

# Marcelo Aaron Bonilla Worsley

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## Appointments

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### Assistant Professor, Learning Sciences and Computer Science

*Northwestern University, School of Education and Social Policy & McCormick School of Engineering*

## Education

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### Ph.D. in Learning Sciences and Technology Design (2014)

*Graduate School of Education, Stanford University, Stanford, California*

Dissertation: Making with Understanding: Research on Studies from a Constructionist Learning Environment

Dissertation Committee: Paulo Blikstein (advisor), Dan Schwartz, Bryan Brown

### M.S. in Computer Science (2014)

*Computer Science Department, Stanford University, Stanford, California*

Specialization: Artificial Intelligence and Information Management and Analytics.

Advisor: Steve Cooper

### B.S. in Chemical Engineering (2007)

*Chemical Engineering Department, Stanford University, Stanford, California*

Advisor: Zhenan Bao

### B.A. Spanish and Portuguese (2007)

*Spanish and Portuguese Department, Stanford University, Stanford, California*

Advisor: Lisa Surwillo

## Publications

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### Journal Papers

#### In Progress

Worsley, M. (in progress). Bridging Engineering Education and Conceptual Change: An Analysis of Changes in Students' Perceptions of Structural Stability during Hands-on, Collaborative Learning Tasks.

Worsley, M. & Blikstein, P. (in progress). Engineering Design Cognition: the Impact of Different Reasoning Strategies on Engineering Design Problem Solving Behavior. *Cognition and Instruction*.

#### Under Review

Worsley, M. & Blikstein, P. (under review). A Multimodal Analysis of Making. *International Journal of Artificial Intelligence in Education*.

Worsley, M. & Blikstein, P. (in press). Reasoning Strategies in the Context of Engineering Design with Everyday Materials. *The Journal of Pre-College Engineering Education Research*.

#### Published

Ochoa, X. & Worsley, M. (2016). Augmenting learning analytics with multimodal sensory data. *Journal of Learning Analytics*, 3(2), 213–219. <http://dx.doi.org/10.18608/jla.2016.32.10>

Blikstein, P. & Worsley, M. (2016). Multimodal learning analytics and education data mining: Using computational technologies to measure complex learning tasks. *Journal of Learning Analytics*, 3(2), 220–238. <http://dx.doi.org/10.18608/jla.2016.32.11>

Blikstein, P., Worsley, M., Piech, C., Gibbons, A., Sahami, M., & Cooper, S. (2014) Programming Pluralism: Using Learning Analytics to Detect Patterns in Novices' Learning of Computer Programming. *The Journal of the Learning Sciences*. 23 (4), 561-599. Routledge.

Worsley, M. & Blikstein, P. (2014). Analyzing Engineering Design through the Lens of Computation. *Journal of Learning Analytics*. 1 (2), 151-186.

### Peer-Refereed Conference Proceedings

Worsley, M., Abrahamson, D., Blikstein, P., Grover, S., Schneider, B., & Tissenbaum, M. (2016). Situating multimodal learning analytics. In C.-K. Looi, J. L. Polman, U. Cress, & P. Reimann (Eds.), "Transforming learning, empowering learners,"

- Proceedings of the International Conference of the Learning Sciences (ICLS 2016) (Vol. 2, pp. 1346-1349). Singapore: International Society of the Learning Sciences.
- Worsley, M., Scherer, S., Morency, L.P., & Blikstein, P. (2015). Exploring Behavior Representation for Learning Analytics. In Proceedings of the 2015 International Conference on Multimodal Interaction. ACM, New York, USA. pp. 251-258.
- Worsley, M., Chiluiza, K., Grafsgaard, J., & Ochoa, X., (2015). 2015 Multimodal Learning and Analytics Grand Challenge. In Proceedings of the 2015 International Conference on Multimodal Interaction. ACM, New York, USA. pp. 525-529.
- Worsley, M. & Blikstein, P. (2015). Leveraging multimodal learning analytics to differentiate student learning strategies. In Proceedings of the Fifth International Conference on Learning Analytics and Knowledge, Poughkeepsie, New York, pp. 360-367.
- Worsley, M. and Blikstein, P. (2015). Using Learning Analytics to Study Cognitive Disequilibrium in a Complex Learning Environments. In Proceedings of the 5<sup>th</sup> Annual Conference on Learning Analytics and Knowledge. pp. 426-247. ACM
- Ochoa, X., Worsley, M., Chiluiza, K., & Luz, S. (2014). MLA'14: Third Multimodal Learning Analytics Workshop and Grand Challenges. In Proceedings of the 16th International Conference on Multimodal Interaction. pp. 531-532. ACM.
- Worsley, M. (2014). Multimodal Learning Analytics as a Tool for Bridging Learning Theory and Complex Learning Behaviors. In Proceedings of the 2014 International Conference on Multimodal Interaction. ACM, New York, NY, USA. pp 1-4
- Worsley, M. & Blikstein, P. (2014). Deciphering the Practices and Affordances of Different Reasoning Strategies through Multimodal Learning Analytics. In Proceedings of the 2014 International Conference on Multimodal Interaction. ACM, New York, NY, USA. pp 21-27.
- Worsley, M. & Blikstein, P. (2014). Using Multimodal Learning Analytics to Study Learning Mechanisms. In Proceedings of the 2014 Educational Data Mining Conference. pp 431-432.
- Worsley, M. & Blikstein, P. (2014). Assessing the Makers: The Impact of Principle-Based Reasoning on Hands-on, Project-Based Learning. In Proceedings of the 2014 International Conference of the Learning Sciences. Vol 3. pp 1147-1151.
- Morency, L. Oviatt, S., Scherer, S. Weibel, N. & Worsley, M. (2013). ICMI 2013 Grand Challenge Workshop on Multimodal Learning Analytics. In Proceedings of the 15th ACM international conference on Multimodal Interaction (ICMI '13). ACM, New York, NY, USA. pp. 373-378.
- Worsley, M., & Blikstein, P. (2013). Programming Pathways: A Technique for Analyzing Novice Programmers' Learning Trajectories. In Artificial Intelligence in Education. Springer Berlin Heidelberg. pp. 844-847.
- Gomes, J. Yassine, M., Worsley, M., Blikstein, P. (2013) Analysing Engineering Expertise of High School Students Using Eye Tracking and Multimodal Learning Analytics. In Proceedings of the Educational Data Mining 2013 (EDM '13). Memphis, TN, USA. pp. 375-377.
- Worsley, M. & Blikstein, P. (2013). Toward the Development of Multimodal Action Based Assessment. In Proceedings of the Third International Conference on Learning Analytics and Knowledge (LAK '13). ACM, New York, NY, USA, pp. 94-101.
- Worsley, M. (2012). Multimodal Learning Analytics: Enabling the Future of Learning through Multimodal Data Analysis and Interfaces. In Proceedings of the 14th ACM international conference on Multimodal interaction (ICMI '12). ACM, New York, NY, USA. pp 353-356.
- Scherer, S., Worsley, M. & Morency, L. (2012). 1st international workshop on multimodal learning analytics: extended abstract. In Proceedings of the 14th ACM international conference on Multimodal interaction (ICMI '12). ACM, New York, NY, USA, pp. 609-610.
- Worsley, M. & Blikstein P. (2012). A Framework for Characterizing Student Changes in Student Identity During Constructionist Learning Activities. In Proceedings of Constructionism 2012. pp 115-125. Athens, Greece.
- Worsley, M. & Blikstein, P. (2012). An Eye For Detail: Techniques For Using Eye Tracker Data to Explore Learning in Computer-Mediated Environments. In the Proceedings of the 2012 International Conference of the Learning Sciences (ICLS '12). Sydney, Australia. pp 561-562.
- Worsley, M., Johnston, M. & Blikstein P. (2011). OpenGesture: a low cost authoring framework for gesture and speech based application development and learning analytics. In Proceedings of the 10th International Conference on Interaction Design and Children (IDC '11). ACM, New York, NY, USA. pp 254-256.
- Worsley, M. & Blikstein P. (2011). What's an Expert? Using learning analytics to identify emergent markers of expertise through automated speech, sentiment and sketch analysis. In Proceedings for the 4<sup>th</sup> Annual Conference on Educational Data Mining. Eindhoven, Netherlands. pp 235-240.
- Worsley, M. & Johnston, M. (2010). Multimodal Interactive Spaces: MagicTV and MagicMAP. Spoken Language Technology Workshop (SLT '10), IEEE. San Francisco, CA, USA. pp 161-162

### **Refereed Conference Presentations**

- Fuhrmann, T., Worsley, M. & Blikstein, P. (2016). Eliciting Engineering Expertise from Novices. Paper presented at Constructionism 2016 (C2016). Bangkok, Thailand.
- Worsley, M. Blikstein, P. Bradford, K, Martin, T, Sipitakiat, A, & Tutiyaiphungprasert, N. (2016). Constructionism and the Internet of Things. Paper presented at Constructionism 2016 (C2016). Bangkok, Thailand.
- Bonilla, T. & Worsley, M. (2014). Using Network Analysis to Explore the Role of Status and Reciprocity in Politicians' Voting Behavior. Paper Presented at the Annual American Political Science Association Conference. Washington, D.C., USA
- Worsley, M. & Blikstein, P. (2014). An Approach for Combining Qualitative Analysis with Learning Analytics to Study Learning Processes in Open-Ended Environments. Paper Presented at the Annual Meeting of the American Education Research Association (AERA). Philadelphia, PA, USA.

- Worsley, M. & Blikstein, P. (2013). Designing for Diversely Motivated Learners. Paper Presented at the Digital Fabrication and Making In Education Workshop at the 2013 Interactive Design for Children Conference (IDC 2013), New York, NY, USA.
- Worsley, M. & Blikstein P. (2013). Learning to Paraphrase: Using Paraphrase Detection of Spoken Utterances to Predict Learner Expertise. Paper presented at Annual Meeting of the American Education Research Association. San Francisco, CA, USA.
- Worsley, M. & Blikstein P. (2012). OpenGesture: A Low-Cost, Easy-to-Author Application Framework for Collaborative, Gesture-, and Speech-Based Learning Applications. Paper Presented at the Annual Meeting of the American Education Research Association (AERA). Vancouver, Canada.
- Blikstein, P., Safdari. M., & Worsley, M. (2012) Using Dynamic Time Warping and Cluster Analysis to Analyze the Learning of Computer Programming. Paper Presented at the Annual Meeting of the American Education Research Association (AERA). Vancouver, Canada.
- Blikstein, P., Safdari. M., & Worsley, M. (2012) Using Dynamic Time Warping and Cluster Analysis to Analyze the Learning of Computer Programming. Paper Presented at the 10<sup>th</sup> Annual International Conference of the Learning Sciences (ICLS). Sydney, Australia.
- Blikstein, P., & Worsley, M. (2011). Computing What the Eye Cannot See: Educational Data Mining, Learning Analytics and Computational Techniques for Detecting and Evaluating Learning. Paper Presented at the Annual Meeting of the American Education Research Association (AERA). New Orleans, LA, USA.
- Worsley, M. & Blikstein, P. (2011). Using machine learning to examine learner's engineering expertise using speech, text, and sketch analysis. Paper Presented at the 41<sup>st</sup> Annual Meeting of the Jean Piaget Society (JPS). San Francisco, CA, USA.
- Worsley, M. & Blikstein P. (2010). Towards the Development of Learning Analytics: Student Speech as an Automatic and Natural Form of Assessment. Paper Presented at the Annual Meeting of the American Education Research Association (AERA). New Orleans, LA, USA.
- Worsley, M., & Blikstein, P. (2010). Learning Analytics - Natural Assessments for Constructionist Learning Environments. HSTAR-Cicero Workshop on Learning, Learning Environments and Technologies. Stanford, CA, USA.

### Book Chapters

- Blikstein, P. & Worsley, M. (2016). Children are not Hackers: building a culture of powerful ideas, deep learning, and equity in the maker movement. In Pepler, K. & Kafai, Y. & Halverson, E. (Eds), Makeology.

### Whitepapers

- Blikstein, P. & Worsley, M. (2013). Multimodal Learning Analytics and Assessment of Open-Ended Artifacts. Bill and Melinda Gates Foundation, Learning Analytics Working Group

### Invited Talks

- 2016**      Cultivating the Fablearn Ecosystem – **Fablearn Hong Kong Keynote**  
 Programming Pluralism – **University of Colorado, Boulder**  
 Learning Analytics as a Lens into Engineering Design Cognition – **Northwestern University**  
 Empowering Design with Technology – **University of Colorado, Boulder, ATLAS Institute**
- 2015**      Engineering Design Cognition: Studies on the Origins and Implications of Students' Design Strategies – **Vanderbilt University**  
 The Honeymoon's Over: Moving Beyond a Romanticized View of "Making" – **University of California, Los Angeles**  
 Learning Analytics Unplugged – **Robert H. Smith School of Business**  
 More Than a Feeling: Using Affect and Pose-based Cues to Intuit Learner Behaviors – **Stanford University**  
 How to Assess Learning that Matters? Creating Complex Evaluations with Multimodal Data – **Lemann Conference**  
 Making D-I-Y and the Teacher Revolution – **University of California, Los Angeles, CRESST Conference**  
 Collecting Data in Classrooms – **Stanford University, Fablearn Conference**
- 2014**      Priming the Pump – A Multimodal Analysis of Hands-on STEM Learning – **Virginia Polytechnic and State University, Engineering Education Seminar**  
 It's all in the approach - Using Learning Analytics to identify and compare different engineering design strategies in hands-on learning environments – **Arizona State University Computing, Informatics and Design Science Engineering Department**  
 Making the MOOC Experience Tangible and Diversified – **University of Colorado Boulder, MOOCShop at the International Conference of the Learning Sciences**  
 Using Multimodal Learning Analytics to Study the Mechanics and Semantics of Effective Learning Strategies – **University of Colorado Boulder, Learning Analytics Workshop at the International Conference of the Learning Sciences**  
 Multimodal Learning Analytics – **Harvard University, Learning Analytics Summer Institute**  
 So You Want to be an Engineer? – **Stanford University, Summer Engineering Academy**  
 Crafting Education's Digital Future(s) – **University of Southern California, Rossier School of Education**

Methods for Leveraging Multimodal Learning Analytics to Study Engineering Design – **Indiana University**

- 2013** Multimodal Learning Analytics: Techniques for Understanding and Enhancing Student Learning – **Stanford University Computer Science LEAD Program**  
Constructionism 2.0 – Reimagining Constructionism through the Lens of Artificial Intelligence - **Massachusetts Institute of Technology Media Lab**  
Multimodal Learning Analytics – **Stanford University, Education’s Digital Future Seminar**  
Taking the Tools of Learning Analytics to the “Wild” – **Columbia University Teacher’s College, Learning Analytics Seminar**  
Multimodal Learning Analytics: A Future in the Making – **AT&T Labs**  
The Making of an Educational Data Scientist – **Society of Learning Analytics Research, Learning Analytics Summer Institute**  
Multimodal Learning Analytics – **Society of Learning Analytics Research, Learning Analytics Summer Institute**  
Intersecting Computer Science and Education – **Stanford University, Summer Engineering Academy**

### Invited Workshops and Working Groups

- 2015** Next Generation Assessment/Tracing Learning Workshop – **The New York Hall of Science**  
Developing Strong Cyberlearning Proposals Workshop – **The Center for Innovative Research in Cyber Learning**  
Cyberlearning 2015 Connect, Collaborate and Create the Future - **The Center for Innovative Research in Cyber Learning**  
Advancing Data Intensive Research in Education – **Computing Research Association**  
NSF Maker Summit – **American Society of Engineering Education**  
Assessment in Makerspaces and Fablabs – **Gordon Commission Fellows**  
Deep Multimodal Data Jam Workshop – **Learning Games Play Data Consortium and Analytics4Learning**

### Research Experience

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- 2014 – 2016** *Post-Doctoral Researcher, University of Southern California, Rossier School of Education, Educational Psychology/Learning Sciences Concentration, Los Angeles, California*  
Conducted research that is aimed towards improving how well the field can understand and foment STEM learning among K-16 students. Worked with Rossier faculty and PhD students to identify the emergence of conceptual change in student-centered, hands-on learning environments.
- 2014 – 2016** *Post-Doctoral Researcher, University of Southern California, Institute for Creative Technologies, Behavior Analytics and Machine Learning Group, Playa Vista, California*  
Worked to develop and implement strategies for using computational techniques to study complex learning environments. Specifically focused on using multi-level, latent models to process and analyze multimodal data. Collaborated with Computer Science faculty and mentored Computer Science PhD students.
- 2009 – 2014** *Project Director, Transformative Learning Technologies Lab, Multimodal Learning Analytics Group, Stanford, California*  
Directed a team of fifteen undergraduate and graduate students researching methods for integrating computer vision, speech recognition and analysis, natural language processing and machine learning with educational assessment in hands-on project based learning environments.
- 2011 (Summer)** *Data Science Researcher, IBM Research, San Jose, California*  
Developed a tool, called the Feedback Comment Extractor, for automated analysis of free responses and scaled response survey data. This tool supports natural language processing and several Bayesian machine learning capabilities and identifies both quantitative and qualitative trends in the data being analyzed.
- 2010 (Summer)** *Multimodal Researcher, AT&T Research, Florham Park, New Jersey*  
Developed an application framework creating multimodal applications on large screen displays. The application framework supports multimodal integration of speech, gesture and gaze in an open microphone environment and was the basis for the Multimodal Remote Control patent.

### Teaching Experience

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#### Undergraduate & Graduate Courses at Northwestern University

- 2017** *Instructor, Designing Interactive Media & Technology for Learning (LS 307), Evanston, IL*

**(Spring)** Students will complete a series of technology design activities that range from using speech and gesture technologies, to designing a toy for a kid. Students will be challenged to apply their knowledge of the learning sciences to real-world applications as they learn about different forms of new media that enable learners to experience and engage learning in new ways.

**2017** *Instructor, Inclusive Making (Proposed)*, Evanston, IL

**(Fall)** An interdisciplinary group of faculty members from Computer Science, Communication, Learning Sciences and Design will push students to 1) critically explore Making as a practice that promotes democratization, 2) develop interfaces that allow a broader population of students to participate in digital fabrication and 3) co-design artifacts that positively impact accessibility and inclusivity. The course will include guest speakers, laboratory portions and a final project that encourages students to develop publishable scholarship and/or functional prototypes.

### Graduate Courses at the University of Southern California

**2015** *Guest Lecturer, Political Analysis (PS 311)*, Los Angeles, CA

**(Fall)** Gave an introductory lecture on using text analysis in social science research.

**2015** *Guest Lecturer, Political Behaviors and Attitudes (PS 422)*, Los Angeles, CA

**(Spring)** Gave guest lectures on using text analysis and network analysis to model and study political behavior and attitudes.

### Graduate Courses at Stanford University

**2013** *Instructor, Computational Social Sciences Workshop: Network Analysis and Web Mining*, Stanford, California

**(Summer)** Designed and taught a two-day course on Network Analysis to social sciences graduate students and post-doctoral students, through the Stanford Institute for Research in Social Sciences Computational Social Sciences Summer Workshop. This course combined lectures with hands-on components in order to introduce students to central concepts, key algorithms, and openly available analytic tools for Network Analysis. I also assisted students in learning the fundamentals of web mining and Python programming.

**2013** *Instructor, Learning Analytics and Computational Modeling (EDUC 390X/ CS424M)*, Stanford, California

**(Winter)** Co-taught and designed course with Professor Paulo Blikstein. This graduate-level course introduces students to computational modeling and learning analytics through student design projects. In my role, I will be teaching lectures on machine learning, text mining, network analysis, web mining and learning analytics. This course also involves conducting skills oriented laboratory sessions on different technologies: Python, Netlogo, RapidMiner, NetworkX and more.

**2012** *Guest Lecturer, Beyond Bits and Atoms: Designing Technological Tools - Lab (EDUC 211X / CS402L)*, Stanford, California

**(Fall)** Conducted an introductory lesson on Kinect libraries for capturing speech and gesture using C#, C++, Processing and OpenGesture.

**2012** *Guest Lecturer, Computational Modeling and Learning Analytics (EDUC 390X/ CS424M)*, Stanford, California

**(Winter)** Gave guest lectures on Social and Information Network Analysis, Natural Language Processing and Learning Analytics. Lectures involved showing and assisting students how to use these techniques for analyzing education and social science data.

**2011** *Lead Teaching Assistant, Beyond Bits and Atoms: Tools for Thinking and Learning (EDUC 236X / CS402)*, Stanford, California

**(Spring)** Organized a team of 5 teaching assistants, conducted office hours and was in charge of grading of student work with qualitative feedback.

**2010** *Teaching Assistant, Beyond Bits and Atoms: Tools for Thinking and Learning – Lab (EDUC 211X / CS402L)*, Stanford, California

**(Spring)** My role consisted of holding office hours, leading laboratory sessions, grading student projects. I also worked closely with students to mentor them through the design and implementation of their final projects.

### Service Experience

#### Professional Service

**2017** *Demo Co-Chair, Interaction Design for Children (IDC) 2017*, Stanford, CA

*Workshop Organizer, Current and Future Multimodal Learning Analytics Data Challenges*, Vancouver, CA

*Ad-hoc Reviewer, Cognition and Instruction*  
*Co-organizer, 2017 LAK Multimodal Learning Analytics Workshop, Vancouver, BC*  
*Ad-hoc Reviewer, ACM Transactions on Computing Education*

- 2016** *Demo Co-Chair, Fablearn 2016, Stanford, CA*  
*Ad-hoc Reviewer, ACM CHI Conference on Human Factors in Computing Systems 2017, Denver, CO*  
*Reviewer, National Science Foundation*  
*Reviewer, International Conference on Intelligent Virtual Agents (IVA) 2016, Los Angeles, CA*  
*Guest Editor, Journal of Learning Analytics: Special Issue on Multimodal Learning Analytics.*  
*Ad-hoc Reviewer, IEEE Transactions of Learning Technologies*
- 2015** *Program Chair, Fablearn 2015, Stanford, CA.*  
*Reviewer, International Conference on Multimodal Interaction (ICMI) 2015*  
*Reviewer, Learning @ Scale 2016, Edinburgh, Scotland*  
*Ad-hoc Reviewer, International Journal of Artificial Intelligence in Education (IJAIED)*  
*Reviewer, National Science Foundation*  
*Grand Challenge Co-Chair, International Conference on Multimodal Interaction, Seattle, Washington*  
*Co-Chair, Multimodal Learning and Analytics Grand Challenge at the International Conference on Multimodal Interactions, Seattle, Washington*
- 2014** *Reviewer, International Conference of International Computer-Supported Collaborative Learning (CSCL) 2015, Gothenburg, Sweden*  
*Poster/Demos Co-Chair, Learning Analytics and Knowledge Conference, Marist College, New York*  
*Co-Chair, Multimodal Learning Analytics Grand Challenge at the International Conference on Multimodal Interaction (ICMI) 2014, Istanbul, Turkey*
- 2013** *Reviewer, National Science Foundation*  
*Reviewer, International Conference of the Learning Sciences (ICLS), Denver, Colorado*  
*Ad-hoc Reviewer, Journal of Learning Analytics (JLA)*  
*Organizer, Multimodal Learning Analytics Grand Challenge at the International Conference on Multimodal Interaction (ICMI) 2013, Sydney, Australia*  
*Discussant, Learning Sciences SIG Roundtable on Engagement, American Educational Research Association Annual Conference (AERA) 2013, San Francisco, California*
- 2012** *Reviewer, Learning Analytics and Knowledge Conferences*  
*Co-chair, 1<sup>st</sup> International Multimodal Learning Analytics Workshop at the International Conference on Multimodal Interaction (ICMI) 2012, Santa Monica, California*

#### University Service

- 2016** *Member, School of Education and Social Policy Global Initiatives Committee*  
*Member, Northwestern University Cognitive Science Committee*

#### Grants

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**NSF Early-concept Grants for Exploratory Research (EAGER): BIGDATA: Catalyzing Research in Multimodal Learning Analytics (PI)**

Dates: October 1, 2015 – September 30, 2017

Amount: \$299, 803

**NSF AISL: Makerspace Identification of Evidence for Learning (Co-PI)**

Pending

**NSF Cyberlearning EXP: Inclusive Making: A Multimodal Naturalistic Platform for Digital Fabrication and Invention (PI)**

Pending

#### Advisees

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#### Undergraduate

Shoshani Shapiro – School of Education and Social Policy - *Honors Thesis Advisor*

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## **Patents**

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US 20120239396 A1 – Multimodal Remote Control (09-20-2012)

## **Technical Skills**

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**Programming Languages:** C++, C, C#, Python, Matlab, PHP, SQL, Action Script, Javascript, DHTML, CSS, Java

## **Additional Skills**

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**Spoken Languages:** Portuguese (*Fluency*), French (*Conversational*), Spanish (*Intermediate*)