



Ubiquitous Care: Case studies in human-centered technology for health and education

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**Georgia
Tech**



College of
Computing

hsi

Health Systems Institute

A Georgia Tech / Emory Initiative



Who Am I?

Professor, School of Interactive Computing, Georgia Tech

- Human-centered computing based in “living laboratories”
 - Created Classroom 2000
 - Founder of the Aware Home

Director of Health Systems Institute





But really...who AM I?

10th of 12 children from Detroit



1967



1980



A mathematician meets magic

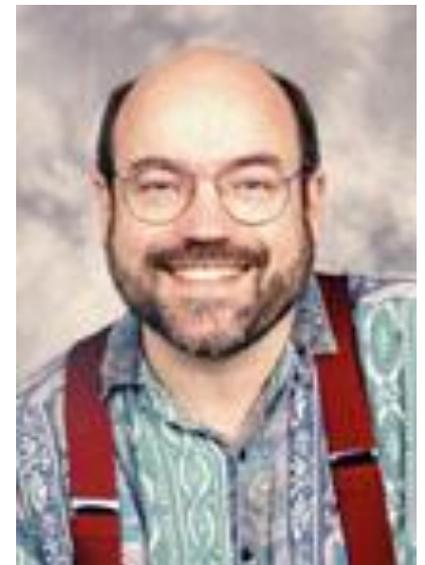
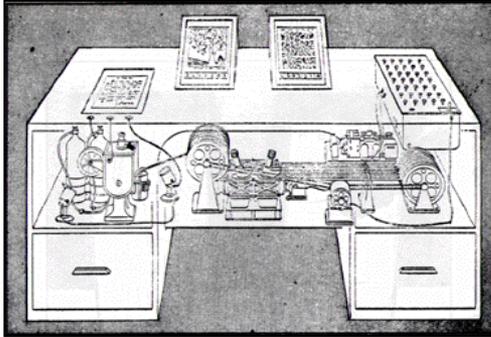
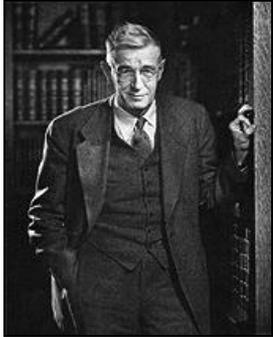
Past education

- B.S. in Mathematics (Notre Dame 1986)
- M.Sc. and D.Phil. in Computation (Oxford 1987, 1991)
- Postdocs at University of York (90-92), Carnegie Mellon University (92-94)

Then I arrived at Georgia Tech, and something happened to me...



Formalizing the Past vs. Inventing the Future





That was then, this is now...

Father of three children, two with autism





1998: a VERY important year for me

- Began the Aware Home effort
 - Aging in place, chronic disease management, ubicomp for real
- My father died...
- My oldest son changed before my very eyes...

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

Charles Swindoll

My father

Richard G. Abowd, Jr. was a handsome fellow.

He married Sara, a buddy's sister.

He was an 8mm film hobbyist.

On Nov. 19, 1998, he died, leaving behind a 30-year archive of home movies.



That Christmas, his faithful projector also died.

Hey, Dad, look at this!



Family Video Archive - tape7_3.avi

File View Tools ?

Tagging Search

Albums

- Christmas in the '60s

hanging the stockings
Stephen, Peter and Gregory holding sign
Anthony with broken arm

December 24, 1967

Dad Mom John M. Abowd Anthony M. Abowd James R. Abowd Christmas hanging s

David G. Abowd Elizabeth Marvnat M. Abowd Rosemarv M. Abowd Michelle

Birthdays: Anthony M. Abowd, Peter S. Abowd
Graduation: Anthony M. Abowd
First Communion: Anthony M. Abowd
The blue and white van
Giddu and Sitti Boulus' home
Charles and Mary Rossi
Baptism: Peter S. Abowd
Tommie and Lorraine Williams family
track and field
Uncle Peter
The '65 black mustang
The Siemposki family

Video collection

- 1950s
- Tape 1
- Tape 2
- Tape 3
- Tape 4
- Tape 5
- Tape 6
- Tape 7
 - tape7_1
 - tape7_2
 - tape7_3
 - Kensington, MI
 - Halloween costume pe
 - Our Lady of Sorrows
 - Mom's birthday
 - Christmas 1967
 - tape7_4
 - tape7_5
 - tape7_6
 - tape7_7
 - tape7_8
 - tape7_9
 - tape7_10

Who

- Relatives
- My family
 - Dad
 - Mom
 - John M. Abowd
 - Anthony M. Abowd
 - James R. Abowd
 - David G. Abowd
 - Elizabeth
 - Marypat M. Abowd
 - Rosemary M. Abowd
 - Michelle
 - Stephen V. Abowd
 - Gregory D. Abowd
 - Peter S. Abowd
 - Paula M. (Abowd) Sina
- Friends
- Where
 - Locations
 - homes
 - Churches
 - schools
 - Vacation spots
 - Other
- Event
 - Holidays
 - Christmas
 - Easter
 - Halloween
 - New Year's Day
 - Mother's Day
 - Thanksgiving
 - Memorial Day
 - Fourth of July

CHRISTMAS EVE

Peter and Gregory
Christmas 1967
Stephen, Peter
Stephen, Peter and Gregory
Gregory holding
Peter
Anthony with broken arm
Anthony with
Anthony
Peter and Gregory holding
Anthony with broken
Gregory holding sign



Technology and Autism

One evening, I was converting video from 1998, and I was shocked at what I saw.



Aidan, 18 months



Aidan, 26 months



Are you at the right lecture?

That's all very touching, Gregory, but what is your point?

Make IT matter!

Encourage passion, creativity and technical competence when you teach/research.



More specifically

Explicit message:

The challenges presented by autism present a great opportunity for many different kinds of computing research.

Implicit message:

Over time, collaborators will come.

This is not unique to autism. Choose your own substitute.

“It is the responsibility of leadership to provide opportunity, and the responsibility of individuals to contribute. ” (William Pollard)

- Gregory’s corollary: Good leaders are good individuals.



Opportunities

Examples of computing research stemming from autism and technology exploration

- Early detection of developmental delay
- Data collection for evidence-based interventions
- Designing interventions for the individual
- Understanding the autism phenotype

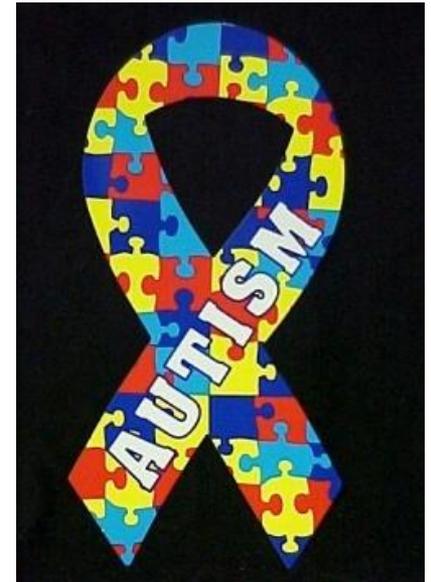
Autism spectrum disorders

A neurological disorder characterized by:

- Deficits in reciprocal social interactions
- Deficits in communication
- Restricted repetitive behaviors

It is highly individualized, with genetic and environmental components.

There is A LOT we do not understand.





Challenges/Opportunities

Many stakeholders

- The individual, the family and friends, teachers, therapists, clinicians, and researchers

Many stages in the continuum of care

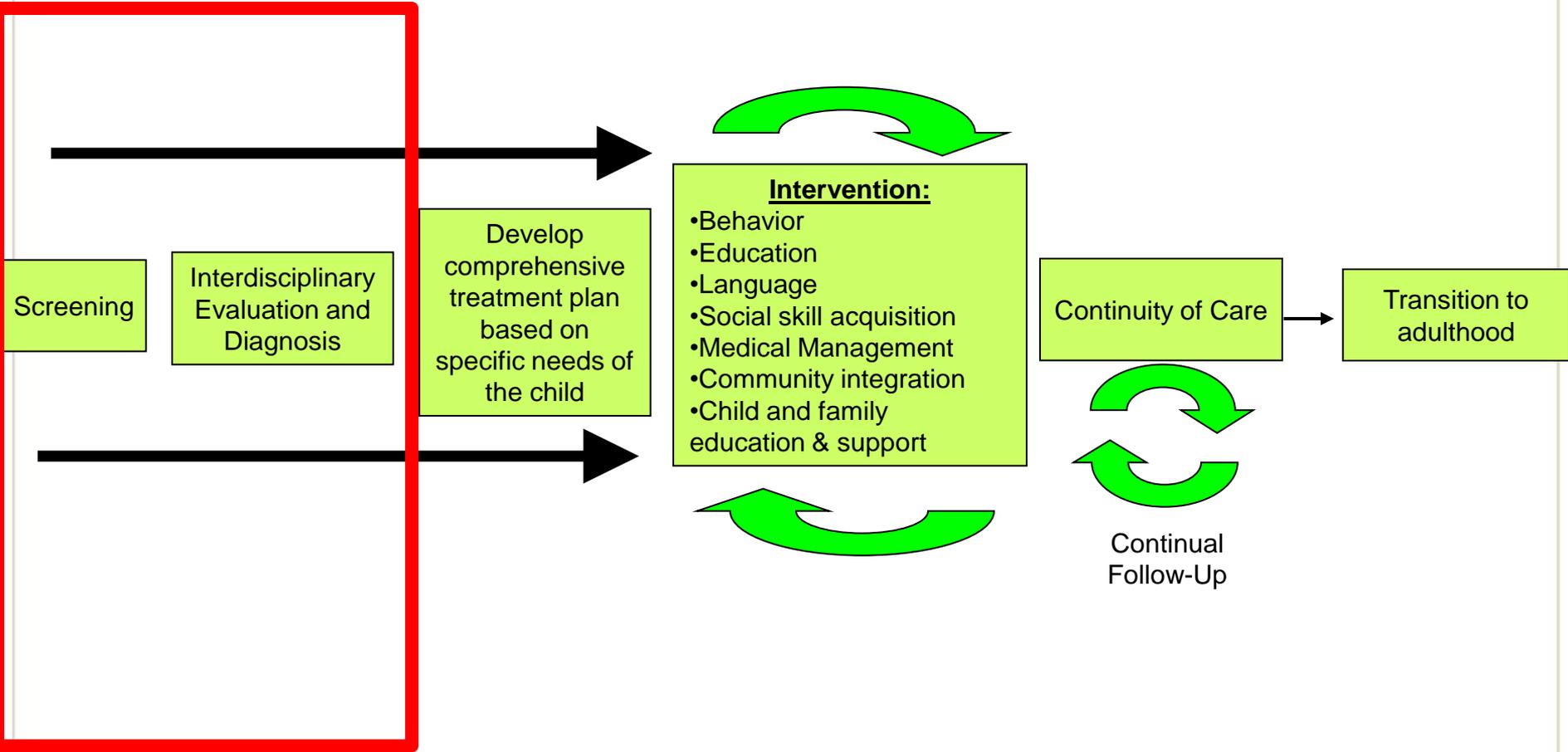
- Screening, diagnosis, treatment, monitoring, transition to adulthood

How can technology help?

I have a valuable perspective as parent, advocate, interdisciplinary research colleague & advisor.



A continuum of care





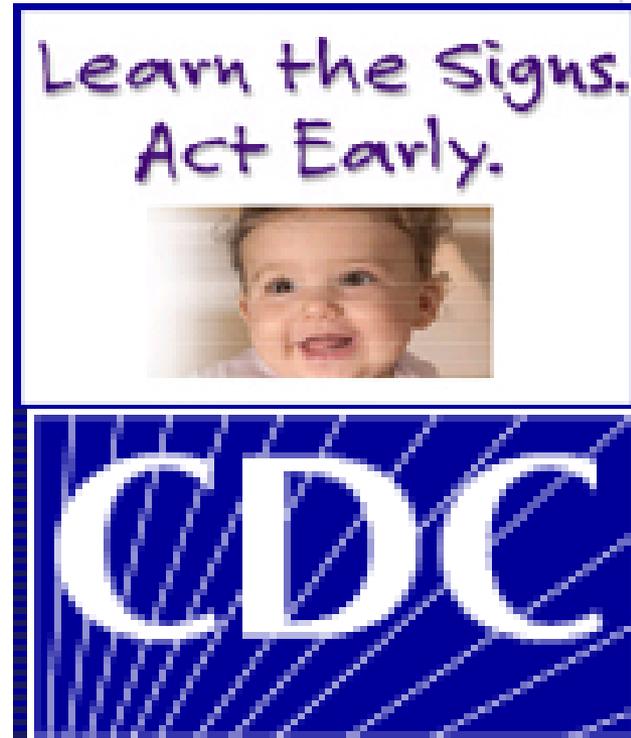
Early Detection

We believe that the earlier autism is detected, the more of an impact therapies can have on the child's development.

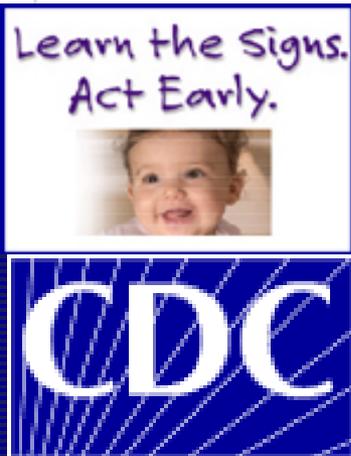
Most diagnoses are made several years after the first warning signs.

Diagnosis based on parent report and clinical observation

This applies beyond autism.



Technologies for Early Detection



Proactive baby calendar

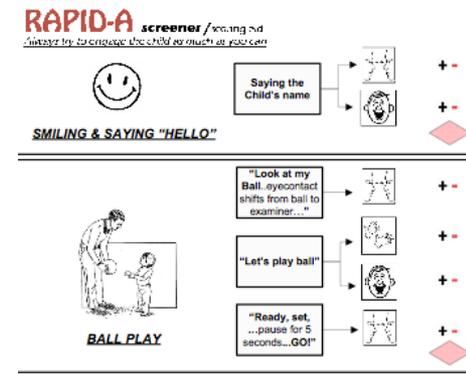


smart baby monitor

+ improves parent observation



Activity recognition



+ simplified screening

improves direct clinical behavior observation

Video mining of social interactions

Social interactions include:

- Repetitions of interactions
- Turn-taking between partners



Ping Wang
with Jim Rehg
(ICCV'09)



A Peek-a-boo Game

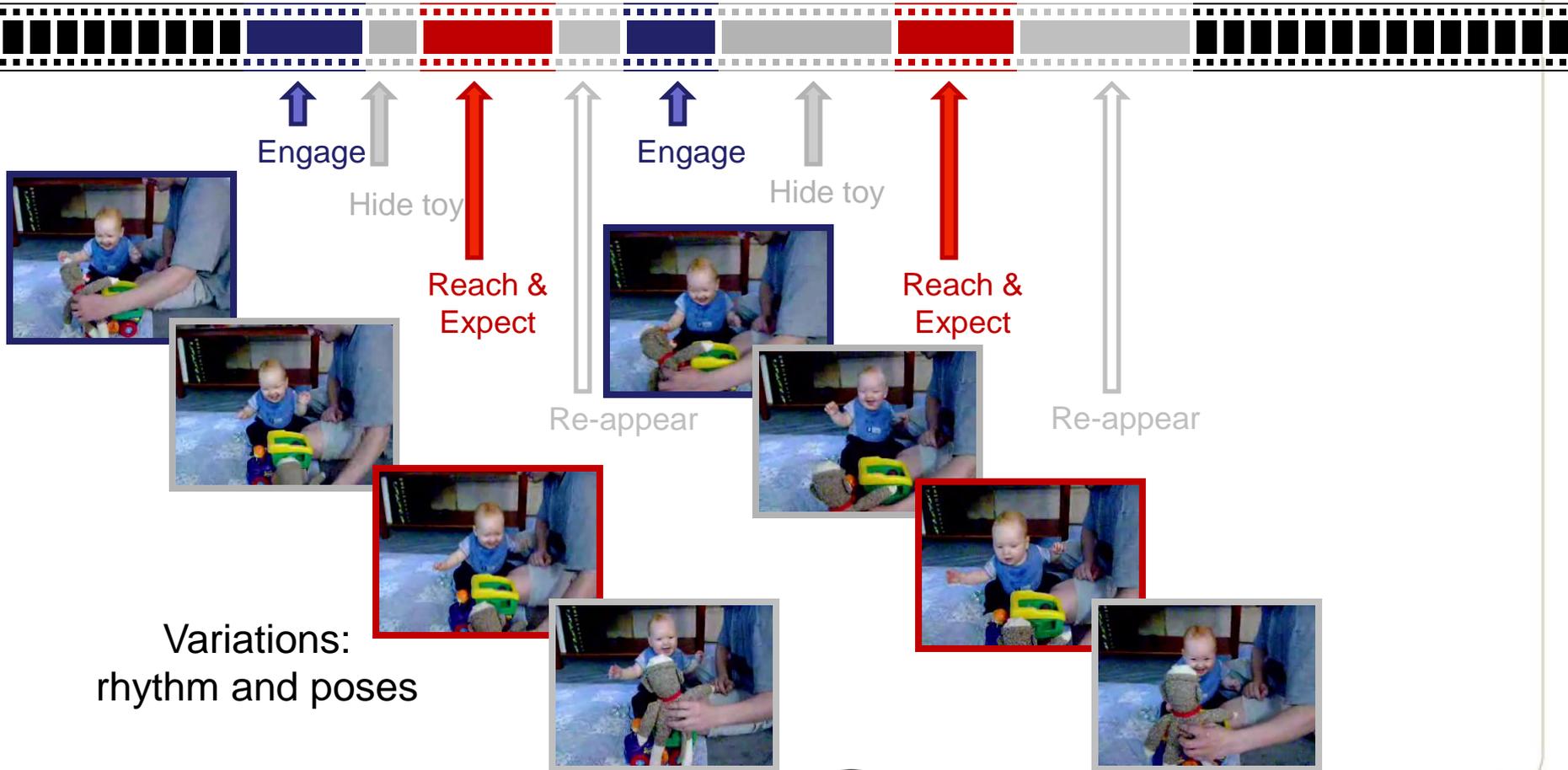


Unstructured video: Home movies



Social Games are Quasi-Periodic

Repetitions with Variations

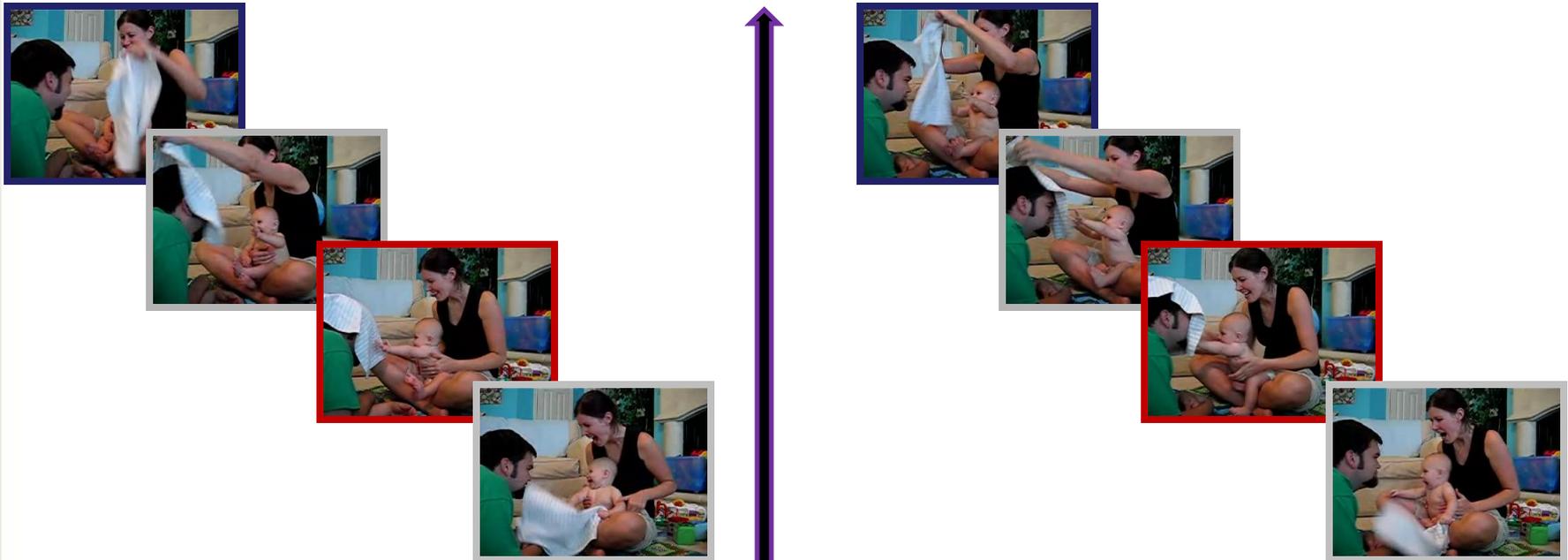


Social Games are Quasi-Periodic

Random Insertion or Deletion of Actions

Lift Cover Reach Uncover

Lift Cover Reach Uncover



Turn the cloth
upside down



Challenges

Detect quasi-periodic events without the knowledge of how the quasi-periodicity occurs

- Periodic motion analysis is not applicable

Detect games without knowing what they are and how they are played

- Supervised methods are not practical since it is difficult to collect representative data

The approach

- No need to pre-define activities
- No need to learn vocabulary of actions
- Automatically parse the stages of a game



2: clapping right hands



Design of the RAPID-ABC

- 1) Behavioral assessment of infants 15 to 27 months
 - Attention and Affect
 - Back-and-forth interaction
 - Communication (e.g., pointing)

- 2) Minimize pediatrician's work load:
 - Assessment can be completed and scored in < 5 minutes
 - One-page protocol
 - Streamline training for non-experts
 - Assessment instrument is easily obtained

Development of a one page protocol

RAPID - ABC / screener™
Development of a one page protocol

SMILING & SAYING "HELLO"

Saying the Child's name

FILL OUT MENUSES

0 Easy to engage to child
 1
 2 Hard to engage the child

Score

BALL PLAY

"Look at my Ball...eyecontact shifts from ball to examiner..."

"Let's play ball"

"Ready, set, ...pause for 5 seconds... GO!"

0 Easy to engage to child
 1
 2 Hard to engage the child

Score

BOOK

"Look at my Book..."

"What do you see in my book.... Can you turn a page for me?"

"Can you turn a page for me...pause for 5 seconds.... Continue"

0 Easy to engage to child
 1
 2 Hard to engage the child

Score

PUTTING ON A HAT

"Look what I'm doing, I'm putting on a hat"

0 Easy to engage to child
 1
 2 Hard to engage the child

Score

SMILING & TICKLING

"I'm going to get you"

"Pause for 5 seconds and Continue"

0 Easy to engage to child
 1
 2 Hard to engage the child

Score

TOTAL IN RED BOXES =





Opportunities with RapidABC

- Automated scoring and cross-clinic aggregation to support surveillance
- Quantitative assessment of the interactional synchrony between child and adult
 - Taking a “social reflex” at the doctor’s office.



Goal: Transforming Science?

Imaging technologies impact medical science

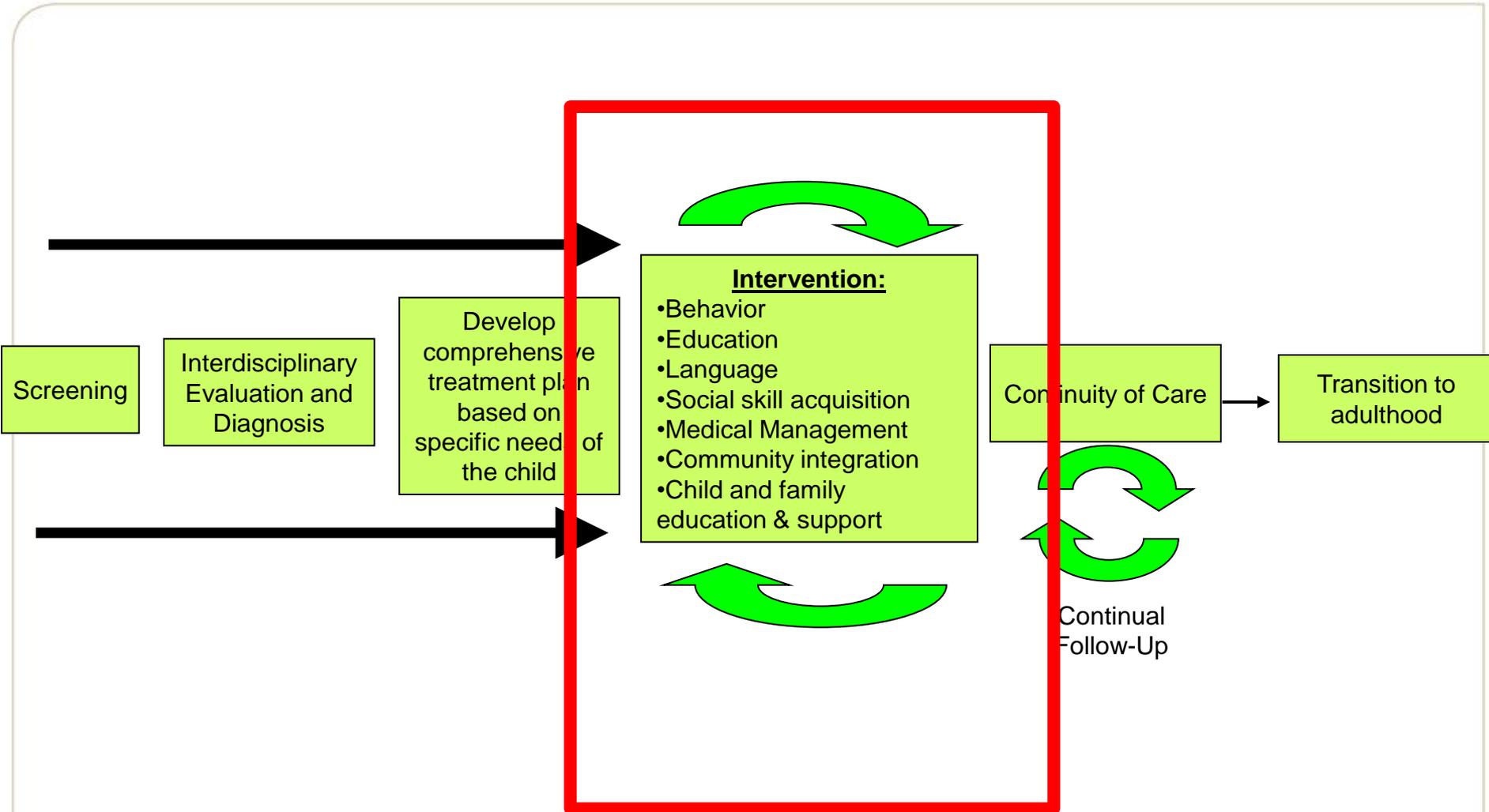
- Orthopedics and dentistry X-RAY
- Cardiology Echocardiogram
- Neurology MRI / CT

Behavioral sciences study developmental & cognitive phenomena

- What is Behavior Imaging and how can it impact the quantitative science of behavior?
- What does it mean to have visually-observable behaviors as part of a medical record?



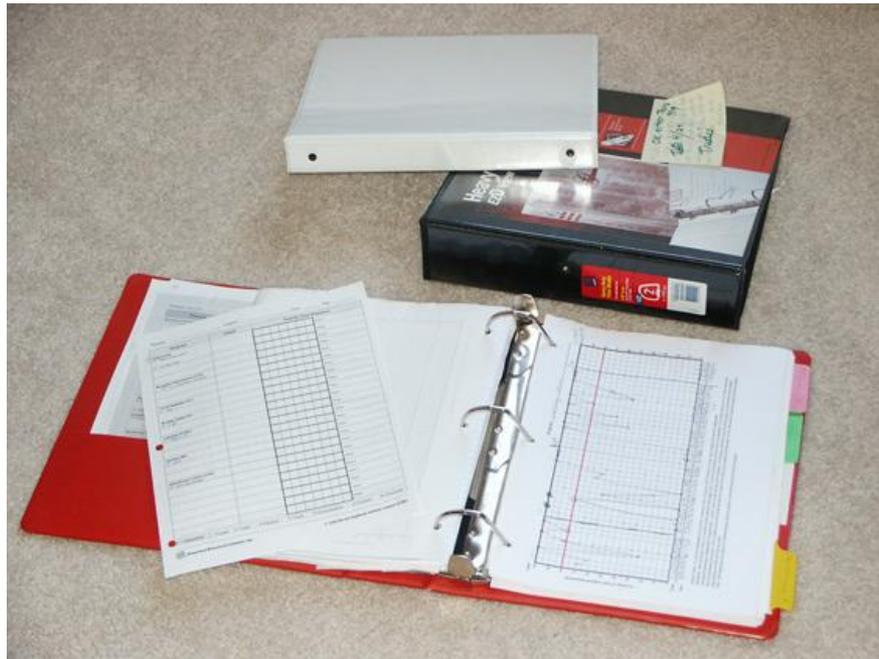
A continuum of care





Supporting evidence-based interventions

Data is important, but it is often hard to collect, aggregate, analyze, and, most importantly, share.



Abaris



Julie Kientz



(with Janet Lund, IBS, Inc.)

A tool to support discrete trial therapy, a popular form of intervention in homes and schools

Support the collaborative, data-based decision-making process of therapy teams

Indexing continuous video to support access during discussions



Abaris: Embedding Capture

Leverages basic therapy protocol to minimize intrusion

Speech detection to timestamp beginning of trial

Record handwriting using Anoto digital pen to collect grades and timestamp end of trial



DISCRETE TRIAL SESSION DATA

Student: John Smith Date: Saturday, July 07, 2007
Teacher: Julie Session ID: 123

Matching					Numbers					Spelling				
Stimulus	+	-	P	EC	Stimulus	+	-	P	EC	Stimulus	+	-	P	EC
currs	✓				7		✓			binge	✓			
	✓				2		✓							
crayons		✓			2		✓							
	✓				4		✓							
	✓						✓							
	✓						✓							
	✓						✓							
	✓						✓							

Drawing					Math					Teaching name				
Stimulus	+	-	P	EC	Stimulus	+	-	P	EC	Stimulus	+	-	P	EC
circle	✓				adding	✓				finger	✓			
	✓					✓								
box		✓			subtraction	✓								
	✓					✓								
face		✓				✓								
	✓					✓								

Copying "hello" Copying Handwriting

Stimulus + - P A EC Stimulus + - P A EC Stimulus + - P A EC



Abaris: Embedding Access

Abaris :: BETA
File Program Maintenance AbarisNet Administration

Program Graph Time-based Gr Review multiple sessions

Receptive Inst

100 %	
95 %	
90 %	
85 %	
80 %	
75 %	
70 %	
65 %	
60 %	
55 %	
50 %	
45 %	
40 %	
35 %	
30 %	
25 %	
20 %	
15 %	
10 %	
5 %	
0 %	

Receptive Instructions (C10)	0	0			55.6 %
Receptive Instructions (C10)			1	1	57.1 %
School (sch)					83.3 %
comple					37.5 %
Sa					64.3 %
Scho					

Graph preview

Zoom: 14 sessions

Program management

- Receptive Instructions (C10)
- Mastered and On Hold Targets
- Vocalization (S1)
- Writing Skills (S4)
- in a book (S4)
- short words
- Mastered and On Hold Targets
- Receptive Categories (na) R
- Receptive Categories (na) R
- Mastered and On Hold Targets
- Labeling (C24)
- Modeling Verbs/Verbs (V)
- Vocabulary - Objects (C15, G4) R
- Vocabulary - Objects (C15, G4) R
- Vocabulary - Pictures (C15, G4) R
- Vocabulary - Pictures (C15, G4) R
- Body Parts (C17) R
- Body Parts (C17) R
- Sensation (S19)

Session selection

- View selected sessions
- View selected notes

Save Close

Therapist: Julie
Location: Basement
Date: 02/21/2005
Time: 02:41:51 PM



Gillian Hayes

(with Juane Heflin, Georgia State and Cobb County Special Ed.)

Collecting rich behavioral data in the unstructured natural environment

Retroactively saving important video

Conscious selection of relevant video episodes

Hayes et al. CHI 2005; Hayes 2007 (thesis); Hayes et al. CHI 2008

Translation to practice



B.I. Capture™

Home Features **FAQs** Testimonials Research Contact Us

Features

- Go "back in time": capture events after the fact
- Annotate & organize videos with a simple interface
- Manage an unlimited number of subjects & videos
- Secure, conforms to HIPAA & FERPA standards
- Works with Excel & other tools for data analysis
- Works with **B.I. CARE** - Consultation & Records Environment

What's Included

- BI Capture Professional Software
- Logitech® USB video camera
- Radio Frequency (RF) remote control
- USB remote control receiver
- Priority phone and e-mail support
- 1 year of free software updates
- (Optional) - pre-configured PC exceeding requirements

View the [System Requirements](#)

caring technologies

Supported in part by NICHD SBIR Phase 1 and 2 grants

B.I. CARE™
Consultation & Records Environment

Home Features **FAQs** Testimonials Research Privacy Contact Us

Health Information Sharing & Archiving

Video clips and other data can be annotated, coded and organized within the user's account in B.I. CARE's Media Gallery, and then archived or shared.

Videos can be tagged, labeled, and commented on. Professionals can highlight moments by tagging certain events along the video timeline, while adding a description of an action. All annotations are time-, date- and author-stamped for optimal data collection and ease of consultation.

Media Gallery

Users build their own secure Media Gallery. B.I. CARE's Media Gallery offers easy ways to search, sort and organize by file type, keywords, titles, tags and comments. These powerful features allow users to organize their data by multiple categories such as family members, clients, behaviors, or other user-defined criteria.

To maximize productivity, you can annotate or share multiple videos and documents at once by highlighting a group of items and then selecting an item from the "More Actions" drop-down menu.

Advanced search and export tools allow for unique data-mining and reporting opportunities of multiple health data types, including video.

Professionals and caregivers can interact privately and remotely through a secure messaging interface about their clients' issues, treatment and progress.

caring technologies

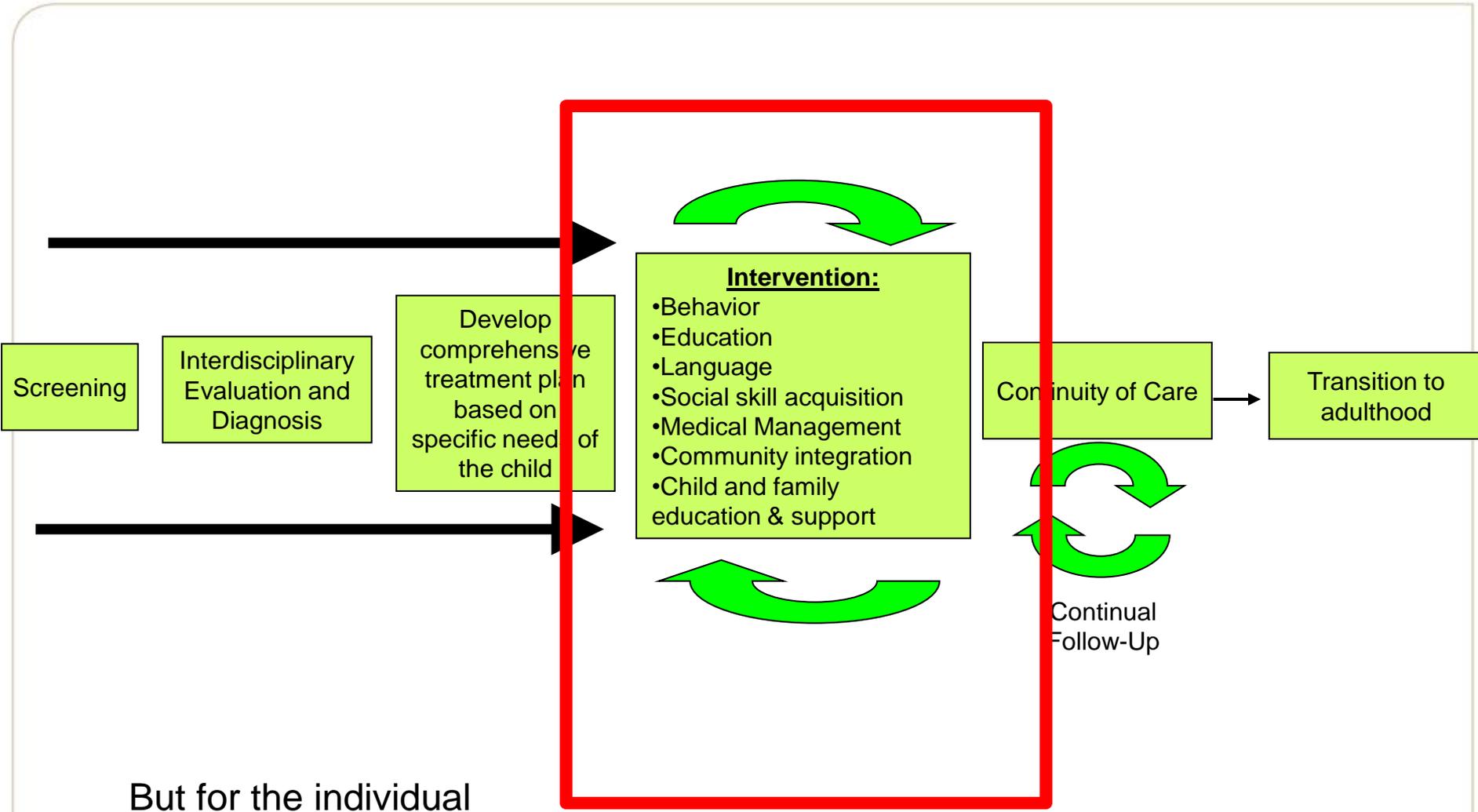


CRAFT: Can parents collect data?

- Collaboration with Marcus Autism Center
 - Nathan Call, Director of Severe Behavior Program
 - Rosa Arriaga, Yi Han, Nazneen
 - HSI-CHOA seed grant
- What would convince MAC to use CareLog/BI Capture?
 - Economic incentive to reduce travel
 - Has to be a good way to catch the behavior episodes and details
 - How many cameras are needed? How long to deploy?
 - Would insurance pay for this?



A continuum of care (CHOA)



But for the individual

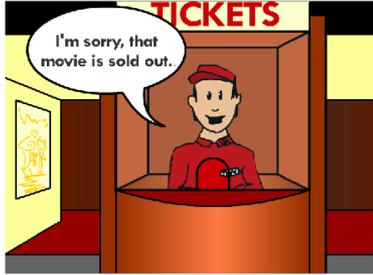
Refl-ex: Teaching social skills

With Juane Heflin and Jackie Isbell, GSU

- Social stories: A way to teach an individual appropriate social actions.
- Refl-ex: a more interactive way to teach why certain behaviors are and are not appropriate.

START FINISH

Problem:
The movie you were planning to go to is sold out.



What should you do?
Choose the best solution.

A 

B 

C 

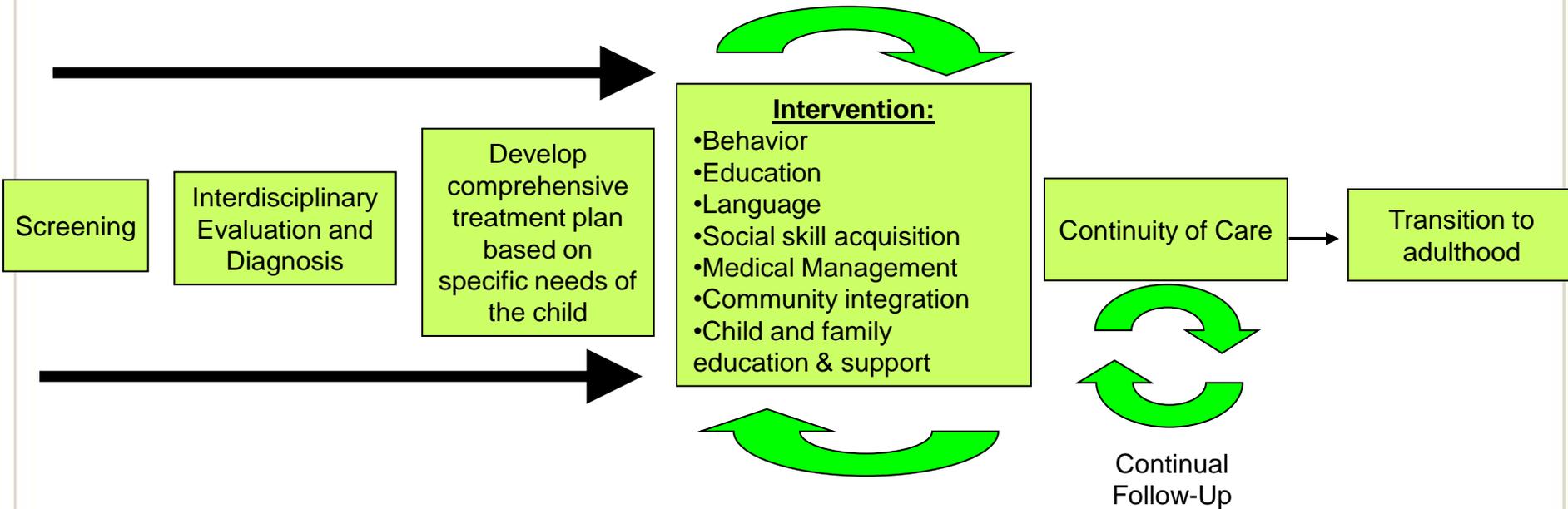
hs
Health Systems Inst
A Georgia Tech / Emory Inst

Refl-ex 2009



A continuum of care

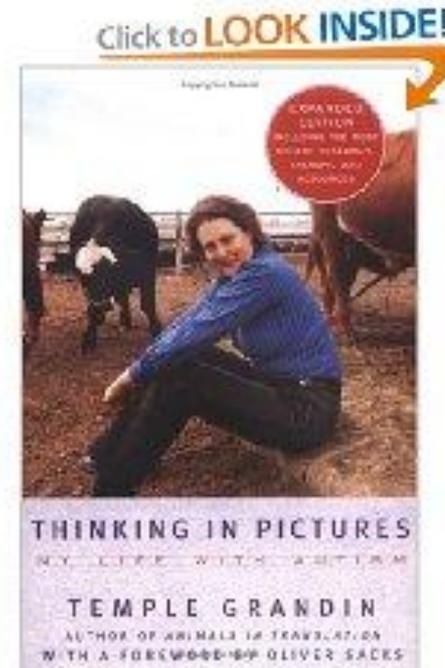
What about basic understanding of the autism experience?





Understanding Autism

Research and individual accounts provide interesting insights into this complex human condition.





VITA: Visual Thinking in Autism

Maithilee Kunda and Ashok K. Goel

School of Interactive Computing, Georgia Tech

mkunda@cc.gatech.edu goel@cc.gatech.edu

THINKING IN PICTURES— WHAT MIGHT IT MEAN?



Individuals
with autism

Pictorial

Verbal

Typically
developing
individuals

Appearance—
“what” and
“where”

Arbitrary—
driven by
inferential
needs

Content

Encoding

Analogical—
structural
correspondence

Propositional—
no
correspondence



Behavioral studies to design tools for assessment—“Cognitive phenotyping”



Reflection

- This has been a very successful agenda, and promises to remain so.
 - 2 PhD students at top universities
 - 1 former student has moved into this area
 - 2 more to graduate this year (co-advised)
 - At least 4 more in the pipeline
 - Atlanta Autism Consortium and the 10-year commitment by CHOA/Marcus Autism Center
 - Commercialization



Team Science?

- Probably not, but it is the best example in my career of involving many different research minds.
 - Connecting to autism researchers vital to success, but that's not surprising
 - Local expertise: Rosa Arriaga (Ph.D. in Dev. Psych) and Agata Rozga (GSU-GT, Dev. Psych)
 - What is surprising (or at least very satisfying) is the growing number of other computing researchers getting involved.
 - Jim Rehg (computer vision), Ashok Goel (cognitive science), Andrea Thomaz (robotics), Thad Starner (machine learning)
 - There are plenty more out there!



Revisiting the message

Explicit message:

The challenges presented by autism present a great opportunity for many different kinds of computing research.

Implicit message:

Over time, collaborators will come.

This is not unique to autism. Choose your own substitute.

“It is the responsibility of leadership to provide opportunity, and the responsibility of individuals to contribute. ” (William Pollard)

- Gregory’s corollary: Good leaders are good individuals.



Acknowledgements

Students

Gillian Hayes (UC Irvine), Julie Kientz (Washington), Tracy Westeyn, Ping Wang, Karthir Prabhakar, Nazneen, Fatima Boujarwah, and many more

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Other colleagues

Opal Ousley (Emory), Juane Heflin (Georgia State)

Support

Cure Autism Now/Autism Speaks, OAR, NSF, NICHD



Questions?

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More information:

<http://www.gregoryabowd.com>

<http://autism.cc.gatech.edu>