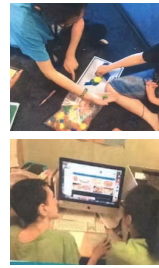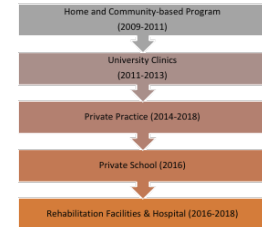**Translating Clinical Knowledge to Mobile and Voice Interaction Design for Children with Communication Impairments**

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1

My Journey

Home and Community-based Program
(2009-2011)

University Clinics
(2011-2013)

Private Practice (2014-2018)

Private School (2016)

Rehabilitation Facilities & Hospital (2016-2018)

2

Subjects of Interests
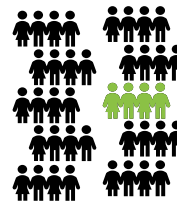
Children with Communication Impairments (CwCI)

Speech Language Pathologists (SLPs)

Mobile Interaction Designers

3

Children with Communication Impairments (CwCI)

Speech and language disorders: "**most common and least diagnosed disability of childhood**" by pediatricians[1] and are **highly prevalent among children with various disabilities:** autism, Down Syndrome, cleft palate, cerebral palsy, learning disability…

4

Speech Language Pathologists (SLPs)

SCHOOL   CLINIC   HOME

Mobile Interaction Designers

- Design interface and experiences for mobile applications and services
- Play, hobbies, and self-expression[2]
- **Challenges: physical, cognitive, and linguistic abilities**
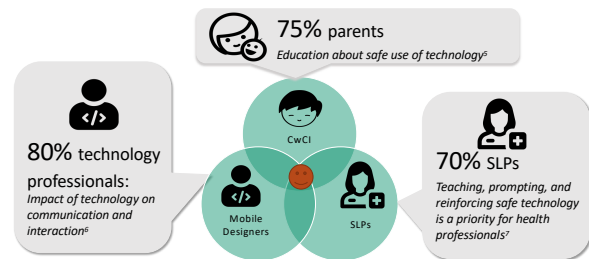
6

Technology Use by Children and SLPs

- By 2016: **80% of children** age 2-4 use tablets or smartphones 20 min/day[3]

- By 2017: **More than 60% of SLPs** use iPads for approximately 25% during a therapy session[4]

7

Problem Space

75% parents
Education about safe use of technology[5]

CwCI

80% technology professionals:
Impact of technology on communication and interaction[6]

70% SLPs
Teaching, prompting, and reinforcing safe technology is a priority for health professionals[7]

Mobile Designers

SLPs

8

Examining the Clinical Utility of Mobile Apps

Game Design: **Qualitative Interview**

Du, Y. (2018). Unpacking meaningful play in the clinical context: Mobile app use between Children with disabilities and their speech language pathologists. Full paper accepted at the *International Academic Conference on Meaningful Play*, East Lansing, Michigan.

9

Augmentative Alternative Communication (AAC) Technology

2010: Hardware

Liberator Vantage Lite

2015: Software

LAMP Words for Life App

10

GIVING VOICE

Mobile Communication, Disability, and Inequality

Meryl Alper

AAC at Home

Nonverbal children with autism who use iPads as AAC devices are "**drawing on a larger ecology of speech tools, including interactive games and apps to develop creative expressions of voice**"[8].

AAC & games in the clinical context?

11

Research Questions

What mobile apps do SLPs use during speech therapy and why do they use these apps?

What are some needs and challenges that SLPs encounter when using apps with CwCI?

What heuristics best support the user experience of these apps for SLPs and CwCI?
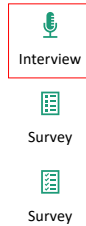
Exploratory Sequential Mixed-Method Approach

The Delphi Technique:
- A consensus-building methodology
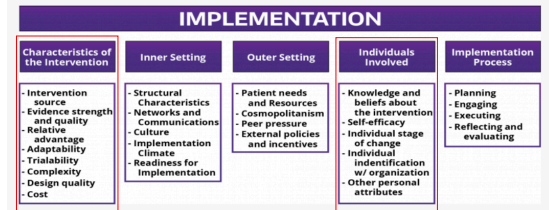- Multiple disciplines: corporate budgeting, policy planning, curriculum development, and speech language pathology[9]

Methods of Analysis:
- Inductive: Thematic Analysis
- Deductive: Heuristic Evaluation

Interview

Survey

Survey

Consolidated Framework for Implementation Research[10]

IMPLEMENTATION

Characteristics of the Intervention	Inner Setting	Outer Setting	Individuals Involved	Implementation Process
- Intervention source - Evidence strength and quality - Relative advantage - Adaptability - Trialability - Complexity - Design quality - Cost	- Structural Characteristics - Networks and Communications - Culture - Implementation Climate - Readiness for Implementation	- Patient needs and Resources - Cosmopolitanism - Peer pressure - External policies and incentives	- Knowledge and beliefs about the intervention - Self-efficacy - Individual stage of change - Individual indentification w/ organization - Other personal attributes	- Planning - Engaging - Executing - Reflecting and evaluating

---

23 SLP App Users

- Snowball sampling and skype calls
- 18 states in the U.S., China, Malaysia, Sweden
- 2-36 years of clinical experience
- School, Clinic, Hospital, Home Health, Teletherapy

Key Findings

App use: AAC apps, speech therapy apps, other educational apps, utility apps, and casual games

Needs & challenges: multimodal interaction, client engagement, financial constraints

Mobile game heuristics: usability, mobility, and gameplay

P4: Speech Production

I remember there was **a RED bird and the RED bird was 'REALLY fast'**, and I would emphasize these sentences to this particular student. He would attempt to **say these sentences back** to me, while thinking about **strategies of the /r/ sound** that we did.

And then once he was able to **give me a certain amount of correct responses**, I would say: "Now let's play this app for like 2-minutes!" We **play that app together**.
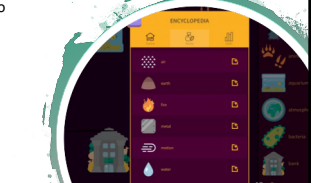

P19: Sentence & Science

I ask kids to **make predictions or talk about why** would that be true, air and air makes pressure. So, why? Because air packed into a space makes pressure.

So, there's **a lot of good vocabulary**, they can **make predictions**, they use the word constantly through it, or you can promote that **complex sentence formulation**.

Playability Heuristics for Mobile Games

Heuristics:
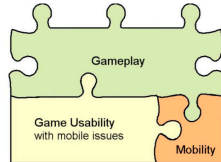A set of principles that people can use to examine and evaluate the interface

Figure 2 Modules in the core playability model
Korhonen & Koivisto (2006) [11]

19

Gameplay Heuristic:
The players can express themselves

So I always say **"pull, go, fly, pigs, oh my gosh"** just to get verbalizations...If you have Angry Birds on one device...then you can do **"cool, fun, oh-no"** and teach them **how to do functional communication**. (P30)

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Gameplay Heuristic:
There are no repetitive or boring tasks

People have designed really good **self-regulation visuals** that relate to Angry Birds or just having (students) **play hands-on games** that are Angry Birds, like the ones with the **real, physical catapults**. (P19)

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Opportunities for Design

Collaborative Play
- Adult and Child
- Child vs. Child

Open-ended, process-based, themes and content

Multimodal, communication-rich environment

22

Translating Clinical Experience into User Interaction Design

Assistive Technology:
Experience Report

Du, Y., Ibraham, S., & Boyd, L.A. (2018). From behavioral and communication intervention to interaction design: User perspectives from clinicians. Experience report accepted at the *20th International ACM SIGACCESS Conference on Computers and Accessibility*, Galway, Ireland.
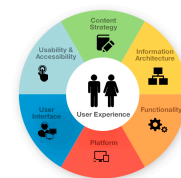
23

Grand Challenge: Translating Practice to Design

Evidence-based Practice

Patient Values & Preferences

Best Evidence

Clinical Expertise

Evidence-based Medicine

User-centered Design

Content Strategy

Usability & Accessibility

Information Architecture

User Interface

User Experience

Functionality

Platform
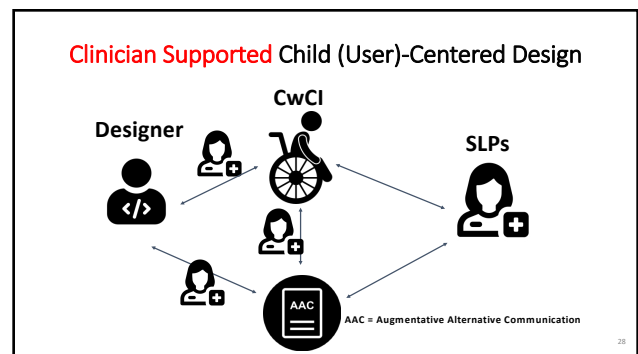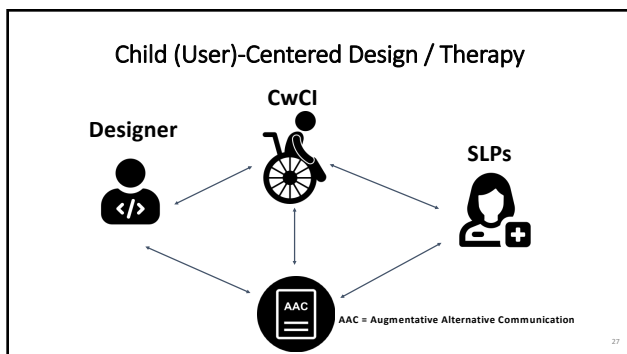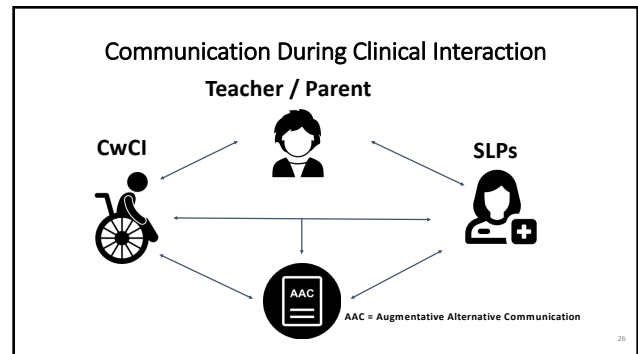
24

Meta-Question #1

How can we design technology to *support* and *interpret* these kinds of interactions between children and their communication partners?
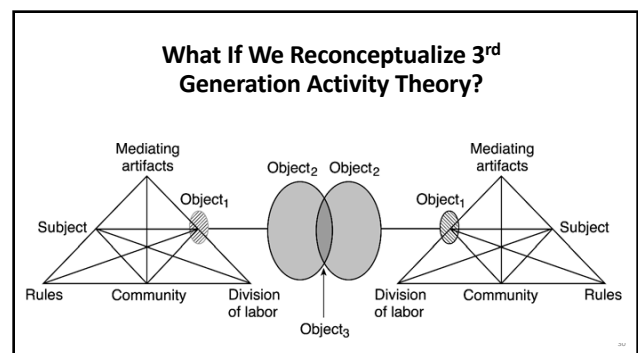
25

Communication During Clinical Interaction

Teacher / Parent

CwCI

SLPs

AAC

AAC = Augmentative Alternative Communication

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Child (User)-Centered Design / Therapy

CwCI

Designer

SLPs

AAC

AAC = Augmentative Alternative Communication

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Clinician Supported Child (User)-Centered Design

CwCI

Designer

SLPs

AAC

AAC = Augmentative Alternative Communication

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Julie A. Hengst (2015) - "Distributed Communication"[12]

1. Language and all communicative resources are embedded in activity.

2. Successful communication depends on common ground built up through histories of participation in activities.

3. Language cannot act alone, but is always orchestrated with other communicative resources.

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What If We Reconceptualize 3rd Generation Activity Theory?

Mediating artifacts

Object$_2$ Object$_2$

Mediating artifacts

Object$_1$

Object$_1$

Subject

Subject

Rules   Community   Division of labor

Division of labor   Community   Rules

Object$_3$

30

Dissertation:

Designing a Voice Interface for CwCI

Use "distributed communication" and assistive tech framework to inform interface design

Implement a clinician-supported child centered approach for design

Create voice technology to mediate and interpret communication

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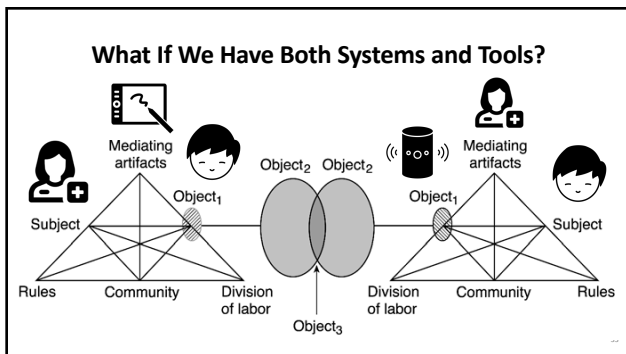## Evolution of Technology, Play, and Learning

2010: Physical Play → 2015: Digital Play → 2020: "Vocal Play"?

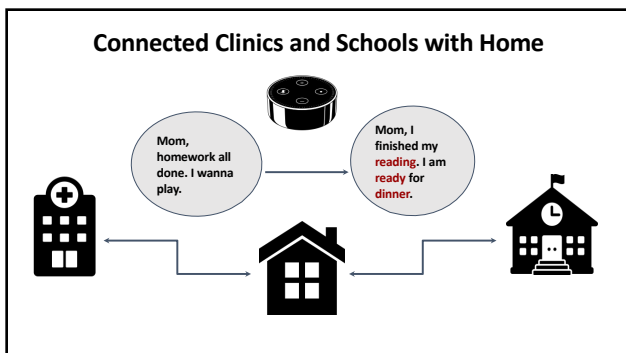---

What If We Have Both Systems and Tools?

Nana Stories: Voice-based Therapy Activities

Mom, homework all done. I wanna play.

… Why don't you come to practice your speech for 15 minutes?

Stories
Games
Songs
….

Connected Clinics and Schools with Home

Mom, homework all done. I wanna play.

Mom, I finished my **reading**. I am **ready** for **dinner**.

Meta-Question #2

How might **child-parent collaborative play** be supported through the use of **accessible games** that integrates multi-stakeholder goals from therapists and parents?
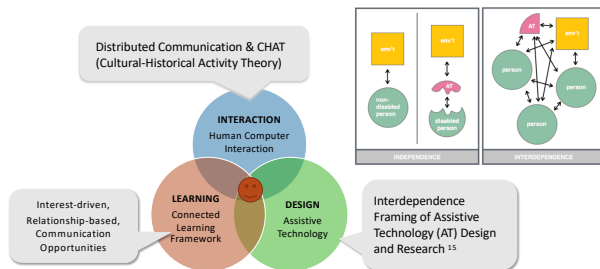
Why Amazon Echo™?

- High Adoption:
30 million U.S. homes [13]

- Affordable: $30 ~ $60

- Multimodal Gadget:
  - Echo Button (tactile)
  - Echo Show (visual)

- Issues: Algorithm biases & ethics in design

AMAZON ECHO
FOR KIDS

Alexa Skills on Amazon Echo™

Conceptual & Theoretical Frameworks

Distributed Communication & CHAT (Cultural-Historical Activity Theory)

INTERACTION
Human Computer Interaction

Interest-driven, Relationship-based, Communication Opportunities

LEARNING
Connected Learning Framework

DESIGN
Assistive Technology

Interdependence Framing of Assistive Technology (AT) Design and Research [15]

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Evidence for Audio Design: Shared Storybook Reading

- Family routine in different cultures & countries

- An evidence-based intervention technique for assessing and treating language and literacy[14]

40

Card Game: Word Esape

Word Escape: a narrative puzzle-based co-storytelling card game to support speech/language and social communication
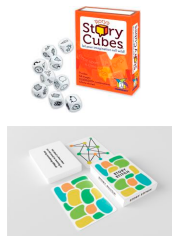
Age: 5-10 years old

Goal: parent-child interactivity to mirror technical constraints prior to designing voice

Assumptions:
- Is it possible to use card games to teach co-storytelling?
- Is a puzzle game engaging and motivating for children?
- Is this kind of play-based language and narrative activities meaningful?

Inspired By:
Story Cubes & Story Stitch

Alexa Voice Game: Nana Stories

Nana Stories: a child-only voice interaction that allows the conversational agent (CA) to facilitate speech and language activities for CwCI in the home setting.

RQ: How might a child-centered evidence-based learning experience be augmented through the use of a voice-based game that is accessible for marginalized children between 5-10 years old, such as children with communication impairments (CwCI) and bilinguals?

Goal: use CA as a proxy to parents

User Interaction / Story Architecture
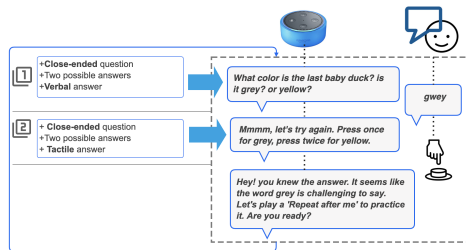
Literature Review

What existing literature in AAC can inform the design and development of voice and tactile based solutions?

Design

How might we reimagine the therapy activities (e.g., stories, games) for CwCI when interacting with voice assistants, such that their communication breakdowns are acknowledge and supported?

Positionality

What perspectives guide how we study and design AT for communication?

Deficit-driven?
Value-driven?
Ability-based?
Child-centered?

Evaluation

What factors need to be considered when evaluating a new intervention on a new technical tool?

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