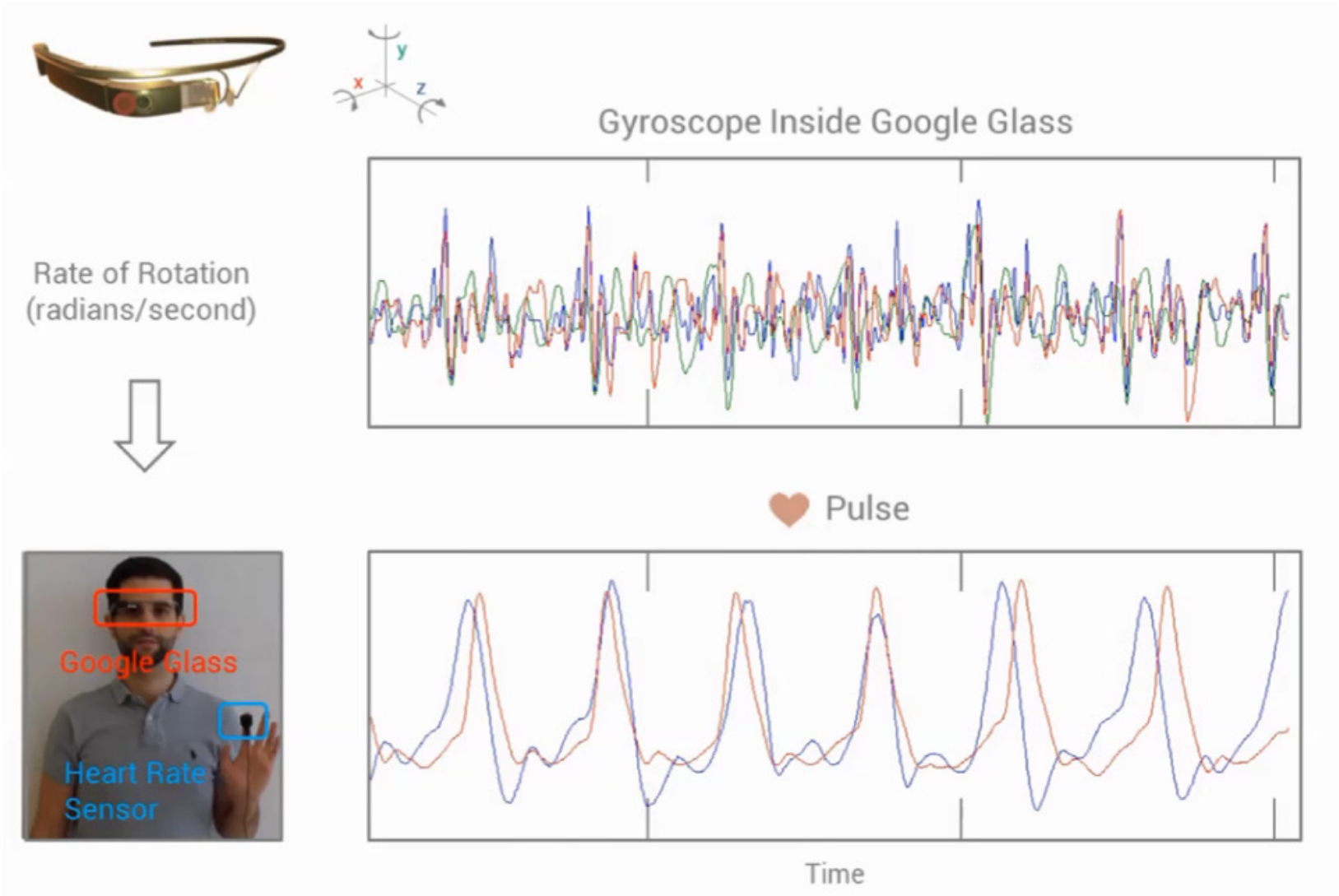
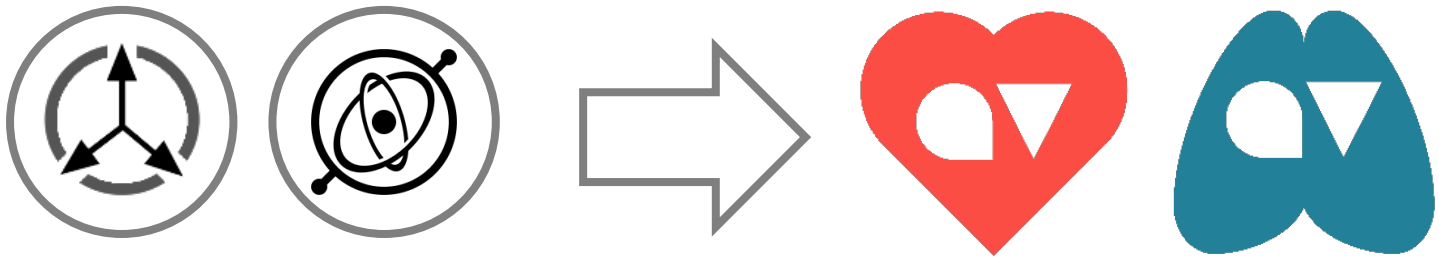


Hernandez, J., Li, Y., Rehg, J. and Picard, R. "Cardiac and Respiratory Parameter Estimation Using Head-mounted Motion-sensitive Sensors," EAI End. Trans. on Pervasive Health and Technology, 2015.

Global Vitals

Cloud-based API for large scale and comfortable physiological sensing with motion sensors such as those of smartphones



Democratizing physiological sensing

BOSE

SIX CAPITAL

FAU

POLA

MIT

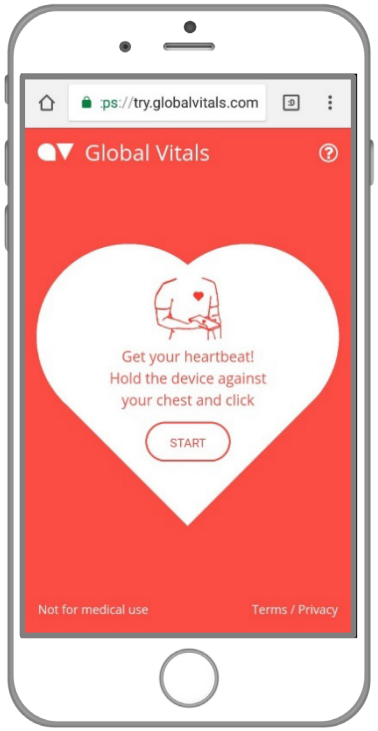
www.globalvitals.com

info@globalvitals.com

Online Demo: Cloud-based Wearable!

Check your heart rate just by visiting a website!

1. Visit ***try.globalvitals.com*** from your phone
2. Place the phone on your lap or your chest
3. Press start
4. Remain still for 30 seconds



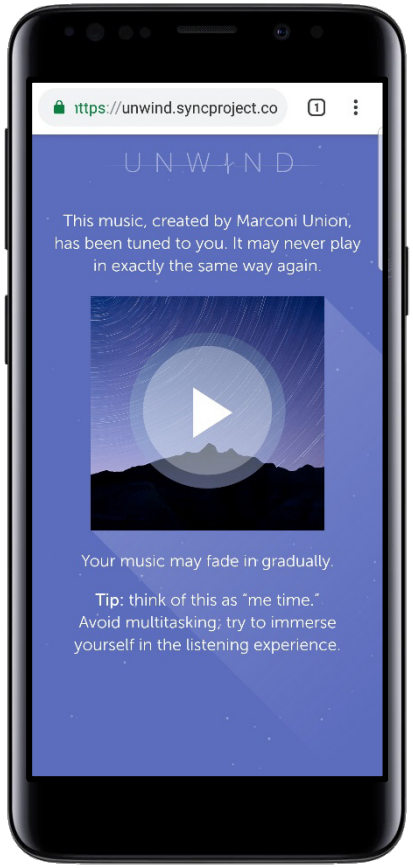
Perfect for remote and large-scale experiments

1. Low-cost
2. Comfortable

Global Vitals
www.globalvitals.com
info@globalvitals.com

Unwind by Sync Project (acquired by BOSE)

Personalized music to help you sleep



Sync Project

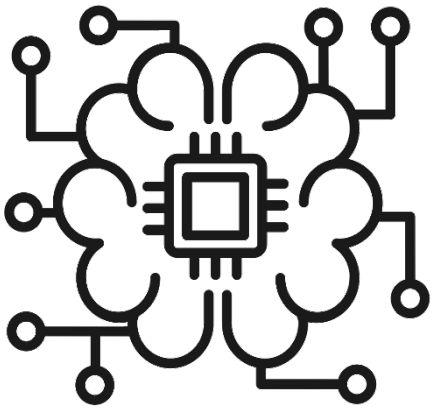
unwind.syncproject.co

yadid@syncproject.co

Comfortable
Sensing

Intelligent
Modelling

Comfortable
Sensing



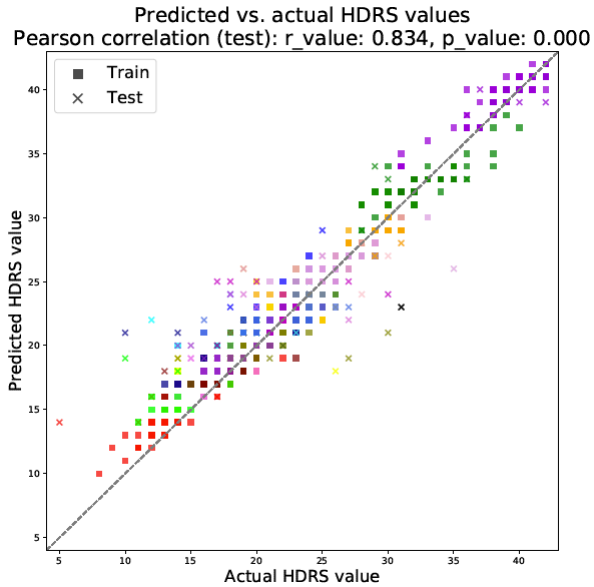
Intelligent
Modelling

6.9% of adults in the U.S. (16M) had at least one major **depressive** episode in the past year

Depression may become #1 disease burden by 2030

NIMH & WHO Statistics

Digital Phenotyping of Depression



22 patients with major depression

Bi-weekly clinical assessments

8 weeks study

0.834 ($p<0.01$) correlation with Hamilton Depression Rating Scale

4.5 root mean squared error

Main digital depressive symptoms associated with: irregular sleep, less motion, fewer incoming messages, and higher EDA asymmetry.

Ghandeharioun, A., Fedor, S., Sangermano, L., Ionescu, D., Alpert, J., Dale, C., Sontag, D., Picard, R. "Objective assessment of depressive symptoms with machine learning and wearable sensors data," International Conference on Affective Computing and Intelligent Interaction (ACII), 2017.

Main contact: Asma Ghandeharioun <asma_gh@mit.edu>

25% of Americans have suffered from **pain** that lasts longer than 24 hours

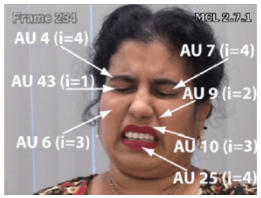
100M Americans suffer from chronic **pain**

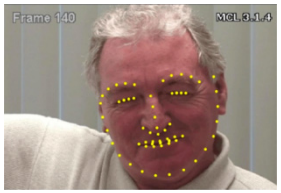
Pain is the leading cause of disability and it is a major contributor to health care costs

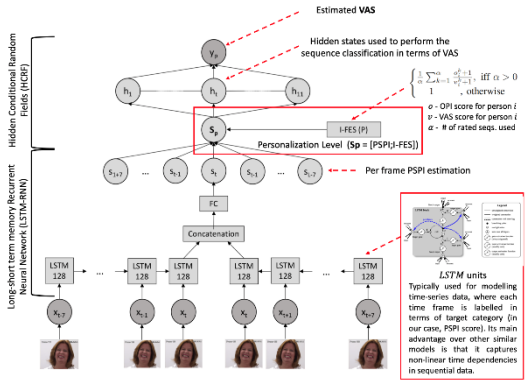
NIH & IMNA Reports

Personalized Pain Measurement

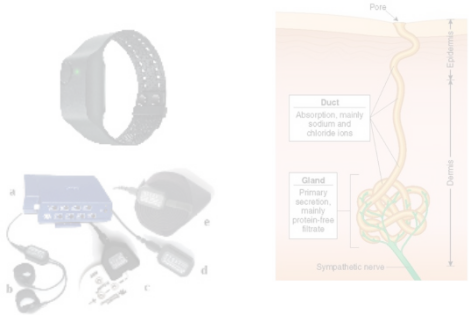
Facial Expressions



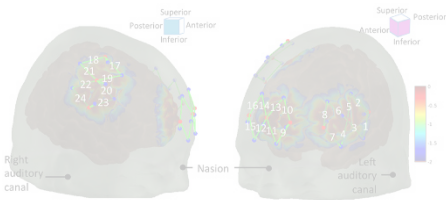




Wearables



Brain Signals

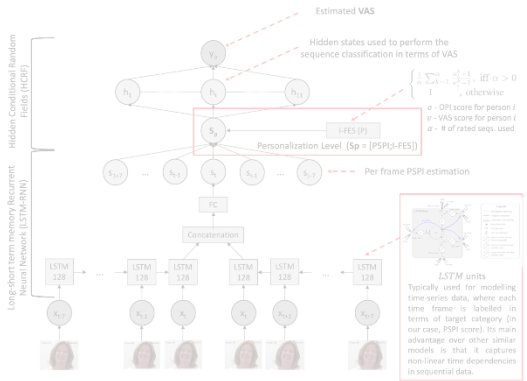


Lopez-Martinez, D., Rudovic, O., and Picard, R. "Personalized Automatic Estimation of Self-reported Pain Intensity from Facial Expressions," Computer Vision and Pattern Recognition (CVPR) Workshop on Deep Affective Learning and Context Modeling, 2017.

Main contact: Daniel Lopez Martinez <dlmocdm@mit.edu>

Personalized Pain Measurement

Facial Expressions



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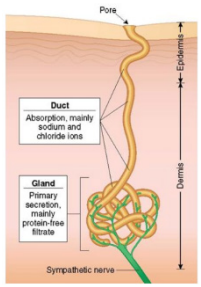
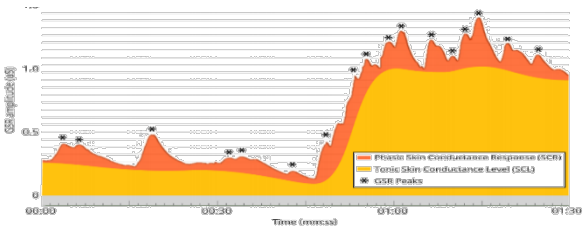
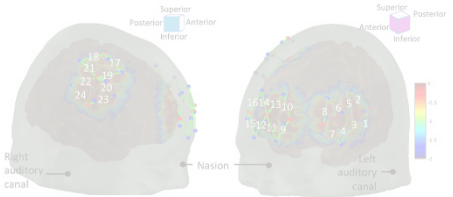




Brain Signals

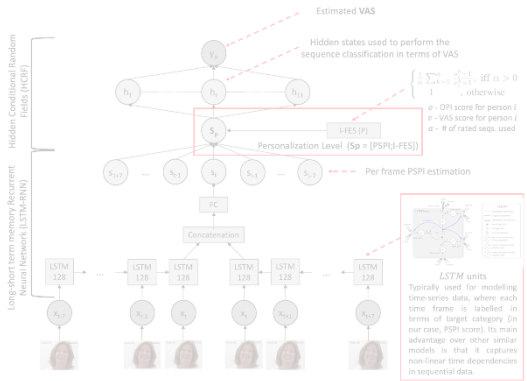


Lopez-Martinez D, Picard R. "Continuous pain intensity estimation from autonomic signals with recurrent neural networks," in IEEE Engineering in Medicine and Biology Society (EMBC), 2018.

Main contact: Daniel Lopez Martinez <dlmocdm@mit.edu>

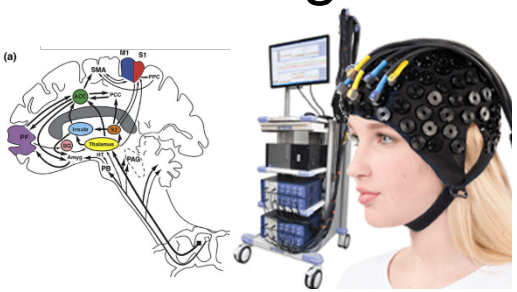
Personalized Pain Measurement

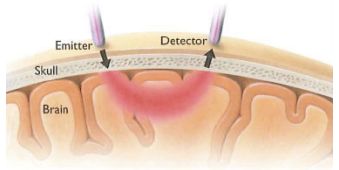
Facial Expressions

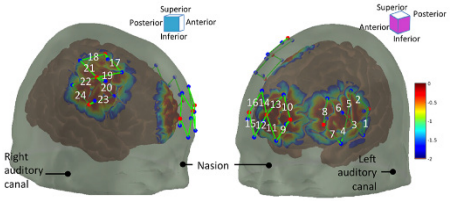


Wearables

Brain Signals







Lopez-Martinez D, Peng K, Steele S, Lee A, Borsook D, Picard R. "Multi-task multiple kernel machines for personalized pain recognition from functional near-infrared spectroscopy brain signals." International Conference on Pattern Recognition (ICPR), 2018.

Main contact: Daniel Lopez Martinez <dlmocdm@mit.edu>

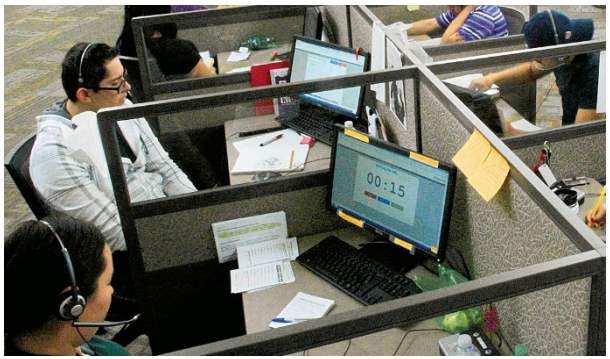
83% of US workers are **stressed**

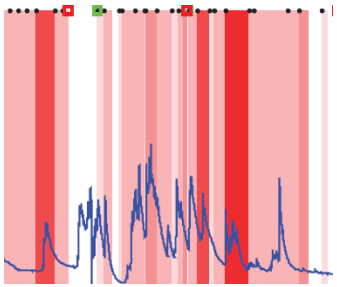
Stressed employees spend 46% more on health care

Stress results in as much as $300 billion in lost productivity

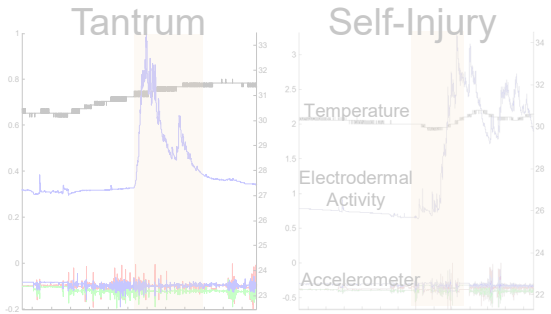
Stress Measurement in the Wild

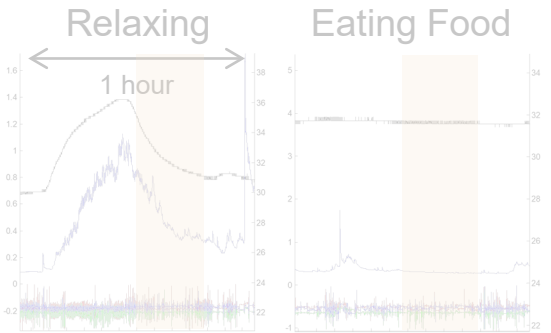
Call Center Employees





Children with Autism





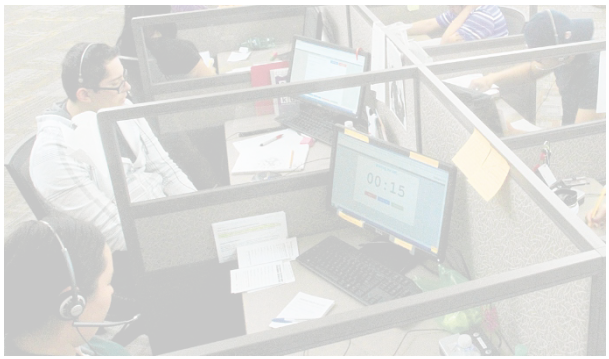
Computer Users

Hernandez, J., Morris, R.R., Picard, R.W. "Call Center Stress Recognition with Person-Specific Models," In Proceedings of the Affective Computing and Intelligent Interaction, 2011

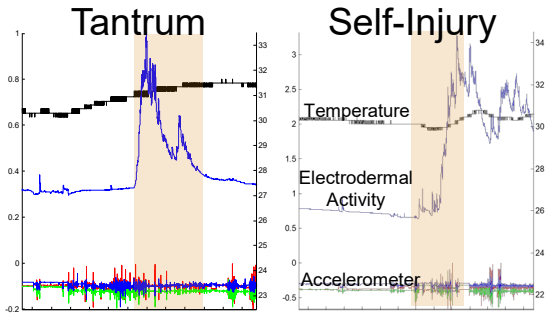
Main contact: Javier Hernandez <javierhr@mit.edu>

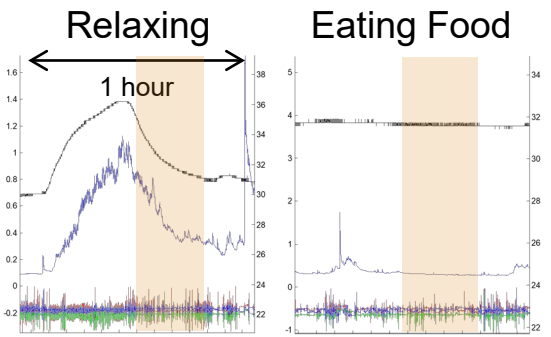
Stress Measurement in the Wild

Call Center Employees



Children with Autism





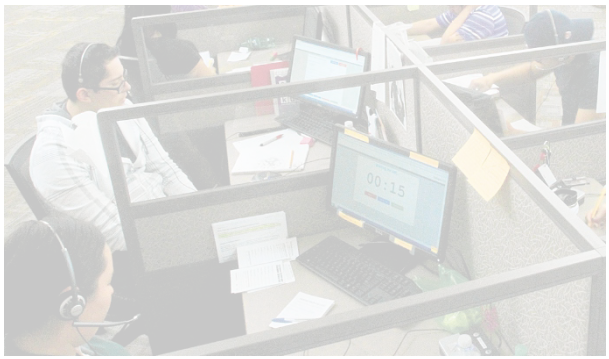
Computer Users

Hernandez J., Sano A., Zisook M., Deprey J., Goodwin M., Picard R. W., "Analysis and Visualization of Longitudinal Physiological Data of Children with ASD", in the Extended Abstract of IMFAR 2013.

Main contact: Javier Hernandez <javierhr@mit.edu>

Stress Measurement in the Wild

Call Center Employees



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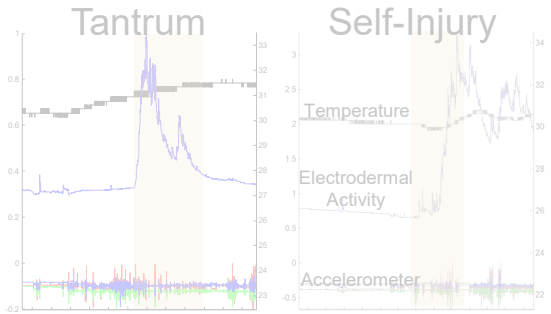

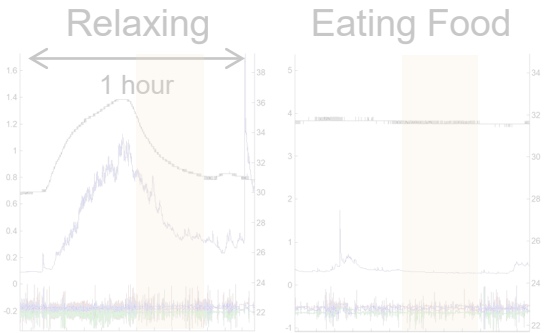

Computer Users

Hernandez J., Paredes P., Roseway A., and Czerwinski M., "Under Pressure: Sensing Stress of Computer Users," In Proceedings for the Computer and Human Interaction Conference (CHI), 2014.

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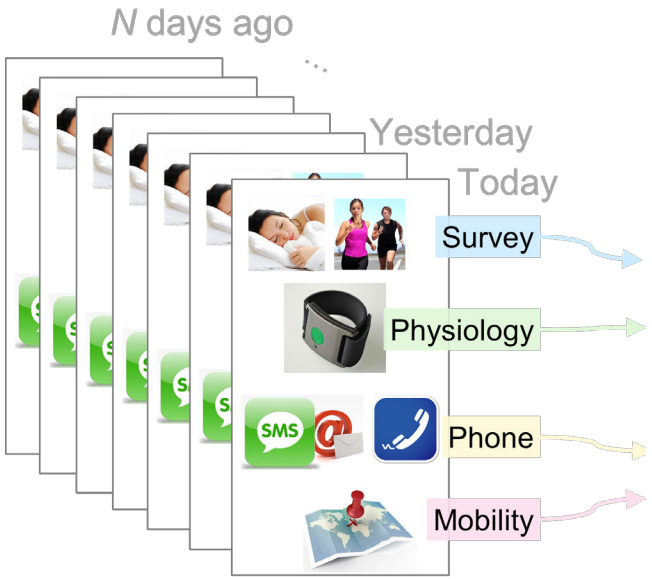
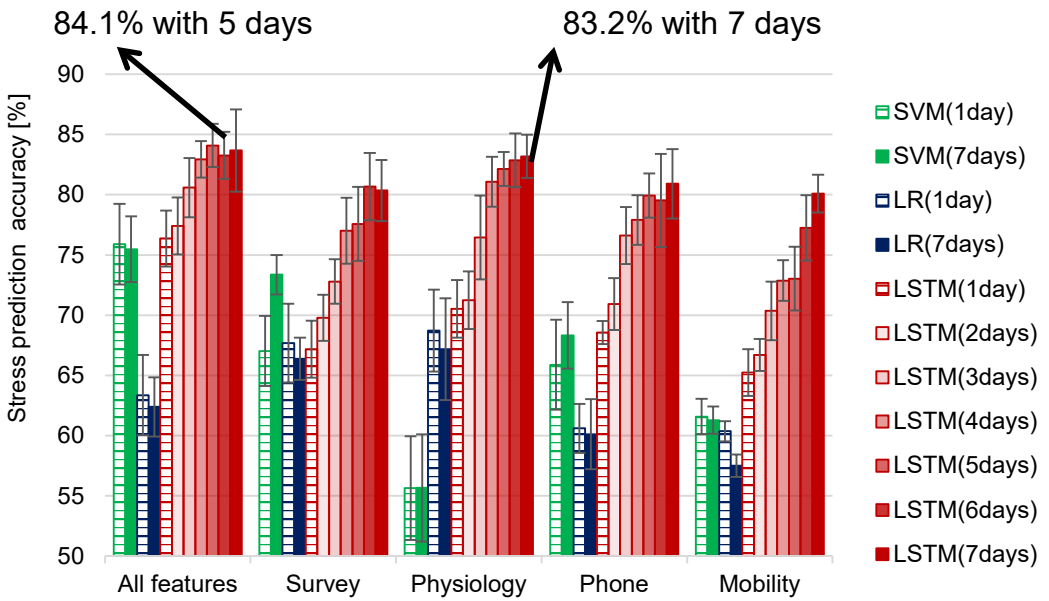
Forecasting Tomorrow Stress





1231 days from 201 college students

Daily self-report scores

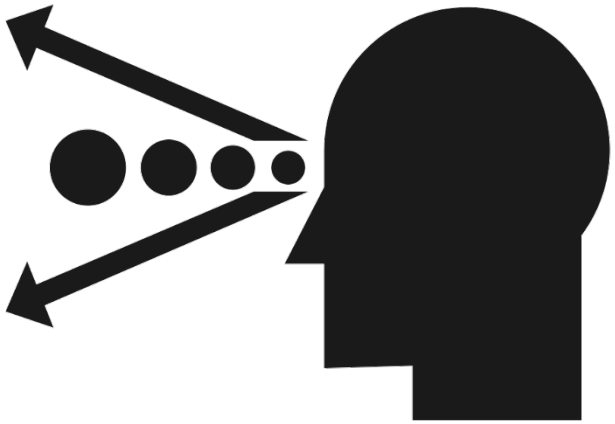
Data: survey, physiology, phone, mobility

Three models:

1. Short-term memory neural network (LSTM)
2. Logistic regression (LR)
3. Support vector machine (SVM)

Umematsu, T., Sano, A., Taylor, S., and Picard, R. "Improving Stress Forecasting using LSTM Neural Networks." IEEE Engineering in Medicine and Biology Society (EMBC), 2018.

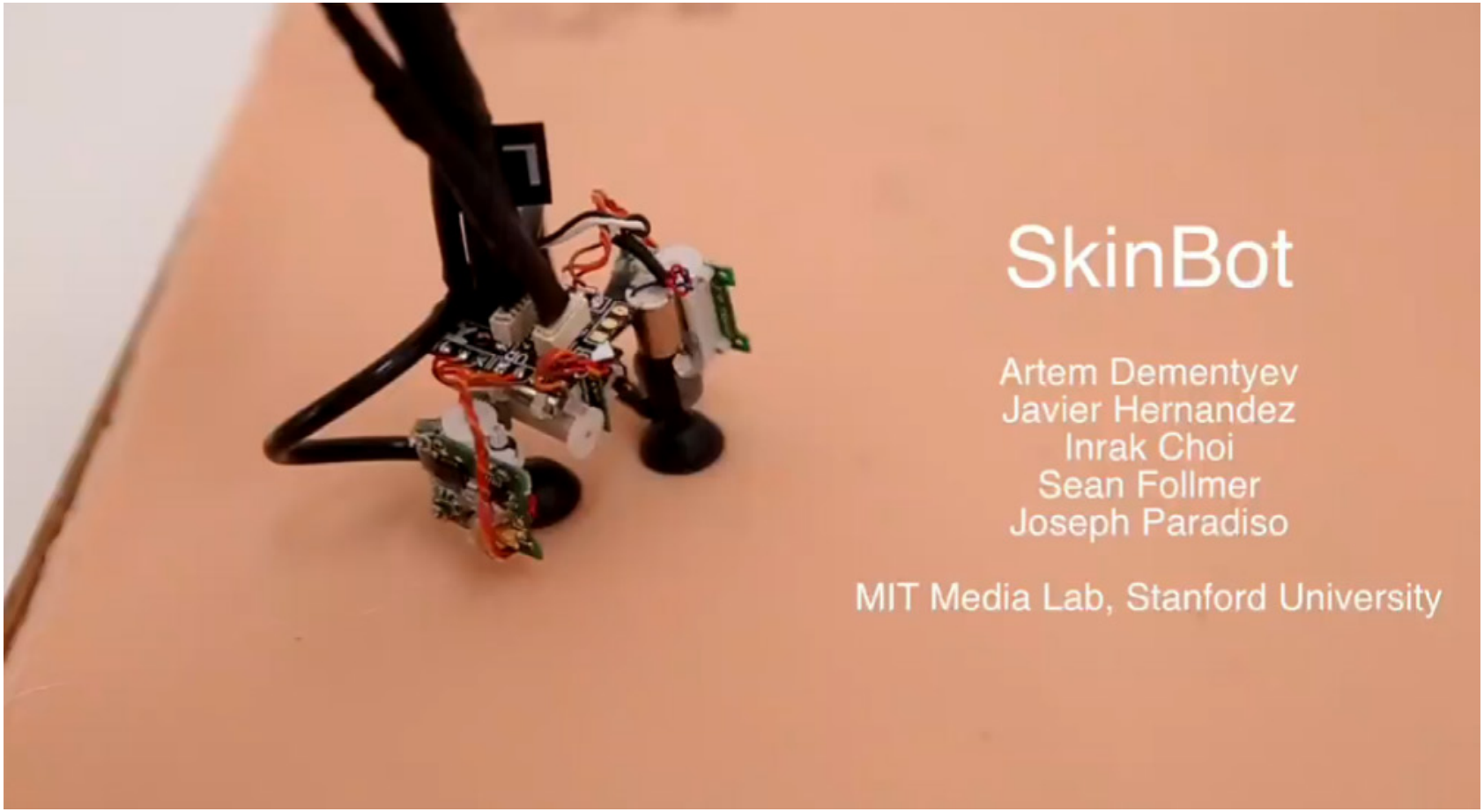
Main contact: Terumi Umematsu <terumi@mit.edu>



New Opportunities for Sensing and Modelling

Existing wearables mostly focused on sensing at a specific body location

Adaptive and Dynamic Wearables



Dementyev A., Hernandez J., Choi I., Follmer S., Paradiso J., "Epidermal Robots: Wearable Sensors That Climb On The Skin" In Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies, 2 (3), 2018.

Main contact: Artem Dementyev <artemd@mit.edu>

Closed-loop Wearables

(from sensing to intervention)

Amores, J., Hernandez, J., Dementyev, A., Wang, X., Maes, P. "BioEssence: A Wearable Olfactory Display that Monitors Cardio-respiratory Information to Support Mental Wellbeing," Proceedings of the International Conference of IEEE Engineering in Medicine and Biology Society (EMBC), 2018

Main contact: Judith Amores <amores@media.mit.edu>

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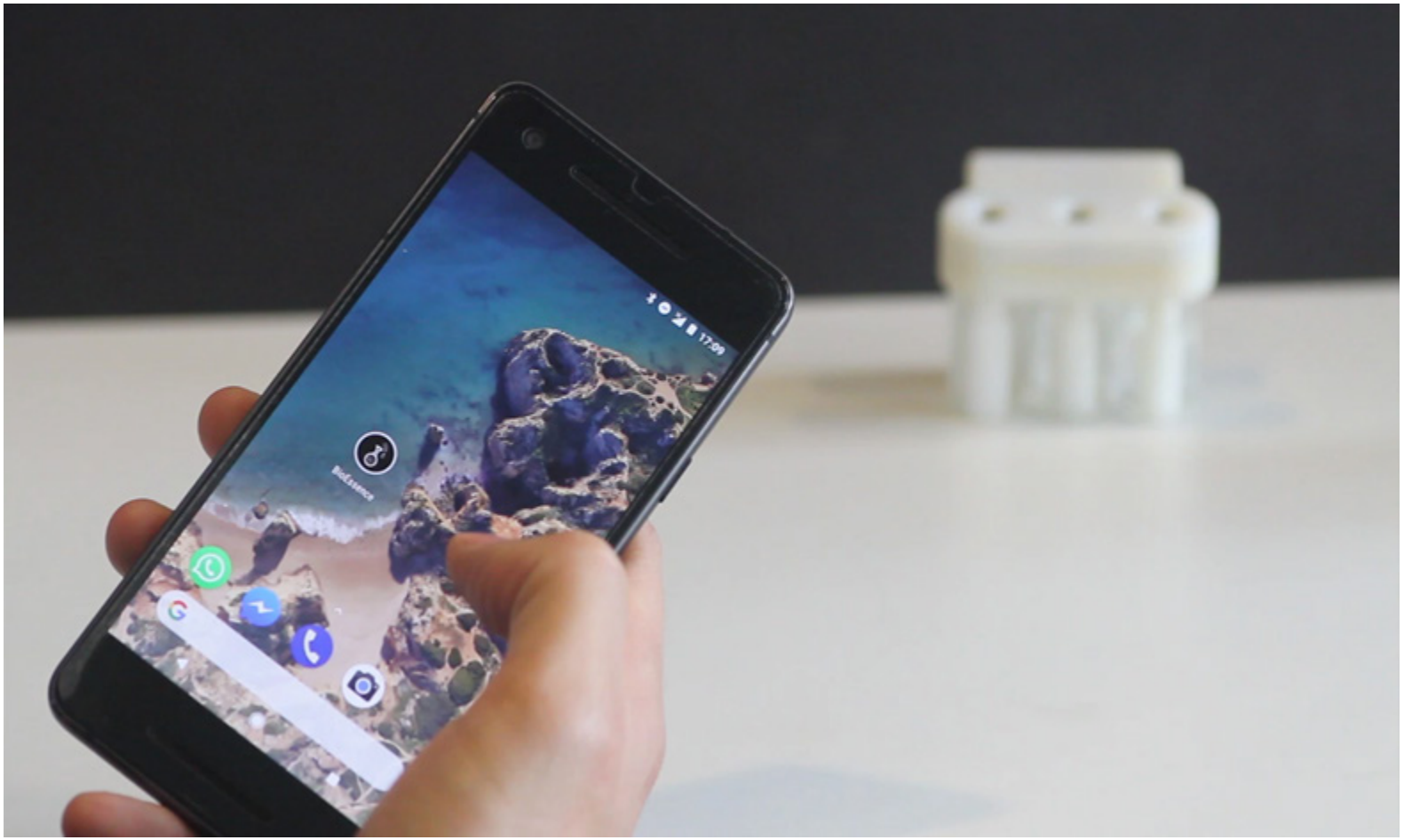

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Main contact: Judith Amores <amores@media.mit.edu>

Opportunistic (in Car) Health Monitoring

Work commute takes ~1 hour in USA

Frequent negative emotions

Controlled and sedentary position

Rich contextual information

Opportunistic (in Car) Health Monitoring

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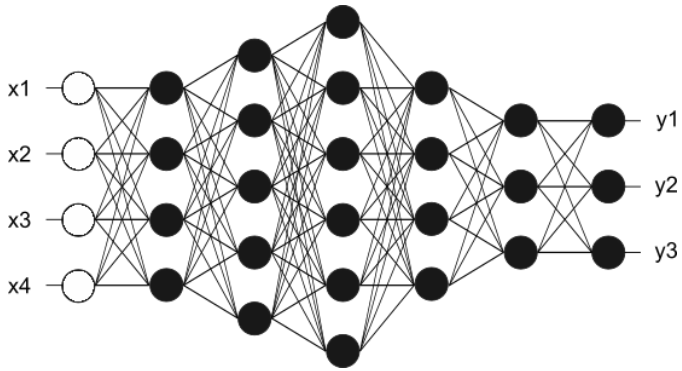
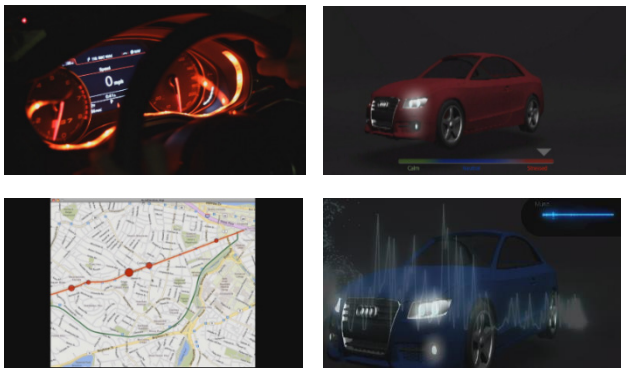
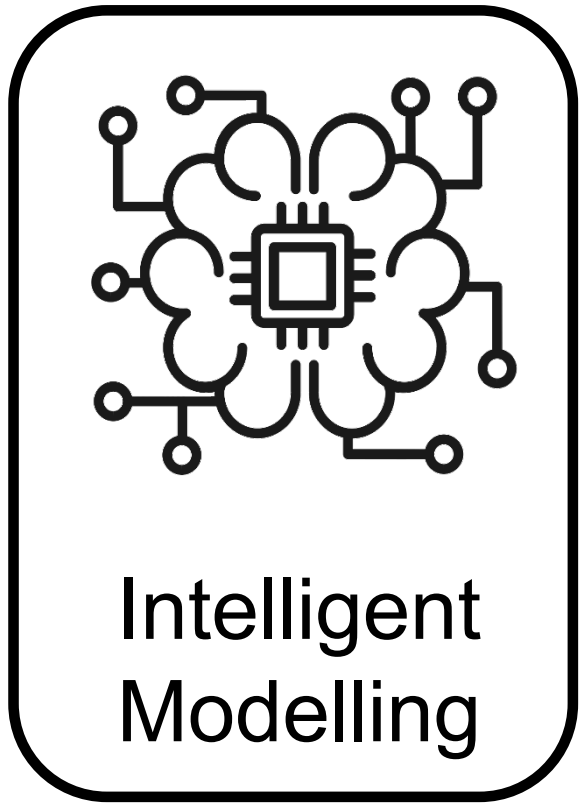
HYUNDAI DAIMLER :) Affectiva NTT DATA simumak simulation & training solutions



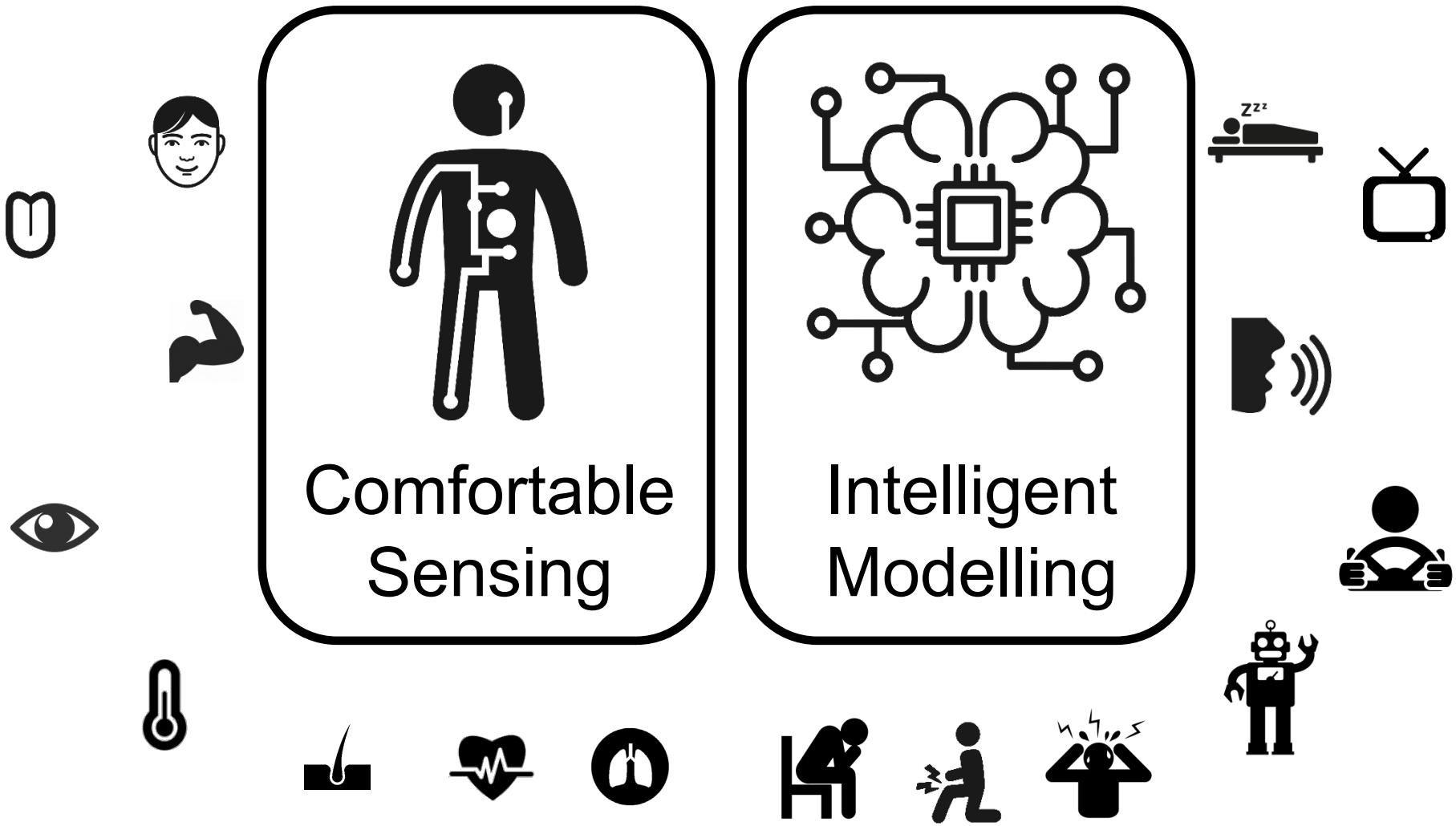


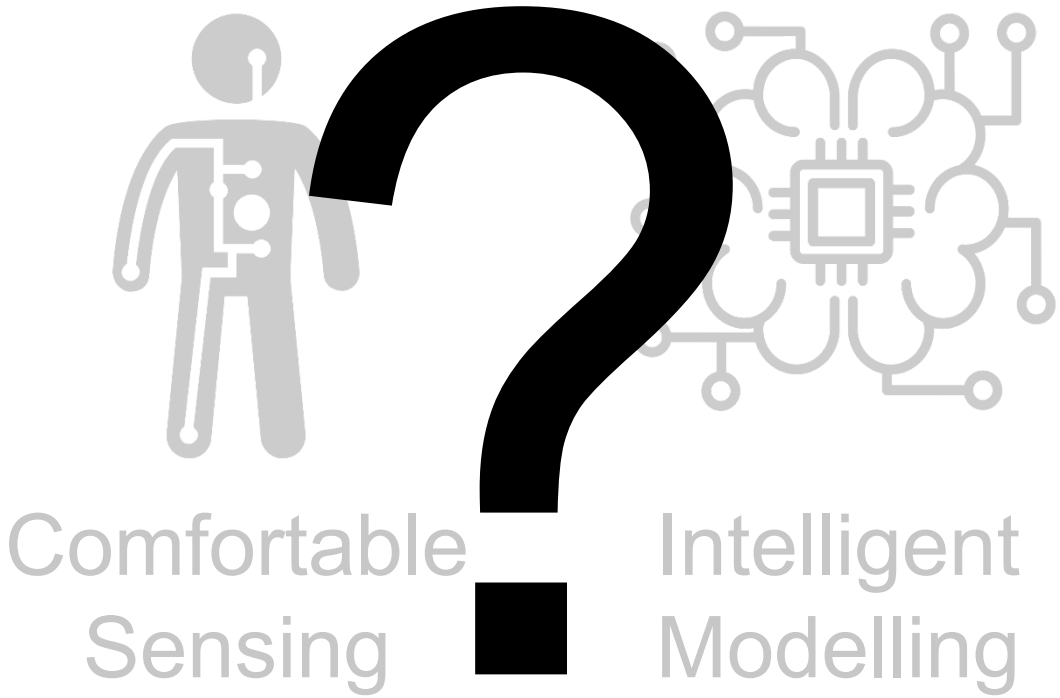
Emotional Navigation SIG: enavigation.media.mit.edu


Comfortable
Sensing


Intelligent
Modelling

Affective Computing Group: https://www.media.mit.edu/groups/affective-computing





How can Emotion AI help improve your business?

Emotion AI and Future Health

Javier Hernandez, Ph.D.

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Founder & CEO, Global Vitals LLC www.globalvitals.com