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

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My Journey

Subjects of Interests
- Children with Communication Impairments (CwCI)
- Speech Language Pathologists (SLPs)
- Mobile Interaction Designers

Children with Communication Impairments (CwCI)
- Speech and language disorders: “most common and least diagnosed disability of childhood” by pediatricians and are highly prevalent among children with various disabilities: autism, Down Syndrome, cleft palate, cerebral palsy, learning disability...

Speech Language Pathologists (SLPs)
- Design interface and experiences for mobile applications and services
- Play, hobbies, and self-expression
- Challenges: physical, cognitive, and linguistic abilities

Mobile Interaction Designers
Technology Use by Children and SLPs

- By 2016: 80% of children age 2-4 use tablets or smartphones 20 min/day³
- By 2017: More than 60% of SLPs use iPads for approximately 25% during a therapy session⁴

Problem Space

- 75% parents: Education about safe use of technology
- 80% technology professionals: Impact of technology on communication and interaction
- 70% SLPs: Teaching, prompting, and reinforcing safe technology is a priority for health professionals

Examining the Clinical Utility of Mobile Apps

Game Design: Qualitative Interview


Augmentative Alternative Communication (AAC) Technology

2010: Hardware
Liberator Vantage Lite

2015: Software
LAMP Words for Life App

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?

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

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

**Consolidated Framework for Implementation Research**

**IMPLEMENTATION**

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<th>Characteristic of the Intervention</th>
<th>Inner Setting</th>
<th>Outer Setting</th>
<th>Individual's Involved</th>
<th>Implementation Process</th>
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**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

**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

**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

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**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

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**Grand Challenge: Translating Practice to Design**

Evidence-based Practice
- Patient Values & Preferences
- Best Evidence
- Critical Expertise

User-centered Design
- Evidence-based Medicine

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**Assistive Technology: Experience Report**

Meta-Question #1

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

Communication During Clinical Interaction

Teacher / Parent

CwCI

SLPs

AAC = Augmentative Alternative Communication

Child (User)-Centered Design / Therapy

Designer

CwCI

SLPs

AAC = Augmentative Alternative Communication

Clinician Supported Child (User)-Centered Design

Designer

CwCI

SLPs

AAC = Augmentative Alternative Communication

Julie A. Hengst (2015) - “Distributed Communication”

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.

What If We Reconceptualize 3rd Generation Activity Theory?

Mediating artifacts

Object1

Object2

Object3

Subject

Rules

Community

Division of labor

Object1

Object2

Object3

Subject

Rules

Community

Division of labor
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

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
...

Mom, homework all done. I am ready for dinner.

Connected Clinics and Schools with Home

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
- Affordable: $30 ~ $60
- Multimodal Gadget:
  - Echo Button (tactile)
  - Echo Show (visual)
- Issues: Algorithm biases & ethics in design

Alexa Skills on Amazon Echo™

Conceptual & Theoretical Frameworks

Evidence for Audio Design: Shared Storybook Reading

Card Game: Word Escape

Alexa Voice Game: Nana Stories

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?

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 acknowledged 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?

References


