



Technology and Autism: A (limited) retrospective look at 15 years of research @GT

*Gregory D. Abowd
Regents' Professor and J.Z. Liang Chair
Georgia Institute of Technology*





Agenda

- A short historical vignette about an accidental inspiration
- Stakeholder balancing act
- “Better” interventions
 - “We have an app for that!” 2007-present
 - Social support + motion-based games
- “Better” eyes
 - Remote diagnosis
 - Better quantifying and understanding of behavior



The story of how I got here.

AUTISM & ME



1998: An important year in my life

- The Aware Home project launched.
- My father died.
- My oldest son changed before my very eyes.

It took me several years to realize how these events would really impact me.

Richard G. Abowd, Jr.: 8mm film enthusiast



1940



1950



1960

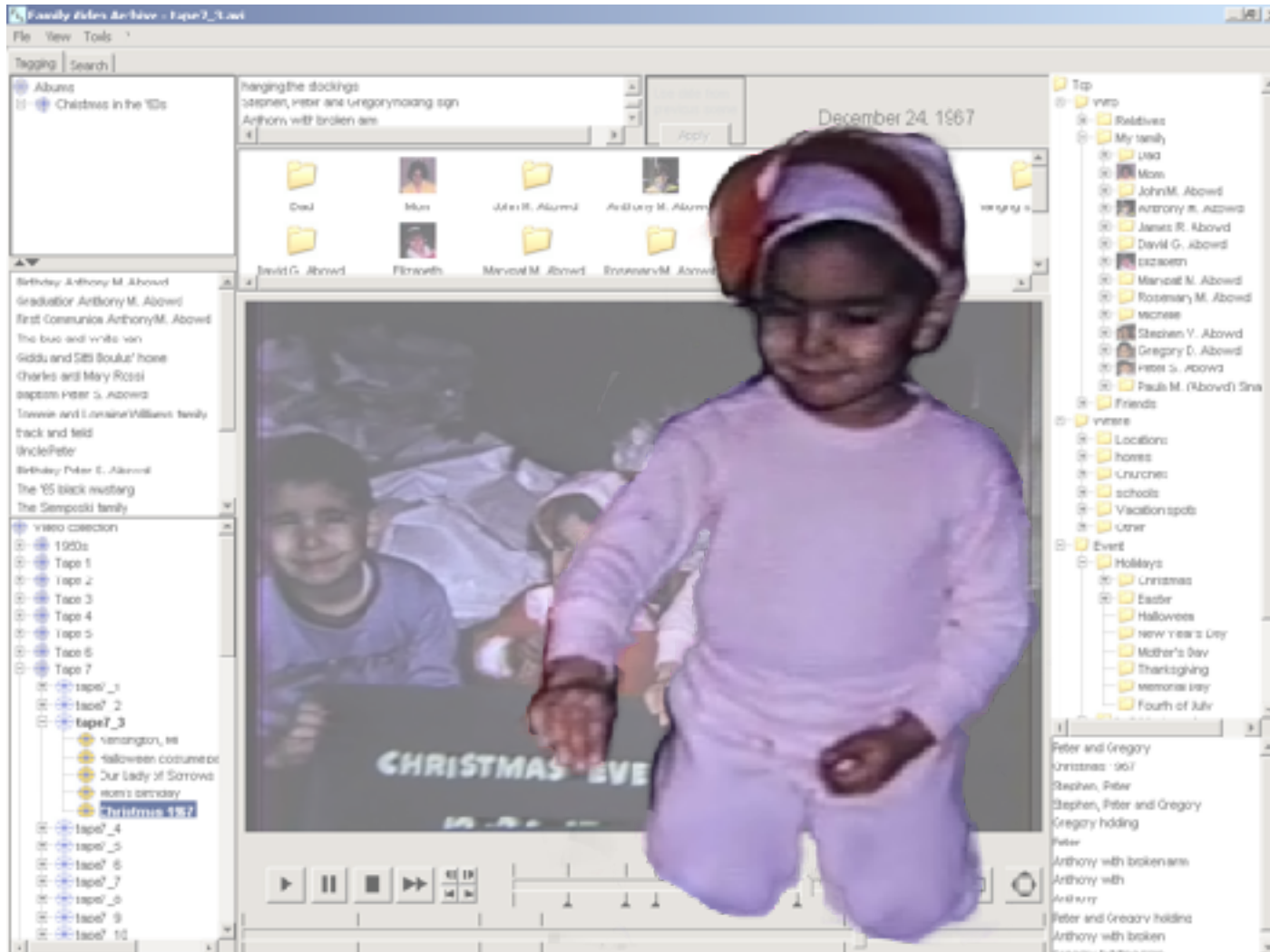


1970



1980

Hey, Dad, look at this!





One evening in 2002...

From whimsical ... (Aidan, Dec. 1998)





... to inspirational (Aidan, July 1999)



This changed everything for me.

- Being a successful computing researcher was not enough.
 - What place does technology play in the space of autism, with all of the different stakeholders?
 - Research vs. Impact
 - What role do I play?
 - Researcher
 - Advisor
 - Parent
 - Advocate





The delicate art of pleasing different audiences

STAKEHOLDER BALANCING ACT



Autism's stakeholders

- The individual
- The family and friends
- The teachers
- The caregivers
- The therapists and clinicians
- The research community
 - genetics, neuroscience, behavioral, computing

In 2008, I founded the non-profit Atlanta Autism Consortium to bring these communities together.



“BETTER” INTERVENTIONS



“Better” interventions

- We have an app for that!
- Addressing the social needs of adolescents with autism.
- Games to encourage movement and social interaction.

We have an app for that!



2007—2012

- Kids with autism LOVE the iPhone/iPad/robot!
- They are relatively cheap and non-stigmatizing.
- They are relatively easy development platform.
- Parents will pay (just about) anything for them!

We have (too many) apps for that!

2001 – 2015

1,800 “Apps for Autism”

- How do you find the one for you?
- How do you know it will work?





How do you find the one for you?

- Services to catalogue them
 - Applications Autisme
 - Appy autism
 - DART apps reviews
 - Autism Speaks apps
 - Wynsum arts

Appyautism Encuentra las mejores Apps para personas con trastornos del espectro autista



ESP | ENG



Inicio

Apps

El proyecto

Quiénes somos

Artículos

Contacto

Encuentra las mejores Apps para personas con trastornos del espectro del autismo.



¡Bienvenidos a Appy autism, mi página con mis Apps favoritas!

1 Marca las características de las apps que buscas

2 Escribe palabras clave

3 Dale a "Buscar apps"

PLATAFORMAS



CATEGORÍAS



DISPOSITIVOS



PALABRA CLAVE

Pe. juegos + emociones

Buscar Apps

Más opciones



WALK WITH US

DONATE

SEARCH

VITALS: Autism Apps | Resource Guide | What Is Autism? | Screen Your Child | Tool Kits

- Home
- FAMILIES & ADULTS
- RESEARCH
- ADVOCATE
- GET INVOLVED
- By age
- select

Autism Apps

[Share](#) 7880
 [Tweet](#) 1437
 [Google +](#) 120
 [Email](#) 2963
 [Share](#) 70

Do you have a favorite autism app you'd like to add to this list? Please email a brief description of the app, including the platform, cost, age group, price, any related research, and a link to FSDB@AutismSpeaks.org and we would be happy to share your recommendation with the Autism Speaks community!

Apps are listed in alphabetical order. You can sort apps by rating by clicking the "Rating" link above that column. You can rate apps by first clicking on the app name to visit the app detail page. Then, below the description of the app, click on the number of stars for your rating of the app.

Apps now have a research rating:

Anecdotal = No specific or related scientific studies for this type of app.

Research = There are some related scientific studies, but no direct research support for this type of app or technology.

Evidence = There is solid or specific scientific evidence that this type of app or technology is helpful.

DART

development
autism
research
technology



THE UNIVER

[HOME](#)[BLOG](#)[AUTISM RESEARCH](#)[ASD TECH](#)[CHILD DEVELOPMENT LAB](#)[FIND OUT MORE](#)[CONTACT US](#)

App Reviews

This library of app reviews is organised alphabetically by app name and updated with about half a dozen new reviews each month. In addition the wheel below (last updated December 2013) summarises the most recommended reviewed apps by type. Please [contact us](#) if you would like to submit a guest review or request a review of a specific app.

RECENT BLOG POSTS

[Can we or should we simulate autism?](#)

[What is "translational re-](#)

Appyautism Azahar

Using Tic-Tac software to reduce anxiety-related beh...

Wynsum Arts - We make it easy for the Autism co...



PARENTS & YOUTH

ABOUT US

RESEARCH

FOR DEVELOPERS

GET INVOLVED

WE MAKE IT EASY

for the Autism community to discover the best apps. Download the FREE i.AM Search® App by Wynsum Arts >>



WATCH OUR VIDEO





How do you know it will work?

That is the question for now and into the future.

Addressing the Social Needs of Adolescents with Autism



Rosa Arriaga & Hwajung Hong



Everyday social challenges

Q: A noisy neighbor makes me insane. Any advice?

“I’ve got new neighbors who live above us and who seem to love having parties. [...] It was 1:30am and the music and their screaming is only getting louder. It was driving me insane. Any advice? I haven't really encountered this problem much before.”



What if you asked an online buddy?

“Buy a drum kit, wait those neighbors falling asleep, and that's when you practice the living daylights out of that kit. Negotiate with them after, say, three or four sessions.”

- *Directness: Yes*
- *Informational support: No*
- *Emotional support: No*
- *Helpfulness: 1 (poor)*



ASPIES Central
Asperger's & Autism Community



What if you asked a “stranger”?

“Noisy neighbors can be very frustrating [...] First, there's a chance that they don't realize they're bothering you. Try talking to them to let them know how you feel. If you're nervous about speaking in person, try leaving polite and respectful note for the neighbors. If that doesn't work, it may be time to involve your landlord. Just be sure to stay calm and be respectful throughout.”

- *Directness: Yes*
- *Informational support: Yes*
- *Emotional support: Yes*
- *Helpfulness: 5 (Very helpful)*





ASPIES Central
Asperger's & Autism Community

VS.



amazon mechanicalturk

	Community answer	Crowdsourced answer
<i>Time to receive the first answer</i>	4.5 days	3 minutes
Length of response	118.5 words	64.3 words
<i>Directness (min: 0, max: 1)</i>	0.69	0.97
Informational support (min: 0, max: 1)	0.41	0.91
<i>Emotional support (min: 0, max: 1)</i>	0.38	0.36
Helpfulness (min:1, mix: 5)	2.22	3.4

inquir.us prototype

The image shows a desktop browser window displaying the inquir.us website. The browser's address bar shows 'discourse.inquir.us'. The website has a navigation bar with 'all categories', 'Categories', 'Latest', and 'Starred'. Below this, there are several category cards, each with a title, a description, and a list of recent posts. The categories are: Social skills and friendships, Work and finding a job, Daily planning, Health, Leisure and entertainment, and Financial planning. A mobile phone is overlaid on the right side of the browser window, showing the website's mobile interface. The mobile interface has a similar navigation bar and category cards, but the text is smaller and the layout is more compact. The mobile phone's status bar shows the time as 2:32 PM and the signal strength as 4 bars.

all categories Categories Latest Starred

Category	Latest
Social skills and friendships This category covers the areas of practical language skills and the social advice on friendship, dating, and manners and etiquette.	A noisy neighbor made me insane Jul 24 Needing school dance advice Jul 8
Work and finding a job 1 new This category aggregates all the content related to your education and career queries.	Workplace conflict <small>new</small> 1h First day back in school Jul 8
Daily planning 1 new This category covers activities of daily living that enhance your ability to manage your own self-care and live independently.	Matching clothes <small>new</small> 1h My sister's baby shower Jul 24
Health This category covers anything to do with medicine, illness, healthcare, nutrition, sleep issues, mental health, fitness ,and exercise.	What are the health benefits of massage? Jul 24
Leisure and entertainment This category is about an activity that aims to entertain and amuse a public. Shows on a TV, movies, music, video game, sports, concerts.	What movies explore themes of loneliness and isolation in the modern world? Jul 24
Financial planning 2 new	Test post <small>new</small> 2d

Games to encourage movement and social behavior

- Agata Rozga, Arpita Bhattacharya & The Lionheart School
- Use of Kinect





Measuring and understanding behavior in new ways

“BETTER” EYES



“Better” eyes

- Behavior imaging as an analogy to medical imaging
- Examples
 - Supporting remote diagnosis
 - Computational Behavioral Science
 - Detecting eye gaze from POV cameras.
 - Classifying severe behaviors from accelerometers
 - Measuring approach and proximity with RGB+D cameras

Supporting remote diagnosis



1 in 68 children in U.S. affected (CDC, 2014).

But it is more than a statistic for me.



Agata Rozga



Rosa Arriaga



Nazneen



Chris Smith
(SARRC)



Ron
Oberleitner
(BIS)

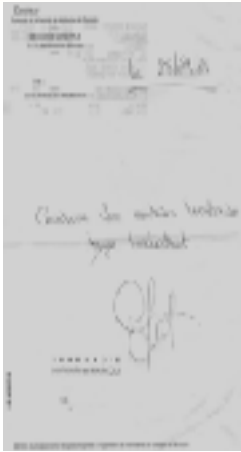
Behavior Imaging Solutions, Inc., for which Gregory Abowd was CRO 2004-2016

Autism diagnosis challenge



12 to 18 Months or More

Inspiration: Lab test of “behavior specimen”



Referral



Specimen Collection



Specimen Analysis

01/14/2012

Hematology
MD7 Analyze

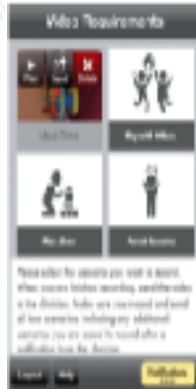
Specimen: Zircellwood
Laurie Lee Spivack patient U733182142p

Classification:

Lab Test:	Result:	Reference Range
pH:	7.37	7.35-7.45
pCO ₂ :	45mmHg	35-45 mmHg
pO ₂ :	97mmHg	80-100mmHg
HFO:	23 mL/L	28-36 mL/L
OG sat:	92%	94-100%

01/14/12

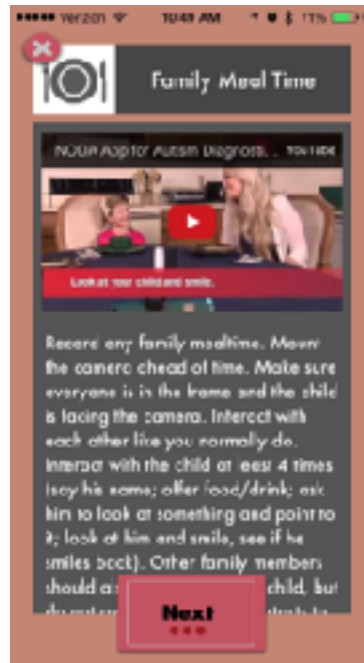
Report



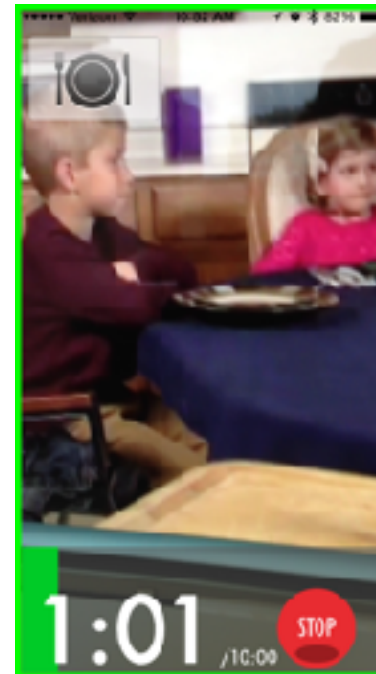
NODA: Naturalistic Observational Diagnostic Assessment



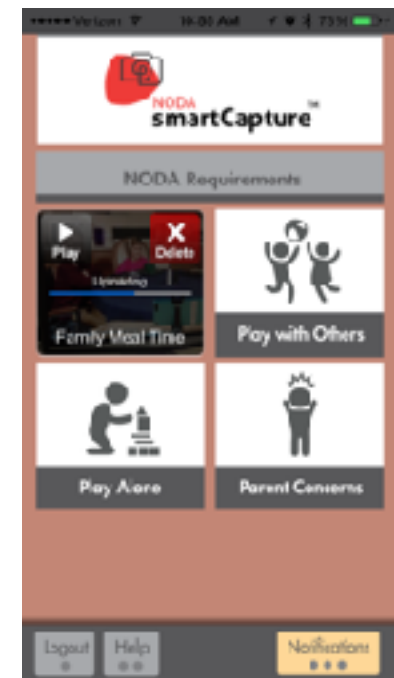
Instructions



Recording



Review & Upload



Remote Analysis via **NODA CONNECT™** Step 1: Tag videos

Tag inserted into video

DSM 5-inspired pre-defined behavior tags

The screenshot displays the NODA CONNECT web interface. At the top, the browser address bar shows 'do-noda.com/behaviorimaging.com/'. The interface includes a user login section for 'Bob Lohb' and 'Susan Erbar'. Below this, there are navigation tabs for 'Home' and 'Settings'. The main content area features a video player showing two children playing with toys. A red circle highlights a green pin icon on the video player's timeline, indicating where a tag is being inserted. To the right of the video player, a dropdown menu titled 'Search Tags' is open, listing various DSM 5-inspired behavior tags. A red box highlights this menu, and an arrow points from the text 'Add comment to tag' to it. Below the tag list, a 'Tag Details' section shows a comment: 'Susan shows a lack of interest with her peer but is focused on the toy.'

Request Evidence
more info

Doc Number: 37161014
Time Recorded: 12:33pm

Flash: Susan Erbar
Age: N/A

Search Tags

- Social: ignoring
- Social: orientation of gaze with other behaviors
- Social: Lack of bringing objects of interest
- Social: Lack of showing objects of interest
- Social: No interest in peer/parent
- Social: No sharing (toy or emotions)/No seeking co...
- Social: No sharing food, toys, activities
- Social: No/limited interest in peer interaction
- Social: No/limited social responses
- Social: Odd social behavior
- Typical: Eye Contact
- Typical: Eye Contact - affectual expression
- Typical: facial expression
- Typical: head/neck tilt or other gestures
- Typical: Play with others
- Typical: Play with toys
- Typical: Posture
- Typical: social response (i.e., laugh)

Tag Details:
Susan shows a lack of interest with her peer but is focused on the toy.

Add comment to tag

Diagnostic Reporting via NODA CONNECT™



NODA Report

Site	
Faculty/Coordinator	Cheryl Kelly/Travis (Director of I & O) ADP Cap Jam Garcia
Provider	Reporting Location
Resource	ADDRESS: 4010A BARNETT 4010A BARNETT 4010A BARNETT 4010A BARNETT

Developmental History

- Recent Developmental Concerns: N/A
- Attention: Indirect: N/A
- Speech: N/A
- Example of child request: N/A
- Current Medical Conditions: N/A
- Learning: N/A
- Initiating/Initiated: N/A
- Understanding a Common Sequence: N/A
- Using Common Objects during play: N/A
- Does child try to find objects hidden behind them: N/A
- Does child look for hidden toy or food: N/A
- Does Child point at items that interest them: N/A
- Other types of gestures: N/A
- Relevant milestones/abilities the same age group: N/A
- Relevant skills and abilities: N/A

Request/Concern

A. Assessment of Socio-Communicative	Category
1. Deficit in reciprocal interaction (e.g., the child has developmental delays and failure of usual back-and-forth conversation; no mutual sharing of interest, attention, or pleasure in being with or responding to others)	1. Deficit in reciprocal interaction (e.g., the child has developmental delays and failure of usual back-and-forth conversation; no mutual sharing of interest, attention, or pleasure in being with or responding to others)
2. Deficit in nonverbal communication (e.g., the child has developmental delays and failure of usual back-and-forth conversation; no mutual sharing of interest, attention, or pleasure in being with or responding to others)	2. Deficit in nonverbal communication (e.g., the child has developmental delays and failure of usual back-and-forth conversation; no mutual sharing of interest, attention, or pleasure in being with or responding to others)
3. Deficit in developing, maintaining, and understanding relationships (e.g., the child has developmental delays and failure of usual back-and-forth conversation; no mutual sharing of interest, attention, or pleasure in being with or responding to others)	3. Deficit in developing, maintaining, and understanding relationships (e.g., the child has developmental delays and failure of usual back-and-forth conversation; no mutual sharing of interest, attention, or pleasure in being with or responding to others)

Division Summary

Summary: This summary is published for the Division Summary on the ODE website. Example summary: This summary is published for the Division Summary on the ODE website. Example summary: This summary is published for the Division Summary on the ODE website.

Request/Concern

B. Restricted, repetitive patterns of behavior	Category
1. Developmentally inappropriate restricted, or abnormal, or stereotyped patterns of behavior (e.g., extreme interest in objects, excessive attachment to routines, or extreme resistance to change)	1. Developmentally inappropriate restricted, or abnormal, or stereotyped patterns of behavior (e.g., extreme interest in objects, excessive attachment to routines, or extreme resistance to change)
2. Interests that are abnormal in focus (e.g., excessive interest in objects, excessive attachment to routines, or extreme resistance to change)	2. Interests that are abnormal in focus (e.g., excessive interest in objects, excessive attachment to routines, or extreme resistance to change)
3. Highly restricted, fixed interests that are abnormal in focus (e.g., excessive interest in objects, excessive attachment to routines, or extreme resistance to change)	3. Highly restricted, fixed interests that are abnormal in focus (e.g., excessive interest in objects, excessive attachment to routines, or extreme resistance to change)
4. Abnormal or extreme repetitive motor movements (e.g., excessive interest in objects, excessive attachment to routines, or extreme resistance to change)	4. Abnormal or extreme repetitive motor movements (e.g., excessive interest in objects, excessive attachment to routines, or extreme resistance to change)

Division Summary

Summary: This summary is published for the Division Summary on the ODE website. Example summary: This summary is published for the Division Summary on the ODE website. Example summary: This summary is published for the Division Summary on the ODE website.



Computational Behavioral Science

We can transform how we **measure**, **analyze**, and **understand** behavior by leveraging advances in **sensing** technology and **computational** analysis methods

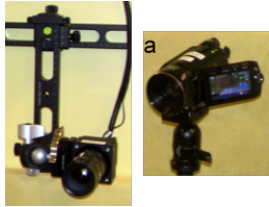
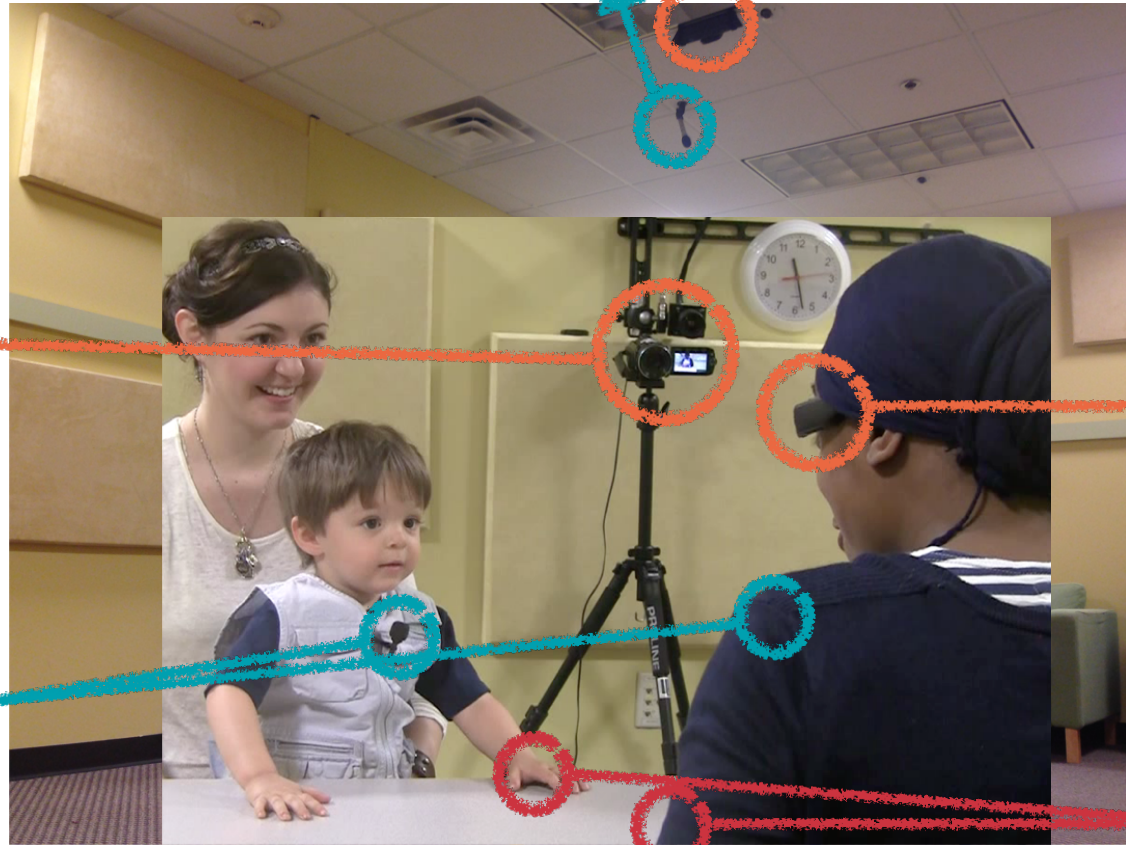
Jim Rehg, Agata Rozga and a team of collaborators from many different universities sponsored by NSF Expeditions program 2010-2016, as well as Simons Foundation.



Georgia Tech



Child Study Lab



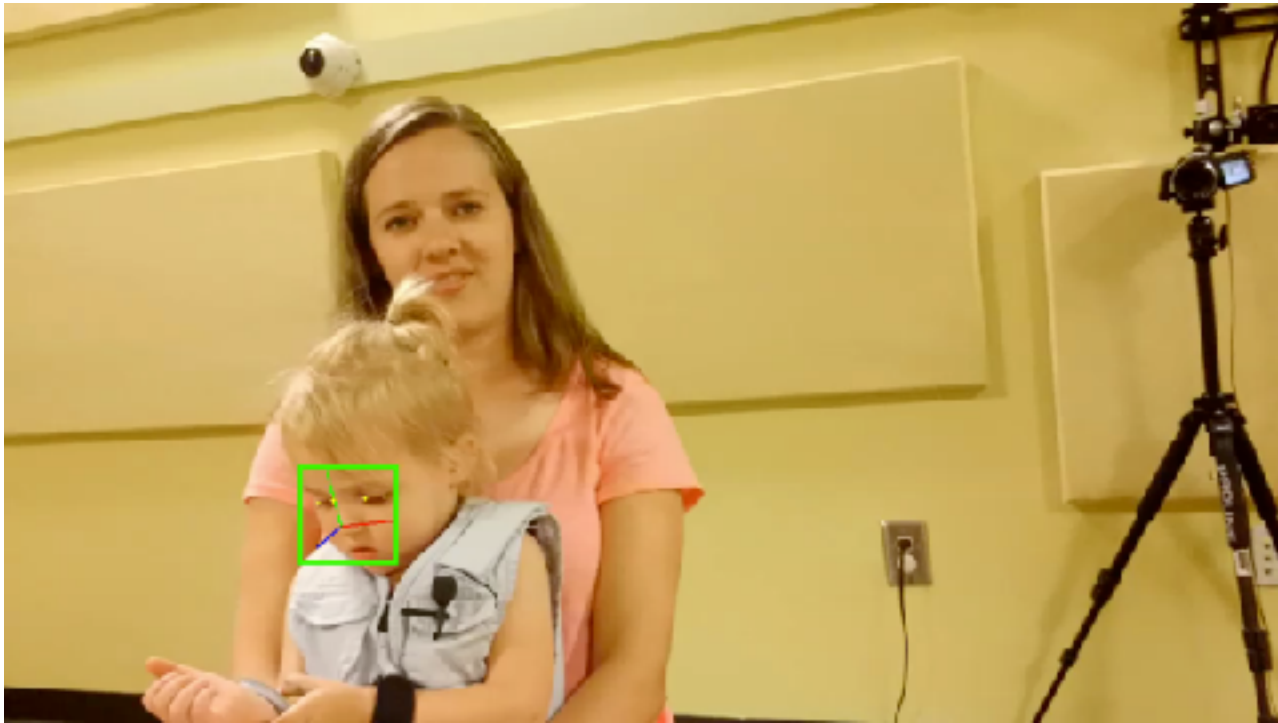
Multimodal Dyadic Behavior Dataset (MMDB): cbi.gatech.edu/mmdb

Eye contact: a new lens on an old phenomenon



Pivothead Kudu
first person point of view (PoV) camera

Automated detection of eye contact: A video



Ye, Z., Li, Y., Liu, Y., Bridges, C., Rozga, A., & Rehg, J. "Detecting bids for eye contact using a wearable camera." *Proceedings of the 11th IEEE International Conference on Automatic Face and Gesture Recognition (FG 2015)*.

Problem behaviors a frequent **co-morbid condition** in individuals with autism



Aggression

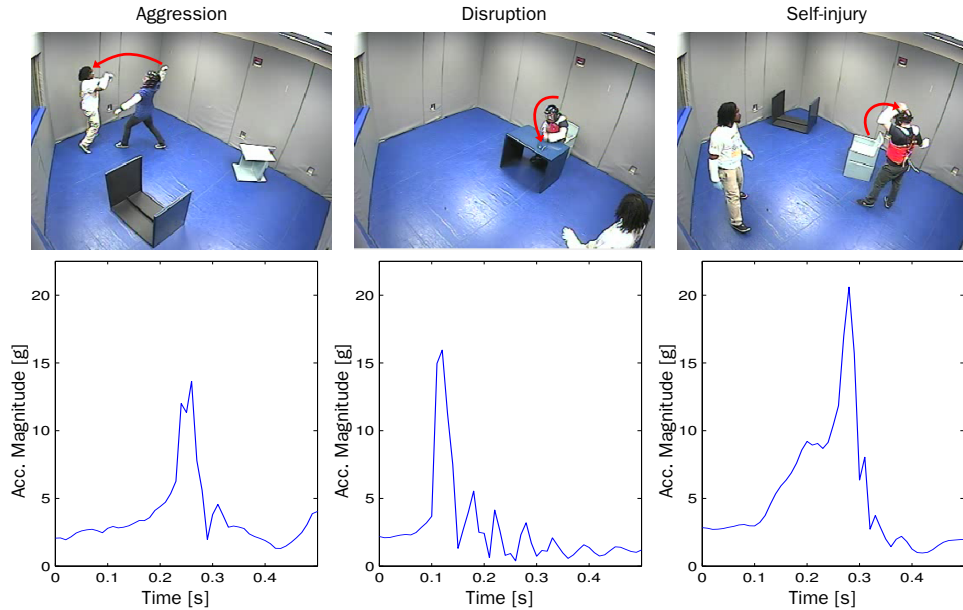


Self Injury



Disruptive/destructive

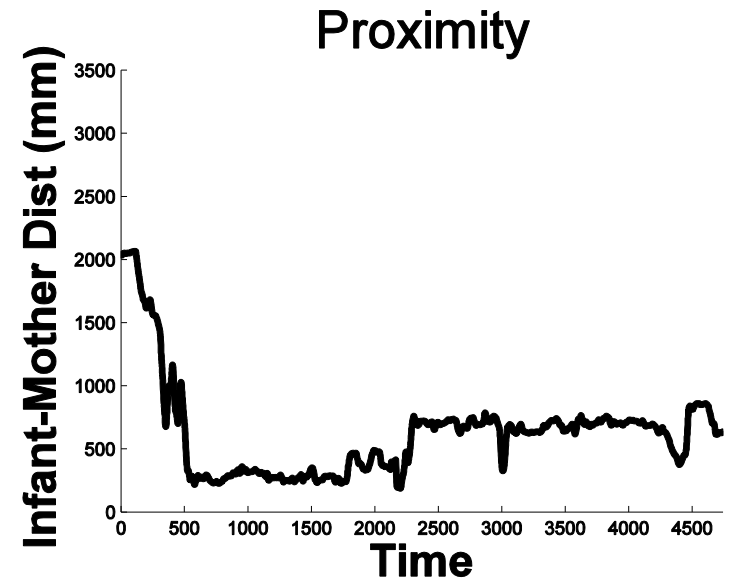
Classifying problem behaviors using wearable



Different classes of problem behavior leave **unique** “**signatures**” in the accelerometry streams

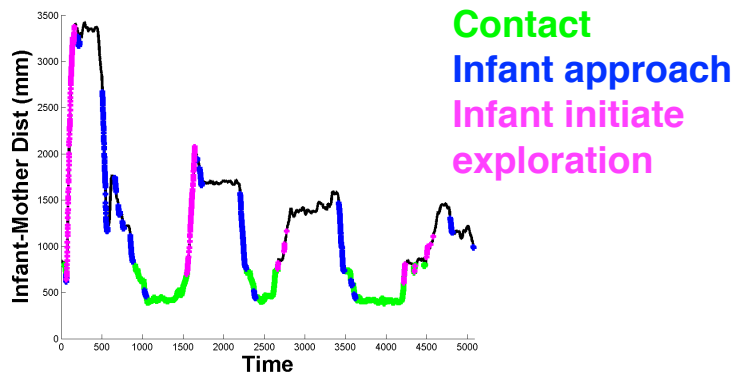
Features: e.g., **spectral, signal energy, orientation change**

Measuring **approach** & **proximity** from video

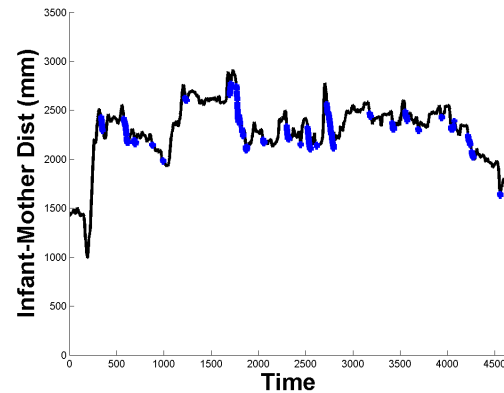


Infant **approach** behavior and mother-infant **proximity** are key

Proximity measure captures individual differences in infant approach and exploration



High proximity rating



Low proximity rating

Emily B. Prince, Katherine Martin, Devon Gangi, Rongfang Jia, Daniel Messinger, Arri Ciptadi, Agata Rozga, and Jim Rehg (2015). Automated measurement of dyadic interaction predicts expert ratings of attachment in the Strange Situation. Poster presented at the Annual Meeting of the Association for Psychological Science, May 21-25, New York, NY.



Acknowledgements

- Jim Rehg, Agata Rozga, Mark Clements, Maithilee Kunda, Irfan Essa, Rosa Arriaga, Stephanie Tofighi, Audrey Sutherland, Chanel Bridges and other National Science Foundations Expeditions colleagues
- Daniel Messinger, Cathy Lord, Matthew Goodwin and Simons Foundation
- Nazneen, Ivan Riobo, Chan Ho Kim, Arri Ciptadi, Arpita Bhattacharya, Hwajung Hong, Julie Kientz, Gillian Hayes
- and, of course...



... Dad, Aidan & Blaise.

“We are all faced with a series of great opportunities brilliantly disguised as impossible situations.”

Charles Swindoll

“Make IT matter.”

Gregory Abowd

