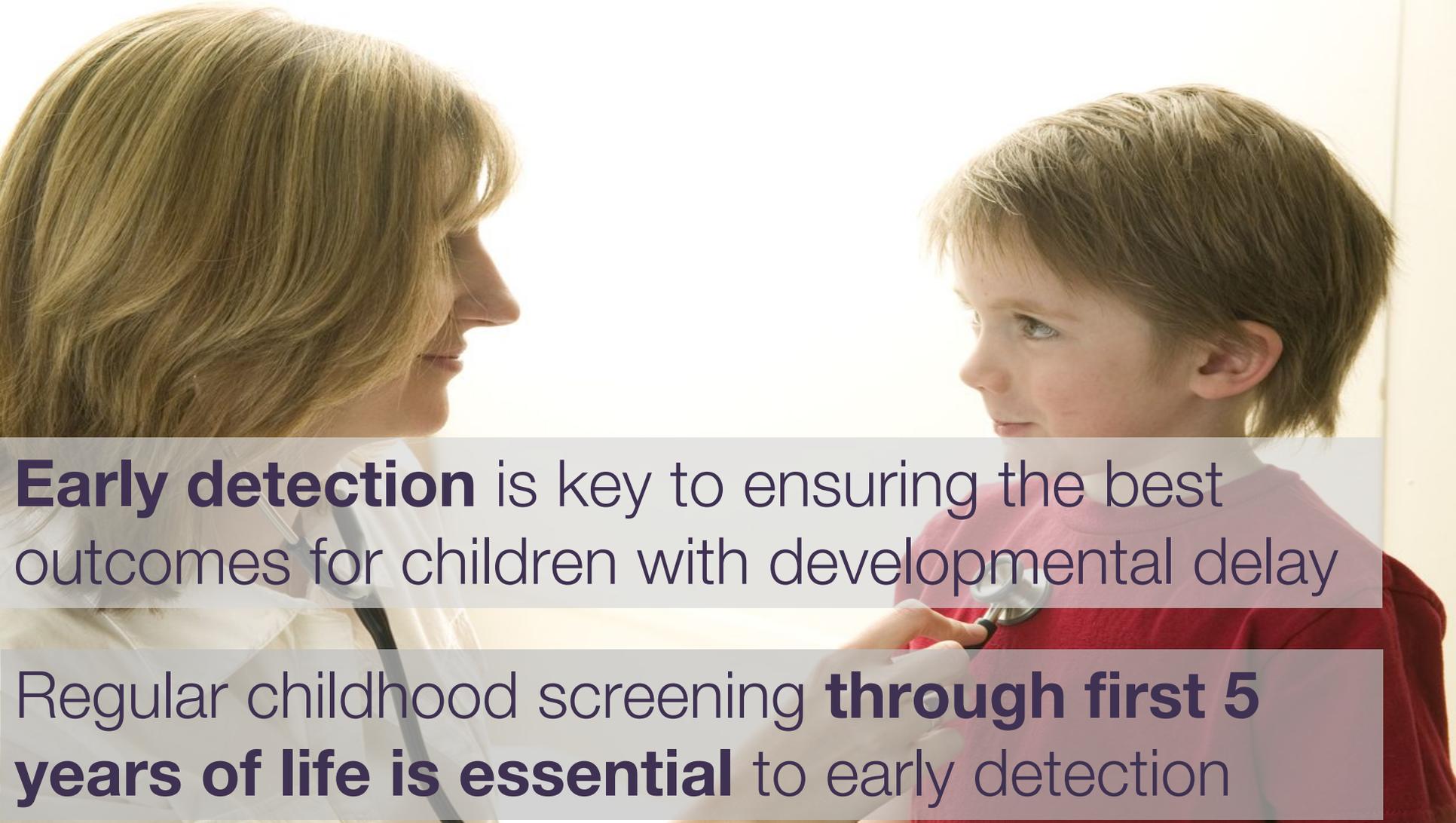


Baby Steps: Designing Technology to Engage Parents in Developmental Screening

Julie A. Kientz & Hyewon Suh
University of Washington





Early detection is key to ensuring the best outcomes for children with developmental delay

Regular childhood screening **through first 5 years of life is essential** to early detection



Universal Developmental Screening Initiative

Goal: Every child through age 5 in Washington State is regularly screened and connected to early intervention services **regardless of income, residency, or background**

<http://www.doh.wa.gov/ForPublicHealthandHealthcareProviders/PublicHealthSystemResourcesandServices/LocalHealthResourcesandTools/MaternalandChildHealthResources/UniversalDevelopmentalScreening>

Developmental screening checks childhood development across five different areas

(Squires, J. & Bricker, D. - Ages & Stages Questionnaire (ASQ), 3rd Edition)

Communication



Gross Motor



Fine Motor



Problem Solving



Personal-Social



Screening via the ASQ consists of 22 questionnaires across 5 years, each asking if children have met 30 milestones

8 months: Does Samuel turn his head in the direction of a loud noise?



14 months: Does Sally play with a doll or stuffed animal by hugging it?



2 years: Can Aisha kick a ball by swinging her foot?



Parents respond with “Yes” “Sometimes” or “Not Yet” and the results are provided for each of the five categories

On Track: Aisha is developing on schedule in this area



Let's Watch: Sally could use some encouragement in this area. Try doing activities with her.



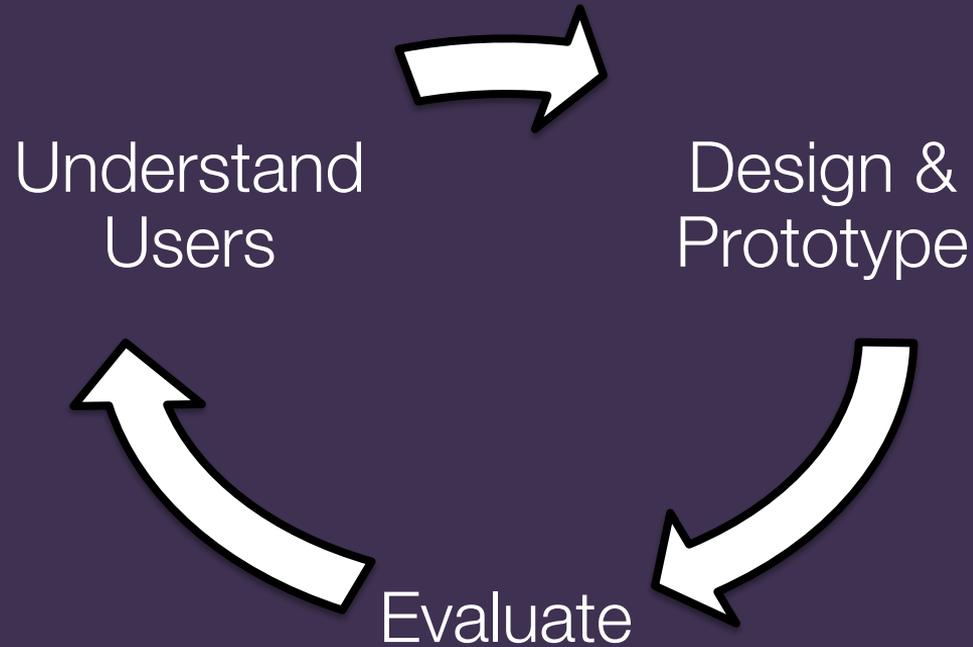
More Evaluation Needed: Samuel may need additional follow up in this area. Talk to his doctor or call Help Me Grow WA at 1-800-322-2588 for screening.



Design Question:

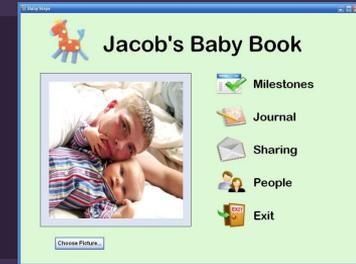
How can interactive technology engage families in tracking developmental milestones for every child in Washington State over a period of five years?

Approach: Human-Centered Design



Two Iterations on Baby Steps Design

Baby Steps 1.0: A desktop application and a mobile capture tool that was designed and evaluated with 8 families



Baby Steps 2.0: An ecosystem of tools to allow parents to respond to milestone questions with whatever technology they are most comfortable

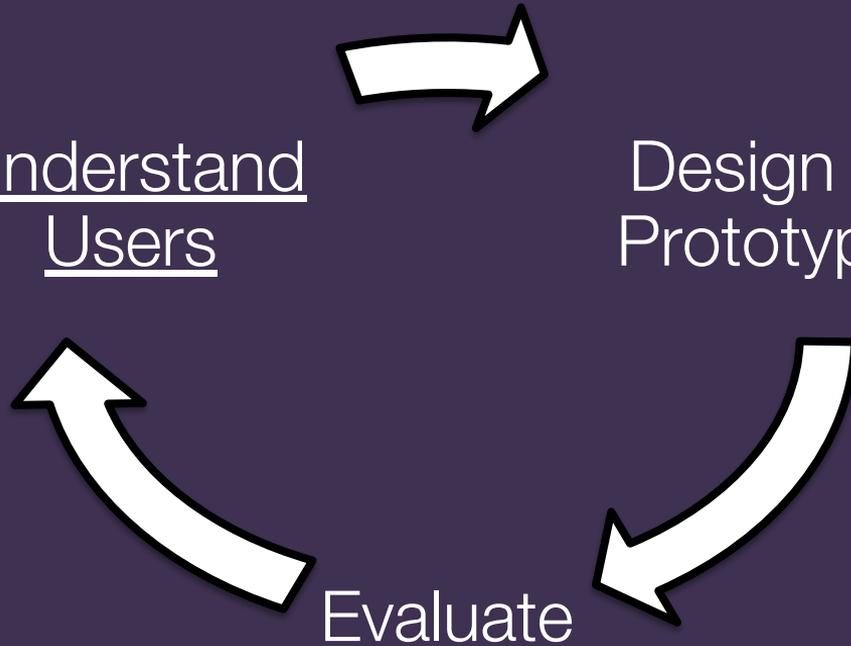


Approach: Human-Centered Design

Understand
Users

Design &
Prototype

Evaluate



Understanding Parents' Needs

Conducted a formative evaluation consisting of interviews and focus groups with 34 stakeholders

- Parents, Pediatricians, Secondary Care Providers

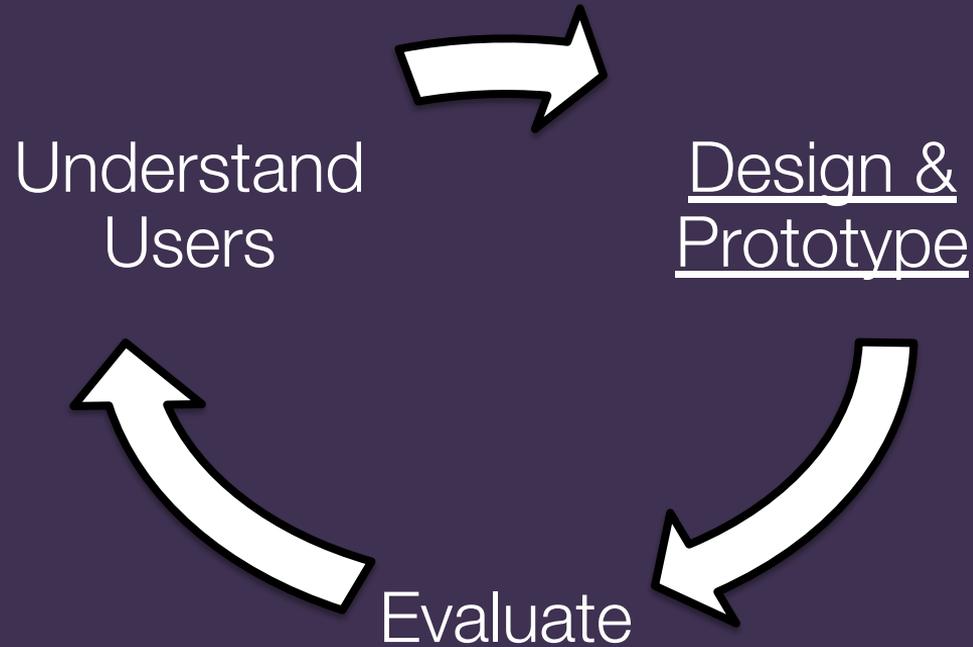
Determined design requirements and reviewed potential prototypes with participants

- Technology should work with the pediatrician
- Parents already keep a lot of sentimental records
- Share child's progress and data friends and family
- Provide easier photo and video capture
- Provide simple reminders

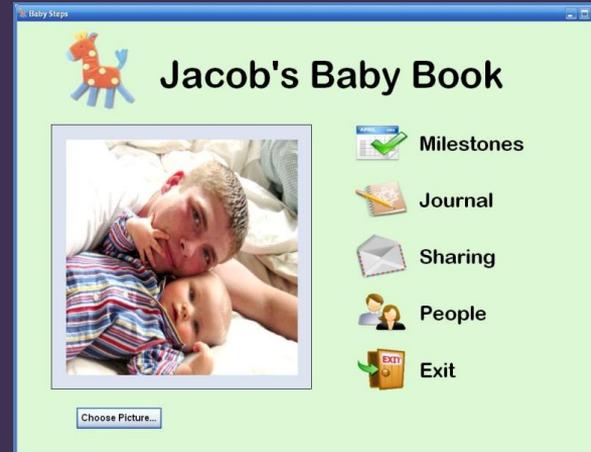
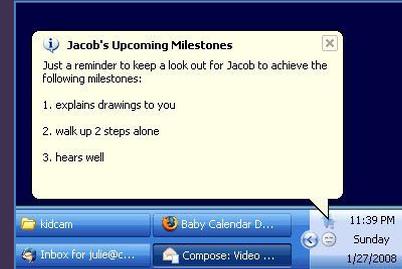
Baby Steps: Desktop software

- Stand-alone software application
- Used the metaphor of a baby book
- Combined sentimental and developmental record-keeping
- Supported sharing of relevant information with pediatricians, family, and friends
- Allowed for spontaneous video recording with “KidCam” companion

Approach: Human-Centered Design



Baby Steps 1.0



Baby Steps

View Completed Milestones  **Jacob's Current Milestone Targets**  View Upcoming Milestones

Age selection tool

4 6 8 10 12 14 16 18 20 22 24 27 30 33 36 42 48 54

Weight: 14 pounds Age: 30 - 33 Months Height: 35 inches

Child information

Milestone status indicators

Gross Motor

Does your child run fairly well, stopping herself without bumping into things or falling?



Update

Without holding onto anything for support, does your child kick a ball by swinging his leg forward?

Milestones based on category

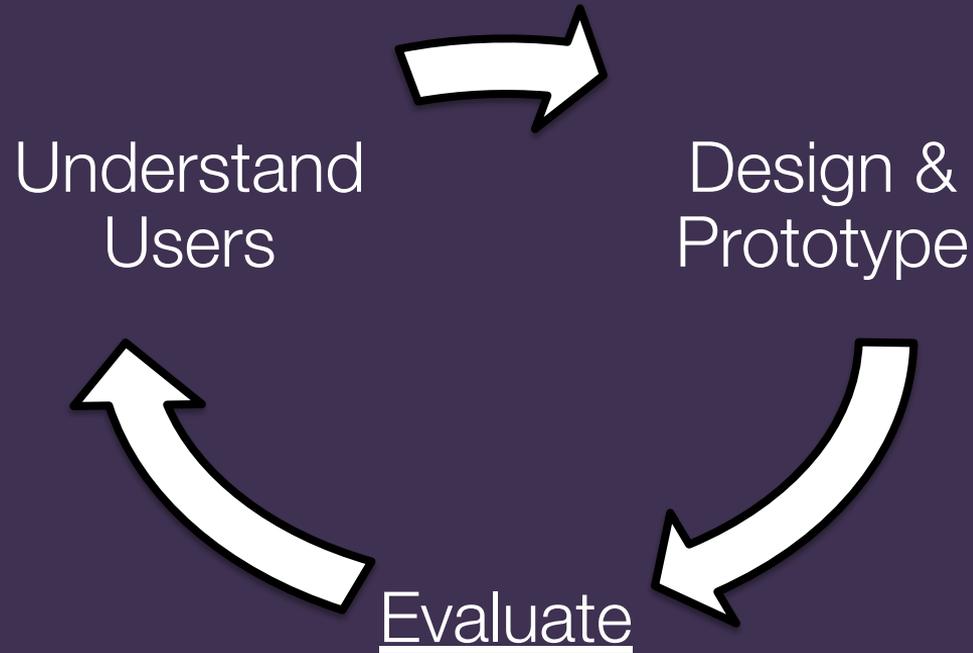
Child's milestone review panel

Media Evidence: C:\Documents and Settings\Julie\My Documents\My Pictures\Hk

Last Seen: 2/22/2008 Recorded By: Shawna

Notes: When Jacob and Henry were trick or treating, they were running everywhere! They couldn't wait to get to the next house.

Approach: Human-Centered Design



Pilot Study

8 families and 2 pediatricians used Baby Steps for 3 months

- Span between 2 Well Child Visits

Data collected

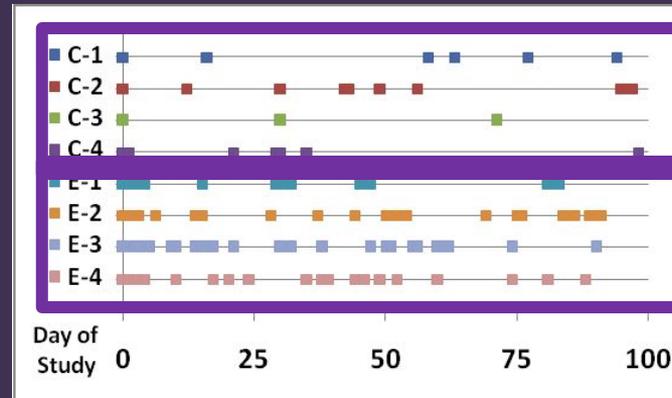
- Amount of data collected and reviewed
- Confidence in records kept
- Collaboration with pediatrician
- General usage information

Results

Amount of data captured and reviewed

Parents in experimental group recorded more milestones
90.5 milestones vs. 48.5 milestones

Parents in
experimental
group reviewed data
more often



Results

Confidence levels increased for both groups

Higher collaboration ratings for experimental group than control group

Suggestions for Improvement

Access to Baby Steps anywhere

Mother, C-4: *“Maybe you could even have this be online? I was thinking that I would use it more, because I was on my Mac a lot. I would have just gone to the website from there.”*

How to convey results without anxiety?

Mother, E-1: *“I’d rather know. I get anxious not knowing. And then I know what to work on, you know? Because you can work on it with play. It’s not like it’s a chore.”*

Flexible and lightweight ways to add data

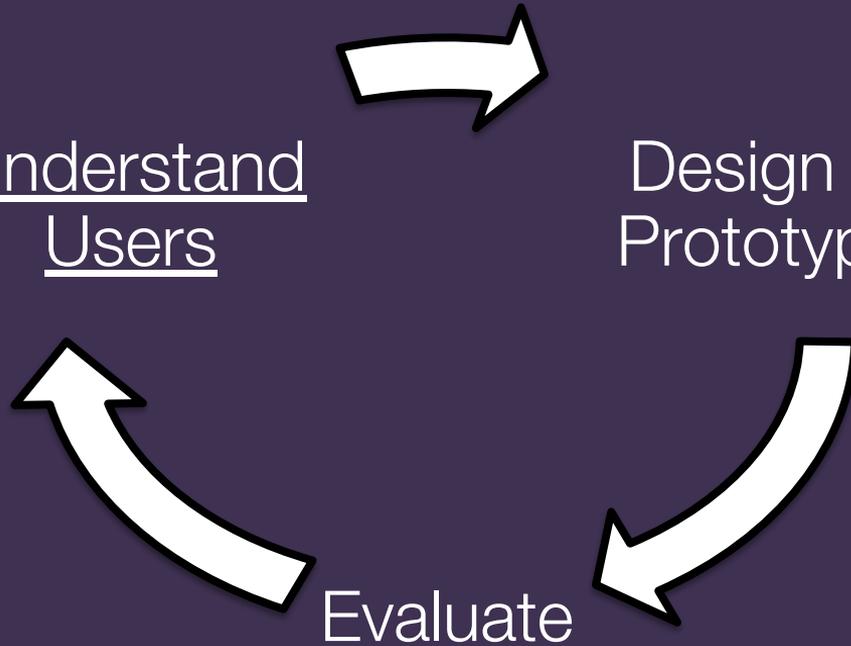
Mother, E-2: *“I had a video of [child’s name] stacking rings. I knew that must be a milestone, but I didn’t want to browse through everything to find it.”*

Approach: Human-Centered Design

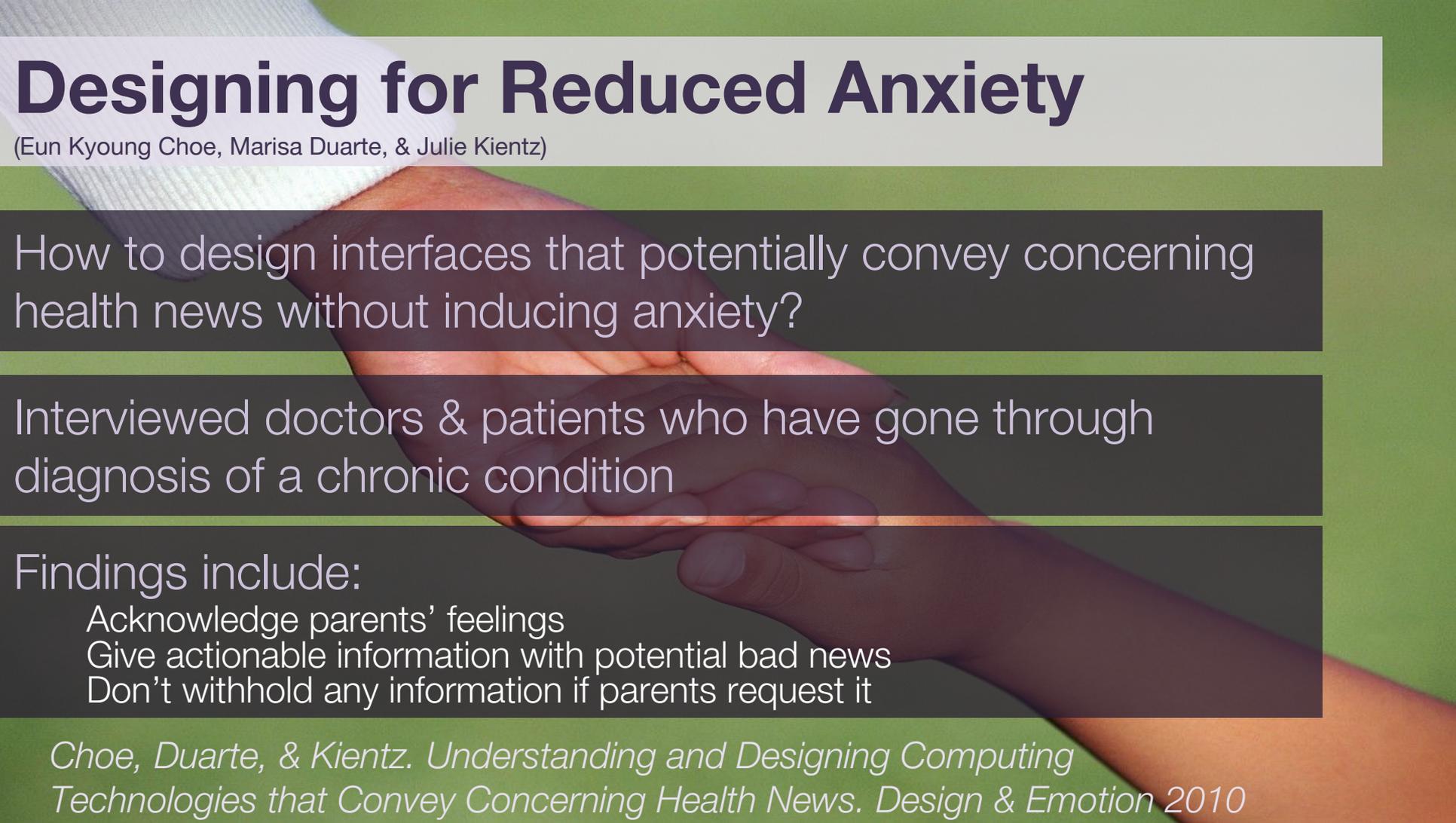
Understand
Users

Design &
Prototype

Evaluate



Designing for Reduced Anxiety



(Eun Kyoung Choe, Marisa Duarte, & Julie Kientz)

How to design interfaces that potentially convey concerning health news without inducing anxiety?

Interviewed doctors & patients who have gone through diagnosis of a chronic condition

Findings include:

- Acknowledge parents' feelings

- Give actionable information with potential bad news

- Don't withhold any information if parents request it

Choe, Duarte, & Kientz. Understanding and Designing Computing Technologies that Convey Concerning Health News. Design & Emotion 2010

Designing for Diverse Backgrounds

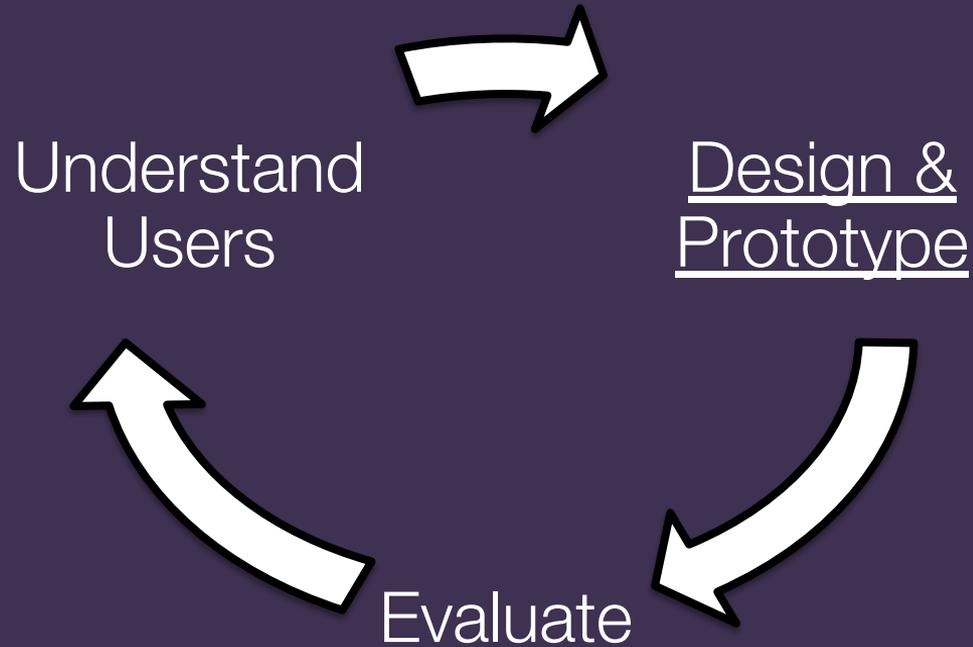


Interviews with advocates and families from Latino populations in Washington State as a first focus

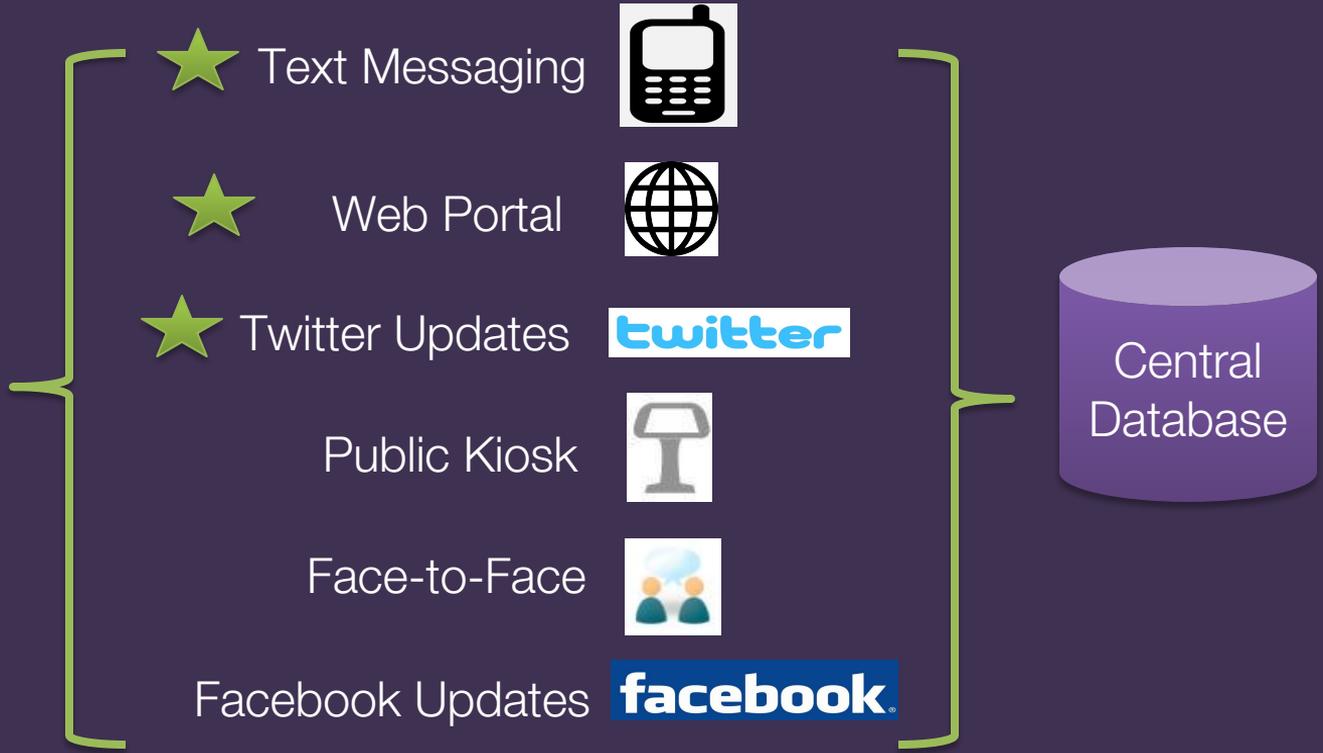
Access to technology is not always consistent or guaranteed

Keeping sentimental records is as important to parents as keeping developmental records

Approach: Human-Centered Design



Baby Steps 2.0: an celebratory approach to tracking both developmental and sentimental records using technology with which parents are most comfortable



★ Text Messaging



★ Web Portal



★ Twitter Updates



Public Kiosk



Face-to-Face



Facebook Updates



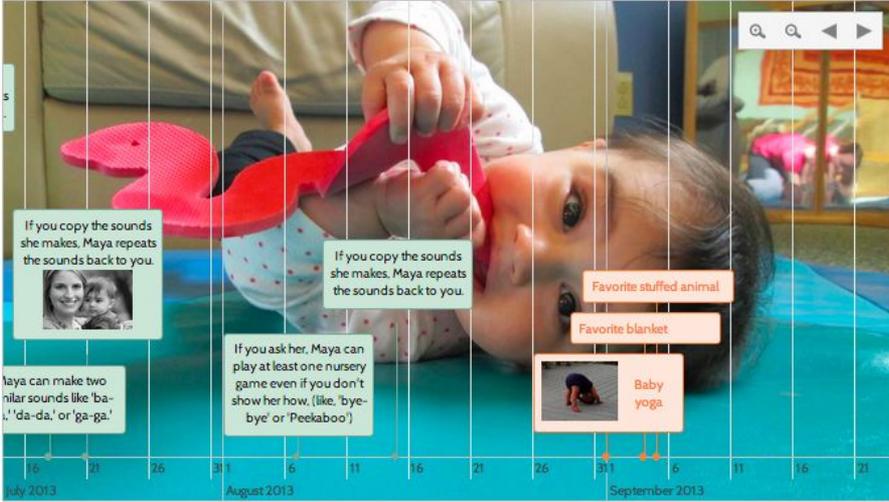
Baby Steps Web Portal

BABY STEPS 

Hello Julie!
Logout | Settings

Home | Milestones | Progress | Activities | Resources | About

Maya



Timeline: July 2013, August 2013, September 2013

 Share 2

Baby Steps Web Portal

BABY STEPS 

Hello Mom!
Logout | Settings

Home Milestones Progress Activities Resources About

Emma Christopher

2 Months
10 / 30 Complete

4 Months
0 / 30 Complete

6 Months
0 / 30 Complete

8 Months
15 / 30 Complete

9 Months
0 / 30 Complete

10 Months

12 Months

14 Months

16 Months

18 Months

20 Months

22 Months

24 Months

27 Months

30 Months

33 Months

9 Months

Milestones for 9 months to 10 months

7/30 Responses

Communication

Can Emma follow one simple command, such as 'Come here,' 'Give it to me,' or 'Put it back,' without your using gestures?

Does Emma make sounds like 'da,' 'ga,' 'ka,' and 'ba'?

Can Emma make two similar sounds like 'ba-ba,' 'da-da,' or 'ga-ga'?

Does Emma say 3 words, like 'Mama,' 'Dada,' and 'Baba'? (A 'word' is a sound/s Emma regularly says to mean something.)

If you ask her, can Emma play at least one nursery game even if you don't show her how (like, 'bye-bye' or 'Peekaboo')?

If you copy the sounds she makes, does Emma repeat the sounds back to you?

Yes Not Yet

Edit Add to Timeline Edit

Yes Sometimes Not Yet



Baby Steps Web Portal

Maya

Rohan

Maya's Milestone Progress

39 Months to 45 Months

30/30 Responses



Communication



Fine Motor



Gross Motor



Personal-Social



Problem Solving

Understanding Maya's Progress

Like trees in a forest, children grow at different rates, and sometimes more quickly in some areas than others. That's completely normal!

Web Portal Demo

Baby Steps Twitter



The screenshot shows the Twitter profile for @BabyStepsNov12. The profile picture is a teal square with white footprints. The bio reads: "Baby Steps UW Twitter Research Study account for babies born in November 2012. Follow and reply to this account for milestone questions. Seattle, WA · babystepsuw.org/twitterstudy.h...". The statistics show 202 tweets, 1 following, and 2 followers. The user is currently following the account. Three tweets are visible:

- Tweet 1:** Posted 3h ago. Text: "Haemophilus influenzae type b conjugate vaccine (Hib). Final dose in series offered to children between 12-15 months. #tip". Interactions: Expand, Reply, Retweet, Favorite, More.
- Tweet 2:** Posted 9h ago. Text: "Let your baby 'help' with daily activities. Encourage him to follow simple directions, this is an important skill to learn. #activity". Interactions: Expand, Reply, Retweet, Favorite, More.
- Tweet 3:** Posted 13h ago. Text: "Toddler proof your home by placing plug covers on all unused electrical outlets. #tip". Interactions: Expand, Reply, Retweet, Favorite, More.

Users follow Twitter account for birth month (e.g., @BabyStepsNov12)

@BabyStepsNov12: Does your baby turn his/her head in the direction of a loud noise? #baby168

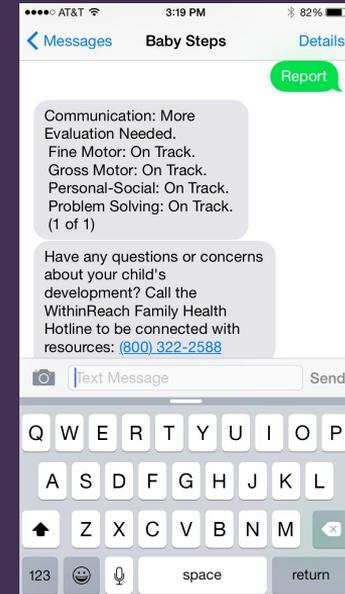
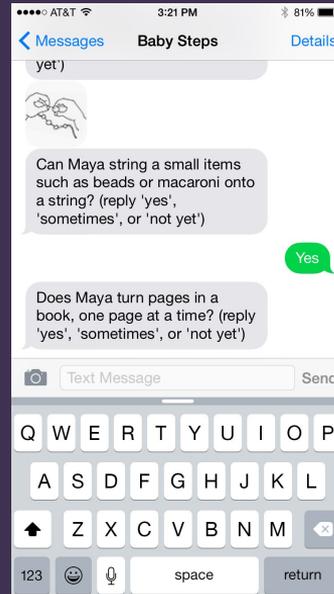
@juliekientz: #Yes #Maya turns her head in the direction of a loud noise #baby168

Baby Steps Text Messaging

Parents automatically receive milestone questions via text message and can reply. Data is stored in main database.

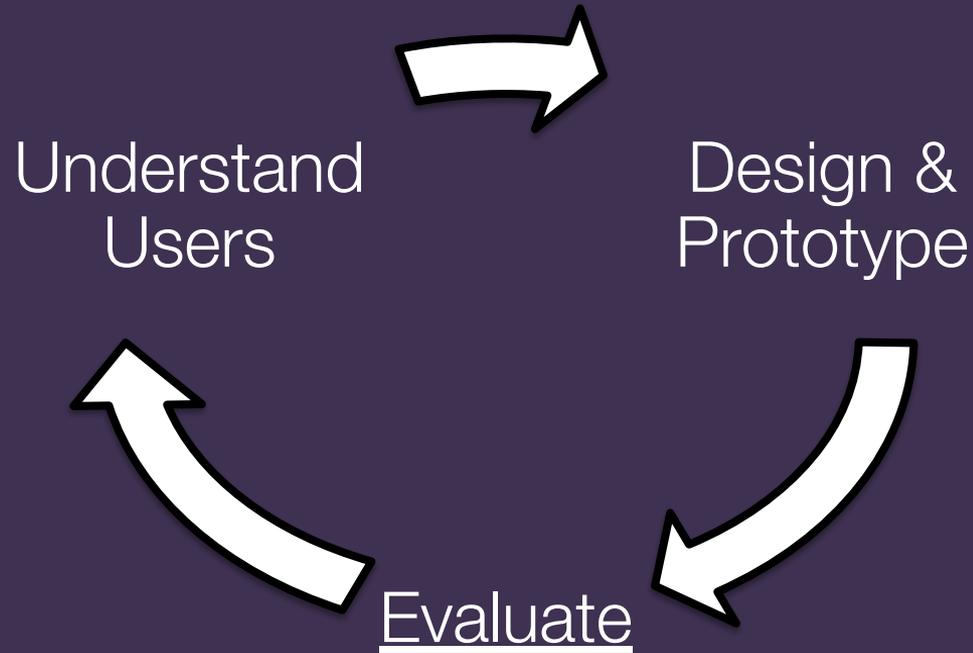
Can Jose throw a ball using both hands? (Reply Y for yes, S for sometimes, N for not yet)

Y



Text Messaging Demo

Approach: Human-Centered Design



Pilot Study: Twitter & Web

Conducted pilot study of Baby Steps Twitter with web portal

- 14 participants
- Excellent adherence to answering questions
- Increased social connection to other parents
- Parents appreciated option of website or Twitter

Suh, H., Porter, J. R., Hiniker, A., & Kientz, J. A. (2014, April). @ BabySteps: design and evaluation of a system for using twitter for tracking children's developmental milestones. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (pp. 2279-2288). ACM.

Pilot Study: Twitter & Web

@BabySteps sent a total of 670 tweets via 11 monthly accounts over 3 weeks

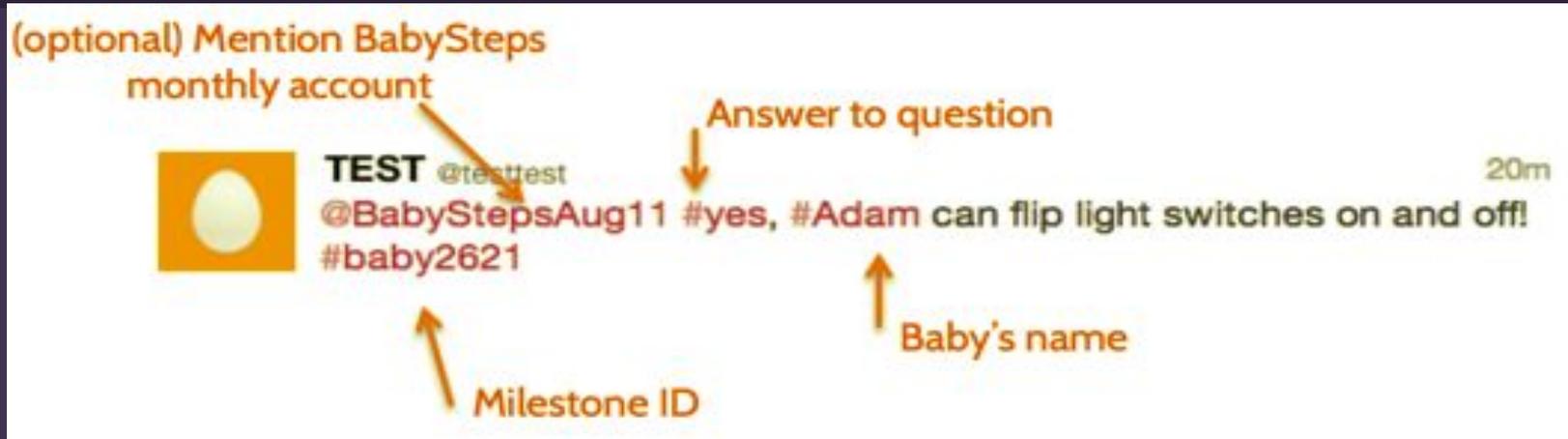
- Approximately ~60 tweets/account
- 42.1 milestone questions
- 16.5 tips & activities
- 1.9 study-related announcements
- Participants received ~3 tweets/day

Participants sent 319 milestone responses

- Approximately ~23 tweets/participant
- Response ratio = 54%

Pilot Study: Twitter & Web

Simplify syntax a bit: 38% of tweets were missing required tags



P2: *"It [Syntax] was good but a little complicated - would have been nice to not have to do a hashtag for all responses"*

Pilot Study: Twitter & Web

Tweeting in Private vs. Public:

P13: “I don't mind publicly responding. I already do a lot of public responses, and tweets about my children.”

P5: “I prefer to respond privately, because a public message is a) incomprehensible to anyone viewing my public timeline and b) runs the risk of giving peering strangers more information about my baby than I care to give.”

Pilot Study: Twitter & Web

Too much baby talk?

P4: "I feel like most people don't want to see me tweeting about my child's development -- I try not to inundate people with pictures on facebook, so I would feel the same on Twitter."

Social Interactions:

P5: "I saw who else was following the @babystepsMMYY and followed those who seemed interesting."

Pilot Study: Text Messaging

Completed 4-week pilot study of text messaging only application with Seattle Children's Odessa Brown Clinic

- 14 participants
- Investigated usability and feasibility of text messaging system
- Measures included compliance rate of responses, understandability of syntax for messages, obtrusiveness, engagement

Pilot Study: Text Messaging

13 participants were able to complete a full screen entirely using text messaging

Baby Steps sent a total of 577 messages (~42 msgs / participant)

Participants sent 520 messages in response (~ 39 msgs / participant)

=> 505 /520 responses (97%) were correctly formatted

Pilot Study: Text Messaging

Continued use after study completion

- Nine out of 12 participants continued responding to milestone questions three months after study completion

“Report” feature was under-utilized and of those who used it, would like more feedback.

Suh, H., Porter, J. R., Racadio, R., Sung, Y. C., & Kientz, J. A. (2016). Baby Steps Text: Feasibility Study of an SMS-Based Tool for Tracking Children's Developmental Progress. In AMIA Annual Symposium Proceedings (Vol. 2016, p. 1997). American Medical Informatics Association.

Pilot Controlled Trial

A photograph of three young children, likely between 5 and 9 months old, sitting on a white sheet. They are looking towards each other, appearing to be in conversation or play. The child on the left is a young girl with dark curly hair, wearing a white diaper. The child in the middle is a young boy with light brown hair, also wearing a white diaper. The child on the right is a young girl with dark hair, wearing a white diaper. They are all sitting on a white sheet that has some colorful toys scattered on it, including a red and blue toy and a yellow and green toy. The background is a plain, light-colored wall.

Recently concluded a 15+ month trial of web portal and text messaging together, compared to basic web-only system

Recruited 139 diverse families across Washington starting with a child initially between 5 and 9 months

Pilot Controlled Trial

A photograph of three young children sitting on a white surface, possibly a bed or floor. The child on the left is a young girl with dark hair, looking down at a colorful toy. The child in the middle is a young boy with light hair, also looking down at the toy. The child on the right is a young boy with dark hair, looking towards the other two children. They are all wearing white diapers. The background is a plain, light-colored wall.

Measures:

Primary:

- Parents completing official screen through WithinReach (Help Me Grow WA)

Secondary:

- Question response rate
- Understanding emotional impact
- User burden
- Improvement of self-efficacy of new parents

Pilot Controlled Trial

Milestones answered

- Control:
11,221 milestones answered via web (165 Qs / participant)
- Experimental:
18,087 milestone questions answered (255 Qs / participant)
=> 8,058 via text message, 10,186 via website

Milestones answered within valid time range

- Control Group: 8,311 / 11,221 (74%)
- Experimental Group:
 - Before text message: 6,251 / 8,680 (72%)
 - After text message: 8,987 / 9,407 (96%)

Pilot Controlled Trial

A photograph of three young children sitting on a white surface, possibly a bed or floor. They are engaged in play. The child on the left is holding a colorful toy. The child in the middle is reaching out towards the child on the right. The child on the right is holding a similar colorful toy. The background is a plain, light-colored wall.

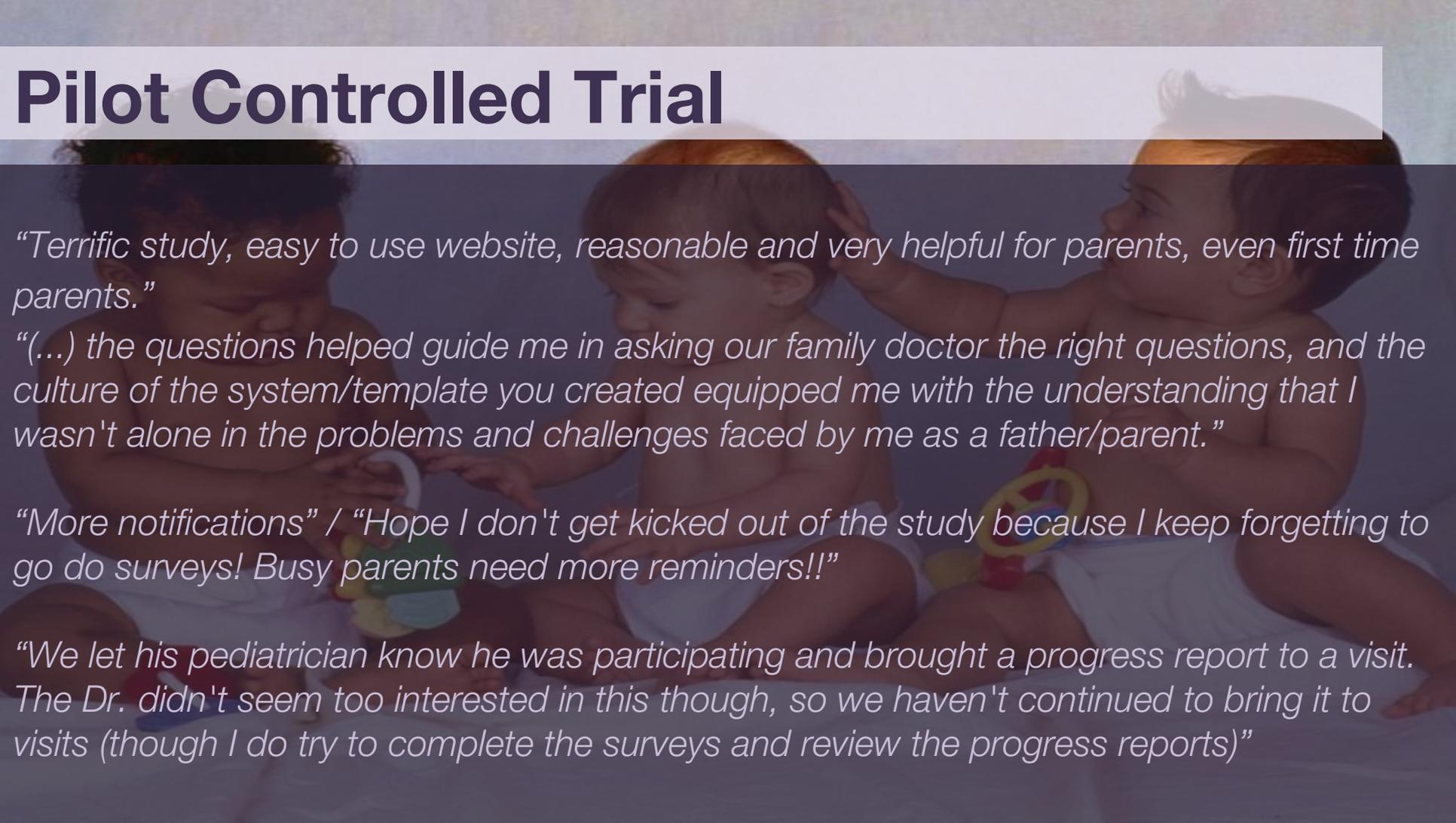
Engagement and Retention

- Experimental Group : 63 out of 71 (89% completion rate)
- Control Group : 26 out of 68 (38% completion rate)

General Findings:

- Using Baby Steps was easy: 3.94 / 5
- Milestone questions were clear and easy to understand: 4.41 / 5
- The number of milestone questions was appropriate: 4.36 / 5
- Baby Steps is enjoyable to use: 3.06 / 4

Pilot Controlled Trial



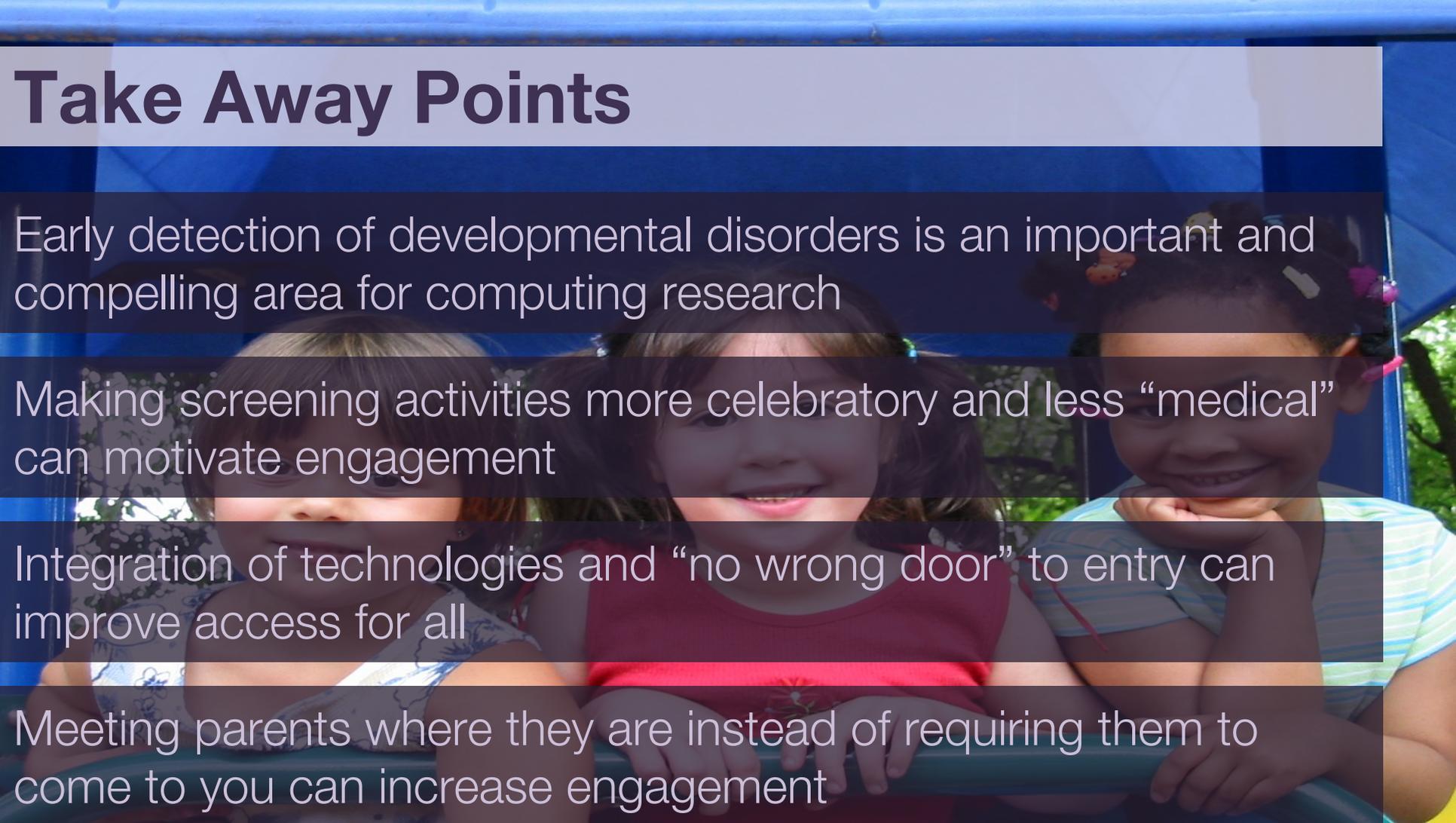
“Terrific study, easy to use website, reasonable and very helpful for parents, even first time parents.”

“(…) the questions helped guide me in asking our family doctor the right questions, and the culture of the system/template you created equipped me with the understanding that I wasn't alone in the problems and challenges faced by me as a father/parent.”

“More notifications” / “Hope I don't get kicked out of the study because I keep forgetting to go do surveys! Busy parents need more reminders!!”

“We let his pediatrician know he was participating and brought a progress report to a visit. The Dr. didn't seem too interested in this though, so we haven't continued to bring it to visits (though I do try to complete the surveys and review the progress reports)”

Take Away Points

A photograph of three young children, two girls and one boy, smiling and looking towards the camera. They are standing on a blue playground structure. The girl on the left has dark hair and is wearing a blue patterned top. The girl in the middle has brown hair and is wearing a red top. The boy on the right has dark hair and is wearing a blue and white striped shirt. The background shows green foliage and a blue sky.

Early detection of developmental disorders is an important and compelling area for computing research

Making screening activities more celebratory and less “medical” can motivate engagement

Integration of technologies and “no wrong door” to entry can improve access for all

Meeting parents where they are instead of requiring them to come to you can increase engagement

Thanks!

Contact us:

jkientz@uw.edu and hyewon25@uw.edu

<http://faculty.washington.edu/jkientz/>



Thanks to our research collaborators:

John Porter, Alexis Hiniker, Kathy TeKolste, Mira Shah, Robert Racadio, Diana Munoz, Brian Hayes, Yi-Chen Sung, Daniel Cortez, Adam Rule, Katie Derthick, Nikki Lee, Kiley Sobel, Gregory Abowd



BACKUP



One in 6 children between 3 and 17 will be diagnosed with a developmental disability

Fewer than 50% of children are diagnosed before they enter kindergarten



- Boyle CA et al. Trends in the prevalence of developmental disabilities in US children, 1997-2008. *Pediatrics*. June 2011; 127(6):1034-42.
- CDC – MMWR Surveillance Summary March 2012 61(3): 1-19

Pilot Controlled Trial (Summer)

Recruiting:

Would love your help! If interested in helping recruit families, please get in touch with me.



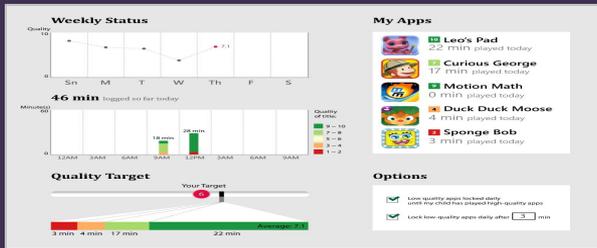
Other Projects of Interest



Texting while Parenting



Understanding Tablet Use in Preschoolers



Tools for helping parents decide on interactive media content



Tablet-based health screening tools for teenagers