

# CURRICULUM VITÆ

## DANIEL MCDUFF

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<http://alumni.media.mit.edu/~djmcduff>  
djmcduff@media.mit.edu  
Cambridge, MA, 02139, USA  
Citizenship: United Kingdom

My research is at the intersection of emotion, computer vision, machine learning and HCI. I am interested in building hardware and software for human-sensing at scale, and in technologies that improve well-being. I am currently leading the collection and analysis of the world's largest corpus of human emotion data.

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### PORTFOLIO

<http://alumni.media.mit.edu/~djmcduff>

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### RESEARCH INTERESTS

Human-Computer Interaction (HCI), Machine Learning, Computer Vision, Affective Computing, Bio-sensors, Psychology, Wellness, Marketing.

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### GOOGLE SCHOLAR

H-Index: 13 · I-Index: 15 · Number of Citations: 1,027

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### EDUCATION

**Massachusetts Institute of Technology**, Cambridge, MA, U.S.A. • Ph.D., 2014

Cumulative GPA: 5.0/5.0

Thesis Topic: *Crowdsourcing Affective Responses for Predicting Media Effectiveness*

Adviser: Prof. Rosalind Picard

**University of Cambridge**, Cambridge, UK • M.Eng., 2009

Thesis Topic: *Stock Market Prediction and Portfolio Optimization*

Adviser: Dr. Jorge Goncalves

**University of Cambridge**, Cambridge, UK • B.A., 2008

First Class - Part I and Part II of the Engineering Tripos

Directors of Studies: Dr. Alex Routh, Dr. David Holburn

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### AWARDS

#### 2015

- WIRED Innovation Fellowships - Selected as one of 12 International Fellows

- BWH Health & Technology Innovation Fund Pitch Competition - Winner

#### 2014

- European Society for Opinion and Marketing Research (ESOMAR) - Finalist Young Researcher of the Year

- SXSW Interactive Awards - Award Winner with Pavlov Poke

- Crisis Text Line Data Visualization Contest - Award Winner: *time and space*

- MIT 100K Pitch and Launch Competition - Semi-Finalist with SENSEi

- MIT-Audi Hackathon - First Prize Winner

- Mass. General Hospital-Samsung Hackathon - Third Prize Winner

#### 2013

- IEEE Conference on Automatic Face and Gesture Recognition - Best Student Paper Award

#### 2012

- SXSW Interactive Awards - Finalist with Know You Exit - Crowdsourced Music Experiment

- MIT-Olympus Hackathon - Third Prize Winner

#### 2011

- Top Ten Invention of the Year Award from Popular Science

#### 2010

- Center for Integration of Medicine and Innovative Technology - CIMIT Primary Healthcare Prize - 3rd place

#### Undergraduate Academic Prizes

- Cambridge University Engineering Department - Prize for Outstanding 4th Year Control Project 2009

- Wright Award/Caius Engineering Trust Prize 2006 - For achievements in examinations.

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### GRANTS AND FELLOWSHIPS

- Remote physiological sensing grant (U.S. Air Force):

\$24,000 Research Grant

- Raised funding for thesis project from Mars Inc.:

\$180,000 Research Contract

- Raised research funding from BBC:

\$12,000 Contract

- Won BWH Health & Technology Innovation Fund Pitch Competition: \$50,000 Research Grant
- Won Center for Integration of Medicine and Innovative Technology Competition: \$60,000 Research Grant
- Received IEEE sponsorship: \$1,000 Travel Grant
- Raised research support from Procter and Gamble: 2nd Year Ph.D. Fellowship
- Raised research support from NEC: 4th Year Ph.D. Fellowship

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#### SUMMARY OF SELECTED PROJECTS

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##### Large-scale Emotion Measurement

- My Ph.D. thesis work was the first in the world project to collect and analyze natural and spontaneous facial expressions over the web, starting the largest database of natural expressions (now containing ~8,000,000,000 emotion data points from around the world).
- Analyses of these data have shown gender, culture and age differences in the expression of emotion. Furthermore, these emotion measurements can be powerful predictors of behavior and media effectiveness.

##### Remote Measurement of Physiology

- CardioCam is a low-cost, non-contact technology for measurement of physiological signals using a basic digital imaging device such as a webcam. This work was also documented in the New York Times, Forbes magazine, Wired and Popular Science amongst other publications.
- The Medical Mirror is an augmented mirror that captures and displays physiological information to the user - reflecting their inner state in addition to their outward appearance.

##### AutoEmotive

- "Bringing Empathy to the Driving Experience" - AutoEmotive shows how emotional sensors can be incorporated into cars in order to improve the driving experience. Winner of the IDEO-VW Hackathon 2014. Featured in The Times and on CNN.

##### AffectAura

- An emotional prosthetic that allows users to reflect on their emotional states over long periods of time. AffectAura includes a multimodal sensor set-up for continuous logging of audio, visual, physiological and contextual data, a classification scheme for predicting user affective state and an interface for user reflection.

##### Acume

- An open-source toolkit for interpreting and visualizing facial expression and gesture data.

##### Pavlov Poke

- A counter-conditioning device that uses application monitoring software and an augmented keyboard to help users avoid addictive habits online. Featured in Tech Crunch, The Daily Mail (UK), Der Spiegel (Germany).

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#### THESES

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**McDuff, D.**, Crowdsourcing Affective Responses for Predicting Media Effectiveness, *PhD. Thesis, MIT*, 2014.

**McDuff, D.**, Stock Market Prediction and Portfolio Optimization, *M.Eng. Thesis, University of Cambridge*, 2009.

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#### JOURNAL PUBLICATIONS - PEER REVIEWED

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- Kaurin, A., Mikita, N., Hollocks, M., Leno, V., Aslani, A., Papadopoulos, A., Harrison, S., Belil, P., **McDuff, D.**, Simonoff, E. and Stringaris, A. Unlocking anxiety expressions in Autism Spectrum Disorders: a human and automated observational approach to the assessment of anxiety and prediction of biological stress responses in ASD., Under Review, 2015.
- **McDuff, D.**, and Kaliouby, R. Expressivity and Aging: Differences in Responses to Online Media from Adolescence to Old Age., In preparation, 2015.
- **McDuff, D.**, and Kaliouby, R. Applications of Automated Facial Coding in Media Measurement., In preparation, 2015.
- **McDuff, D.**, Gontarek, S. and Picard, R. Remote Measurement of Physiological Responses and Prediction of Load During Cognitive Tasks., In preparation, 2015.
- **McDuff, D.**, Girard, J. and Kaliouby, R. Large-scale observational evidence of cross-cultural differences in facial behavior., Under Review, 2015.
- **McDuff, D.**, Kaliouby, R. and LaFrance, M. Automated Analysis of Gender Differences in Facial Reactions to Media Content., Under Review, 2015.
- **McDuff, D.**, Kaliouby, R., Cohn, J. and Picard, R. Predicting Ad Liking and Purchase Intent: Large-scale Analysis of Facial Responses to Ads. *IEEE Transactions on Affective Computing*, Accepted, 2014.
- **McDuff, D.**, Gontarek, S., and Picard, R. Remote Measurement of PPG Systolic-Diastolic Peak Times Using a Digital Camera. *IEEE Transactions on Biomedical Engineering*, Accepted, 2014.
- **McDuff, D.**, Gontarek, S., and Picard, R. Improvements in Remote Cardio-Pulmonary Measurement Using a Digital Camera. *IEEE Transactions on Biomedical Engineering*, 2014.

- **McDuff, D.**, Kaliouby, R., Senechal, T., Demirdjian, D. and Rosalind Picard and Picard, R. Automatic measurement of ad preferences from facial responses gathered over the Internet. *Image and Vision Computing*, 2014.
- **McDuff, D.**, Kaliouby, R., and Picard, R. Crowdsourcing Facial Responses to Online Videos. *IEEE Transactions on Affective Computing*, 2012.
- Hoque, M.E., **McDuff, D.J.** and Picard, R.W.. Exploring Temporal Patterns in Classifying Frustrated and Delighted Smiles. *IEEE Transactions on Affective Computing*, 2012.
- Poh, M. Z., **McDuff, D.**, and Picard, R. Advancements in Non-contact, Multiparameter Physiological Measurements Using a Webcam. *IEEE Transactions on Biomedical Engineering*. 2010.
- Poh, M. Z., **McDuff, D.**, and Picard, R. Non-contact, automated cardiac pulse measurements using video imaging and blind source separation. *Optics Express*, Vol. 18, Issue 10, pp.10762-10774, 2010.
- The manuscript ‘Non-contact, automated cardiac pulse measurements using video imaging and blind source separation’ has also been selected for publication in the latest edition of the *Virtual Journal for Biomedical Optics (VJBO)*.

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#### BOOK CHAPTERS

- Morris, R. and **McDuff, D.** Crowdsourcing Techniques for Affective Computing. In *R.A. Calvo, S.K. D'Mello, J. Gratch and A. Kappas (Eds). Handbook of Affective Computing*, Oxford University Press, 2014.

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#### CONFERENCE PUBLICATIONS - PEER REVIEWED

- **McDuff, D.**, Debord Smith, A., Vosburgh, K. and Nyugen, L. Smartphone Measurement of Peripheral Blood Flow. *37th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC'15)*, 2015.
- **McDuff, D.**, Estep, J., Piasecki, A. and Blackford, E. A Survey of Approaches for Remote Photoplethysmographic Imaging. *37th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC'15)*, 2015.
- Hernandez, J., **McDuff, D.**, and Picard, R. Physiology Monitoring from Peripheral Smartphone Motions. *Submitted, 37th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC'15)*, 2015.  
\*\*FINALIST FOR BEST STUDENT PAPER AWARD\*\*
- Hernandez, J., **McDuff, D.**, and Picard, R. Wearable Motion Sensors Can Recognize Personal Identity and Stationary Posture. *Proceedings of Body Sensor Networks Conference*, 2015.  
\*\*WINNER OF BEST STUDENT PAPER AWARD\*\*
- Senechal, T., **McDuff, D.**, and Kaliouby, R. Facial Action Unit Detection using Active Learning and an Efficient Non-Linear Kernel Approximation. *Submitted*, 2015.
- Hernandez, J., **McDuff, D.**, and Picard, R. Estimation of Heart and Breathing Rates from Wrist Motions. *Proceedings of Pervasive Health*, 2015.
- Vandal, T., **McDuff, D.**, and Kaliouby, R. Event Detection: Ultra Large-scale Clustering of Facial Expressions. *Proceedings of the 2015 Eleventh IEEE International Conference on Automatic Face and Gesture Recognition*, 2014.
- **McDuff, D.**, Song, Y., Vasisht, D. and Kapoor, A. Exploiting Sparsity and Co-occurrence Structure for Facial Action Recognition *Proceedings of the 2015 Eleventh IEEE International Conference on Automatic Face and Gesture Recognition*, 2014.
- **McDuff, D.**, Gontarek, S., and Picard, R. Remote Measurement of Cognitive Stress via Heart Rate Variability. *36th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC'14)*, 2014.
- Hernandez, J., **McDuff, D.**, Amores, J., Benavides, X., Picard, R. and Maes, P., AutoEmotive: Bringing Empathy to the Driving Experience to Reduce Stress. *ACM conference on Designing Interactive Systems (DIS)*, 2014.
- **McDuff, D.**, Kaliouby, R. Kodra, E. and Larginat, L. Do Emotions in Advertising Drive Sales? *ESOMAR*, 2013. Oral Presentation.  
\*\*BEST METHODOLOGY, CASE HISTORY AND OVERALL PAPER AWARD NOMINATIONS\*\*
- **McDuff, D.**, Kaliouby, R., Kodra, E. and Picard, R. Measuring Voter's Candidate Preference Based on Affective Responses to Election Debates. *International Conference on Affective Computing and Intelligent Interactions*, 2013. Oral Presentation.
- Hernandez Rivera, J., **McDuff, D.**, Fletcher, R. and Picard, R. Inside-Out: Reflecting on your Inner State. *Proceedings of the International Conference on Pervasive Computing*, 2013.
- **McDuff, D.**, Kaliouby, R., Demirdjian, D. and Picard, R. Predicting Online Media Effectiveness Based on Smile Responses Gathered Over the Internet. *Proceedings of the 2013 Tenth IEEE International Conference on Automatic Face and Gesture Recognition*, April, 2013. Oral Presentation.

**\*\*WINNER OF BEST PAPER AWARD\*\***

- Kodra, E., Senechal, T., **McDuff, D.** and Picard, R. From Dials to Facial Coding: Automated Detection of Spontaneous Facial Expressions for Media Research. *Proceedings of the 2013 Tenth IEEE International Conference on Automatic Face and Gesture Recognition*, April, 2013. Poster Presentation.
- **McDuff, D.**, Kaliouby, R., Senechal, T., Amr, M., Cohn, J. and Picard, R., Affectiva-MIT Facial Expression Dataset (AM-FED): Naturalistic and Spontaneous Facial Expressions Collected In-the-Wild. *Proceedings of the CVPR 2013 Workshop on Analysis and Modeling of Faces and Gestures*, 2013. Oral Presentation.
- Burzo, M., **McDuff, D.**, Mihalcea, R., Morency, L.P., Narvaez, A. and Prez-Rosas, V. Towards Sensing the Influence of Visual Narratives on Human Affect. *Proceedings of the 14th international conference on multimodal interfaces*, 2012.
- **McDuff, D.**, Karlson, A., Kapoor, A., Roseway, A. and Czerwinski, M. AffectAura: An Intelligent System for Emotional Memory. *ACM SIGCHI*, 2012. Oral Presentation.
- Czerwinski, M., Roseway, A., **McDuff, D.**, Kapoor, A. and Karlson, A. Emotion Tracking for Memory and Awareness. *Proceedings of ACM SIGCHI Workshop on Intelligent Design and Emotional Wellbeing*, 2012.
- **McDuff, D.**, Kaliouby, R. and Picard, R. Crowdsourced data collection of facial responses. *Proceedings of the 13th International Conference on Multimodal Interfaces*, 2011. Oral Presentation
- Poh, M.Z., **McDuff, D.** and Picard, R. A medical mirror for non-contact health monitoring. *Proceedings of ACM SIGGRAPH 2011, Emerging Technologies*, 2011.
- Baltrusaitis, T., **McDuff, D.**, Banda, N., Mahmoud, M., Kaliouby, R., Robinson, P. and Picard, R. Real-time inference of mental states from facial expressions and upper body gestures. *Proceedings of the 2011 Ninth IEEE International Conference on Automatic Face and Gesture Recognition*, March 26th, 2011.
- **McDuff, D.**, Kaliouby, R., and Picard, R. Acume: A novel visualization tool for understanding facial expression and gesture data. *Proceedings of the 2011 Ninth IEEE International Conference on Automatic Face and Gesture Recognition*, March, 2011.
- **McDuff, D.** A Human-Markov Chain Monte Carlo Method For Investigating Facial Expression Categorization. In: *Proceedings of the 2010 International Conference on Cognitive Modeling*, August 7th, 2010. Poster presentation.
- **McDuff, D.**, Kaliouby, R., Kassam, K., and Picard, R. Affect Valence Inference From Facial Action Unit Spectrograms. In: *Proceedings of the CVPR 2010 Workshop on Analysis and Modeling of Faces and Gestures*, June 14th, 2010. Oral presentation.

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DEMOS AND POSTER PRESENTATIONS (NON-PEER REVIEWED)

- **McDuff, D.**, Karlson, A., Kapoor, A., Roseway, A. and Czerwinski, M. AffectAura: Emotional Wellbeing Reflection System. *Proceedings of Pervasive Health*, 2012.
- **McDuff, D.**, Kaliouby, R., and Picard, R. See me smile: Crowd-sourcing facial expression. *MIT Media Lab Annual Research Conference*, April 4th, 2011.

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PATENTS

Five patents filed:

“Method and System for Measurement of Physiological Parameters,” M.Z. Poh, **D. McDuff** and R.W. Picard, USPTO Application #13/048965, Utility Patent filed March 16, 2011.

“Method and System for Measurement of Physiological Parameters,” A. Kapoor, A. Karlson, M. P. Czerwinski, A. Roseway, **D. McDuff**, USPTO Application #13/365,265, Utility Patent filed February 3, 2012.

Another three provisional patents filed - details available on request.

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TEACHING

Massachusetts Institute of Technology

- *Teaching Assistant + Lecturer*: Pattern Recognition, Fall 2010 (MAS.622J / 1.126J). For this course I set homework assignments and exams, lead recitations and gave lectures.
- *Technical Mentor*: Engineering Health: Understanding & Designing Affordable Health Diagnostics (MAS.S61)
- *Guest Lecturer*: Camera Culture (MAS.132).
- *Guest Lecturer*: Intelligent Multimodal Interfaces, Spring 2013 (6.835).
- *Guest Lecturer*: Affective Computing, Fall 2014 (MAS.630).
- *Guest Lecturer*: Media Arts and Sciences Fundamentals, Spring 2014 (MAS.500).
- *Guest Lecturer*: Affective Computing, Fall 2015 (MAS.630).

Boston College

- *Guest Lecturer*: Marketing Research, Spring 2015 (MKTG215303).
- *Guest Lecturer*: Marketing Research, Fall 2015 (MKTG800101).
- *Guest Lecturer*: Introduction to Organizational Behavior, Fall 2015 (ADBM105201).

Tufts University

- *Guest Lecturer*: Affective Interfaces, Fall 2015 (CS 250-01).

Boston University

- *Guest Lecturer*: Vision Research Group, Fall 2015.

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#### PROFESSIONAL ACTIVITIES

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Invited Talks:

- Northeastern University, Boston, MA - December 2015
- Air Force Research Lab, Dayton, OH - November 2015
- Boston Imaging Meetup, Microsoft (NERD), Cambridge - October 2015
- WIRED Conference, London - October 2015
- TEDxBerlin, Berlin - September 2015
- Sentiment Analysis Symposium, New York - July 2015
- Advertising Research Foundation, New York - June 2015
- Deep Learning Summit, Boston - May 2015
- Strata-Hadoop World, London - May 2015
- INFORMS Business Analytics and Operations Research, Los Angeles - April 2015
- Army Research Lab, Baltimore, MA - October 2014
- MIT Media Lab Tokyo Event, Tokyo - July 2014
- Wharton Business School, Philadelphia - May 2013
- Aspen Ideas Festival, Aspen - July 2012
- Imperial College, London - December 2011

Organizing/Program Committees:

- Workshop on Computer Vision for Affective Computing (CV4AC 2015) at ICCV 2015
- IEEE Conference on Affective Computing and Intelligent Interaction (ACII) 2015
- Workshop on Emotion Recognition in the Wild Challenge (EmotiW 2015) at ICMI 2015
- Workshop on Spontaneous Facial Behavior Analysis at ECCV 2014.
- Workshop on Emotion Representations and Modelling for HCI Systems (ERM4HCI) at ICMI 2014.
- Workshop on Machine Learning for Affective Computing at ACII 2011.

Reviewer:

*Physiological Measurement, IEEE Transactions on Biomedical Engineering, IEEE Transactions on Affective Computing, BMC Bioinformatics, IEEE Transactions on Multimedia, ACM Transactions on Interactive Intelligent Systems, IEEE Transactions on Circuits and Systems for Video Technology, IEEE Transactions on Image Processing, Journal of Advertising Research, UIST 2012, ICPR 2012, CHI 2014, ICPR 2014, ICASSP 2014, TVX 2014, ICMI 2014, ICASSP 2015, CHI 2015, AMFG 2015, ICIP 2015.*

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#### TECHNICAL SKILLS

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Computer Vision/Machine Learning: C++/C#, Python.

Data Science: MATLAB, R, Python, Processing.

Web: Actionscript, HTML, Javascript.

Typesetting: Latex.

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#### ACADEMIC COURSES

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*Massachusetts Institute of Technology*: Computational Cognitive Science, Cognitive Architectures, Computer Vision, Affective Computing, Media Arts and Science Pro Seminar, Biomedical Signal and Image Processing.

Listener: Machine Learning, Marketing

*University of Cambridge*: Machine Learning, Control Systems Design, Robust Multivariable Control, Non-Linear and Predictive Control, Digital Filters and Spectral Estimation, Statistical Pattern Processing, Speech and Language Processing, Technological Innovation: Research and Practice, Radio Frequency Electronics, Integrated Digital Electronics, Signals and Systems, Systems and Control, Signal and Pattern Processing, Data Transmission.

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#### EMPLOYMENT

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**Affectiva**, Waltham, MA, USA.

*Director of Research*

**July 2014 - To date.**

Team leader for the development of computer vision-based facial coding algorithms.

Coordinating the collection and analysis of the world's largest database of human emotion data.

Supervising three full-time researchers and engineers (plus several interns).

**Massachusetts Institute of Technology**, Cambridge, MA, USA.

*Research Affiliate, Camera Culture Group, MIT Media Lab*

**July 2014 - To date.**

Developing novel, affordable health-tech.

**Affectiva**, Waltham, MA, USA.

*Intern, Affectiva Science Group*

**July 2012 to December 2012**

**Microsoft Research**, Redmond, Seattle, USA.

*Intern, Visualization and Interaction (VIBE) Group*

**June 2011 to Sept 2011**

Developed AffectAura, a multi-modal sensor platform for measuring and visualizing emotion data.

**CBS Outdoor/Mouchel**, Lombard Street, London, UK.

*Engineering Intern, Media Wall Group*

**July 2008 to September 2008**

**Mouchel**, West Byfleet, UK.

*Engineering Intern, Rail Structures Group*

**September 2007**

*Engineering Intern, Waste and Insurance Group*

**July 2006 to August 2006**

**Defense Science and Technology Laboratory (DSLTL)**, Farnborough, UK.

*Intern, Future Offensive Air Systems Group*

**August 2004 to June 2005**

SELECTED PRESS

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- **MIT Technology Review** (November, 2015), "Track Your Heart with Your Phone, Even If Your Phone's in Your Bag."
- **Engadget** (November, 2015), "'BioPhone' can do pulse-tracking even when it's in your pocket."
- **WIRED Magazine** (November, 2015), "MIT smartphone knows your heartbeat from across the room."
- **WIRED** (October, 2015), "Why computers need empathy for the human condition."
- **New Scientist** (September, 2015), "Face analysis can tell what you'll buy after watching ads." [Print Edition]
- **The Economist** (June, 2015), "Shifting identity: The fashion for wearable technology may get rid of the need for passwords."
- **The Times** (May, 2014), "Rise of the Machines that Read Your Mind." [Featured on Front Page]
- **CNN** (February, 2014), "Feeling glum, happy, aroused? New technology can detect your mood."
- **MIT Technology Review** (October 2013), "Startup Gets Computers to Read Faces, Seeks Purpose Beyond Ads."
- **Tech Crunch** (August, 2013), "The Pavlov Poke Shocks You When You Use Facebook Too Much."
- **New Scientist** (May, 2013), "Lifelogger reveals the day's emotional highs and lows."
- **New Scientist** (November, 2012), "Obama or Romney? Your face voted we were watching."
- **WIRED Magazine** (October, 2012), "Medic on the Wall."
- **MIT Technology Review** (September 2012), "Delight or Frustration? Tough Call."
- **Wall Street Journal** (September 25, 2012), "Mirrors That Double as Computers"
- **MIT News** (May 25, 2012), "Is that smile real or fake?". [Featured on MIT homepage]
- **BBC News Magazine** (April 16, 2012), "The Science of Smiling." [Featured on BBC homepage]
- **CNN** (Jun 10, 2011), "Medical Mirror Monitors Vital Signs." [Featured in The Big I (idea, innovation, intelligence)]
- **Popular Science** (May 26, 2011), "2011 Invention Awards: A Mirror That Monitors Vital Signs."
- **Forbes** (March 2011), "Interactive: Analyze Your Smile" [Featured on Forbes homepage]
- **MIT Technology Review** (Feb 2011), "Mirror, Mirror on the Wall ... System could monitor vital signs without contact."
- **New York Times** (Jan 1, 2011), "Computers That See You and Keep Watch Over You." [Front page article]
- **New York Times Magazine** (Dec 19, 2010), "Taking Your Pulse By Webcam." [Featured in 10th Annual Year in Ideas]
- **EarthSky** (Dec 16, 2010), "Monitor Your Heart Rate at Home via Webcam." **Forbes** (Dec 3, 2010), "Written All Over Your Face."
- **BBC News** (Oct 19, 2010), "The Place Where Crazy Inventors Create Your Future."
- **ABC News** (Oct 15, 2010), "New System Could Measure Pulse, Respiration and Blood Pressure With a Webcam."

- **Boston Globe** (Oct 11, 2010), Measuring Vital Signs At a Glance. The Harvard Crimson (Oct 7, 2010), Webcams May Now Record Vital Signs.
- **Engadget** (Oct 7, 2010), MIT Medical Lab Mirror Tells Your Pulse With a Webcam.
- **Discovery Channel, Canada** (Oct 5, 2010), Featured on the Daily Planet show
- **EE Times** (Oct 5, 2010), Webcam Takes Vital Signs Noninvasively.
- **The Engineer** (Oct 5, 2010), MIT Develops Low-Cost Cameras For Me
- **CNET News** (Oct 5, 2010), Mirror, Mirror, Show Me My Vital Signs.
- **Popular Science** (Oct 4, 2010), Common Webcams Could Be Used Continuously To Monitor Your Vital Signs.
- **Medgadget** (Oct 5, 2010), MIT Student Uses Webcam to Measure Heart Rate From a Distance.
- **MIT News** (Oct 4, 2010), Your Vital Signs, On Camera. [Featured on MIT homepage]

#### REFERENCES

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Available on request.