From Mobile Apps to Voice Assistants: A Review of Case Studies During the COVID-19 Pandemic

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Abstract

With the exponential growth and adoption of web, mobile, and voice technology, speech-language pathologists (SLPs) have increased access to multimedia tools as digital therapy materials while working with children with communication disorders, especially via teletherapy during the COVID-19 pandemic. Yet limited research has been conducted regarding these tools, such as mobile apps (e.g., Smarty Ears), voice assistants (e.g., Amazon Alexa), and virtual worlds (e.g., Minecraft, Roblox). This multi-case study roundtable paper reports on four studies including interviews with pediatric SLPs and app creators, an analysis of the online game Minecraft for children with autism, the use of Alexa activities and web-based bilingual language assessment during teletherapy. Through these projects, we review the complex ecosystem of educational technology and media being used by SLPs to deliver clinical services via telehealth and highlight both clinical and design implications to address unmet therapy-driven needs for children with communication disorders.

Keywords: Pediatric Speech-Language Pathology, Telehealth, Mobile App, Voice Assistant, Digital Games

Introduction

In recent years, there has been an increase in technology use in the realm of pediatric speech-language pathology (Du et al., 2022; Du and Tekinbas, 2020). During the COVID-19 global pandemic, more than 60% of SLPs have shifted from in-person to virtual therapy (Radville et al., 2022), and this was indeed the first time in life for many

speech-language pathologists (SLPs) to provide services to clients remotely via telehealth. Many clinicians struggle to find and integrate diverse technological tools and activities during telehealth service delivery for pediatric clients). This roundtable paper presents a plethora of projects conducted during the COVID-19 pandemic at the Health, Educational, & Assistive Technology (HEAT) Lab, led by Dr. Yao Du, currently a clinical assistant professor at the Department of Speech-Language Pathology at the University of Southern California. These projects include (1) the examination of clinician and developer perspectives on mobile apps for pediatric speech-language therapy, (2) the evaluation of the digital game Minecraft for improving social communication skills among children with autism, (3) the integration of Alexa voice commands and games during teletherapy, and (4) the implementation of a bilingual web-based Mandarin-English language assessment for bilingual children before and during the pandemic.

Overview of Online Projects During COVID-19 Pandemic

Examining the Design and Implementation of Mobile Apps for Pediatric Speech-Language Therapy

Due to the increase in adoption and use of touchscreen devices in modern households, these children with communication disorders (CwCDs) have increased access to mobile applications (apps) at home and also during speech-language therapy (Heyman, 2018; Edwards & Dukhovny, 2017; Douglas et al., 2012). Although clinicians utilized a variety of mobile apps during speech-language therapy with CwCD (Du et al., 2022; Sauermilch, 2022), their knowledge was limited regarding how these apps were designed as well as best practices in implementing these apps during therapy for CwCD (Sauermilch, 2022; Gosnell, Costello, & Shane, 2011), who typically experience communication difficulties and are unable to provide direct user feedback (Du & Tekinbas, 2020). To understand CwCDs' user experience through the lens of SLP and app designer and developer interviews, this study examines the process of creating and implementing a plethora of mobile apps by clinicians across multiple settings who work with CwCDs. Semi-structured interviews were conducted with 50 participants including 23 SLPs who use apps and 27 individuals who have designed or developed mobile apps (14 individuals with a background as SLPs and 13 individuals without a background as SLPs). Among the participants, 41 individuals were from North America, two individuals from Asia, six individuals from Europe, and one from the Middle East. Interview findings reported that the use of mobile apps in pediatric speech therapy has moved from the experimental phase to full adoption despite issues with design, institutional challenges, and gaps in research (e.g., support for evidence-based practice). SLPs flexibly incorporate apps into their interventions to target a variety of goals within a variety of client populations and disorders. When designing and developing apps, SLP developers appear to be more informed to highlight goals to maximize therapy time, increase client attention, and add client-clinician interaction during therapy. Meanwhile, non-SLP developers focused on design goals to extend and monitor speech exercises outside of therapy, considering that parents do not always have time to work with their children directly, or they misreport practice time. By utilizing multidisciplinary design input and user feedback from both clinical practitioners and technical design practitioners, future research will lead to the most optimal app design and adoption practices to support the well-being of CwCD.

Improving Social Communication Skills in Online Minecraft Community for Children with Autism

For children with autism with difficulties in social communication, finding a secure environment to play in can be a challenge. Parents want their children to be able to preserve social relationships they made at school, and the ongoing COVID-19 pandemic has amplified their needs in doing so. Due to the constraints brought by social isolation, parents and guardians frequently seek out alternative ways to include play in their children's lives, for example, playing online through virtual communities. Virtual worlds such as Minecraft, unlike traditional in-person modalities, can give

a different forum for social expression, allowing for different modes of communication (e.g., text chat, voice chat) beyond face-to-face verbal engagement and interaction (Du et al., 2021a). In this literature review, a scoping review was conducted with 27 published articles that examine the different communication and social interactions that occur within the Minecraft online community for children and adults with autism. Findings suggested positive outcomes about utilizing Minecraft as a virtual gaming platform for individuals with autism, including (1) enhancing their learning abilities and social interactions, (2) instigating friendship through multiplayer networks, and (3) increasing their motivation to learn and stay involved in the classroom. These results indicated that virtual worlds such as Minecraft can help children and adults with autism improve their communication and social interaction skills. Research in this area brings implications to investigating untapped opportunities in promoting social interactions in multimodal ways via online virtual platforms for individuals with autism.

Evaluation of Alexa Games During Teletherapy

Voice assistants (VAs) like Amazon's Alexa have captured children's imagination and helped them engage in technology-based conversational play with real-time speech input (Du et al., 2021b; Du et al., 2019). The Alexa-device adoption recently increased from 390-million users worldwide to 1.8-billion users in 2022, but research is lacking on how Alexa activities are utilized in speech therapy (Lam et al., 2021). Therefore, two remote studies were conducted to examine the use of VAs in teletherapy. The first study tested the user experience of "Let Me Guess", an audiovisual Alexa Skill developed by Du (2022), via Zoom with 20 typically developing children from four to 13 years old. Participants played four game levels and answered 5-questions postgame to share their feedback about the game. Video analysis of 20 participants showed that the game enabled significant communication exchanges from participants with occurrence of communication breakdowns. When communication breakdowns occurred between Alexa and participants, despite built-in verbal prompts, difficulties with speech recognition and natural language processing were evident in all 20 participants' responses. Nevertheless, the successful integration of Alexa skills via video conferencing shows a potential promise for teletherapy sessions as digital therapy tools.

The second study aimed to verify the feasibility of using audio-based Alexa activities (e.g., jokes, games, and songs) during teletherapy. Five children with speech-language disorders participated in 41 teletherapy sessions (50-minute sessions) via Zoom, led by two graduate SLP clinicians supervised by licensed SLPs. During therapy, clinicians displayed an Amazon Echo dot device and trained children that the Alexa's blue light glows when "listening." They also integrated themed lesson plans via Google slides to scaffold Alexa commands that children needed to utter, and modeled Alexa interaction to children with verbal instructions supplemented by visual, verbal, or gestural support. Through analyzing videos of recorded sessions, the study revealed various user-based issues as well as different types of scaffolding clinicians provided during child-clinician Alexa interaction. The study demonstrated that clinicians' implementation of consistent multimodal scaffolding (e.g., verbal, visual, and gesture supports) can help children's successful conversational turns with Alexa. With clinician support, children had fewer difficulties starting a game/song with correct syntax and appropriate volume, resulting in fewer communication repairs.

Bilingual Language Assessment During Teletherapy

With the increasing cultural, racial, ethnic, and identity groups in the United States, the field of speech, language, and hearing sciences face ongoing challenges to meet the cultural and linguistic diverse (CLD) needs of CwCD. There are at least two barriers to the adoption of bilingual child language assessments via teletherapy: a lack of formal standardized tools designed to assess the many languages spoken in the US, and a lack of service providers who can speak the many languages to administer formal and informal measures (Sheng, 2019; Liu et al., 2021). Chinese (Mandarin as one of the most popular spoken Chinese languages) is a global language that is the most spoken Asian-

Pacific island language for those five years and older within the U.S, however, there are no standardized Mandarin and English bilingual language assessments for bilingual Mandarin-English speaking children (Sheng et al., 2021; Song, Luo, & Liang, 2021). Without these assessments, monolingual clinicians had to work with caregivers or interpreters, which may introduce validity and reliability issues related to assessments (Du, Sheng, & Tekinbas, 2020). This study compares an in-person group of 16 parent-child dyads pre-COVID-19 and another virtual group of 16 parent-child dyads during COVID-19 by examining the participants interaction with the Mandarin-English Receptive Language Screener (MERLS), a web-based Mandarin-English language assessment that enables parents as the test agents to administer assessments to their children (Du, Sheng, & Tekinbas, 2020). Findings from comparing the in-person and virtual groups of bilingual children (from age three to eight) indicated a variety of parent interference and support behaviors that can inform the interface and instruction design on the MERLS platform. This study contributes to the understanding of human factor considerations for administering language assessment for bilingual children via remote video conferencing via teletherapy and highlights recommendations for designing child-centered online language assessment tools.

Conclusion

This paper presents four projects that examines how SLP clinicians and researchers investigate or integrate mobile apps, digital games in virtual worlds, voice assistant activities, and web-based assessments during the pandemic to support technology-aided solutions for pediatric speech-language therapy. These projects aim to support marginalized CwCD through a plethora of web, mobile, and voice-based interfaces to support their needs for health, educational, and assistive technology. Lessons learned from these projects included the development of design recommendations for developing multimodal scaffolding and supports informed by clinicians' clinical practice, understanding the technology affordances to meet diverse user needs, and implement best practices in conducting interdisciplinary and collaborative research with remote research teams and virtual participants during the research process. Future work will continue to examine specific mobile, voice, and web-based applications that can enable marginalized children (e.g., bilingual speakers, neurodiverse individuals) to adopt user-friendly tools during remote learning and teletherapy to improve equitable and accessible learning environments.

References

Douglas, K. H., Wojcik, B. W., & Thompson, J. R. (2012). Is there an app for that?. *Journal of Special Education Technology*, *27*(2), 59-70.

Du, Y. (2022). Let Me Guess. Amazon. Amazon Alexa. Amazon Alexa Skill. Retrieved from https://www.amazon.com/Yao-Du-Let-Me-Guess/dp/B09PYW9KVP/ref=cm_cr_arp_d_product_top?ie=UTF8

Du, Y., Choe S., Vega J., Liu Y., Trujillo, A. (2022). Listening to stakeholders involved in speech-language therapy for children with communication disorders (CwCD): A content analysis of iOS app store reviews. *Journal of Medical Internet Research (JMIR) Pediatrics and Parenting, 5*(1):e28661. DOI: http://dx.doi.org/10.2196/28661

Du, Y., Grace, T. D., Jagannath, K., & Salen-Tekinbas, K. (2021a). Connected play in virtual worlds: communication and control mechanisms in virtual worlds for children and adolescents. *Multimodal Technologies and Interaction, 5*(5), 27.

Du, Y., Zhang, K., Ramabadran, S., & Liu, Y. (2021b). "Alexa, what is that sound?" a video analysis of child-agent communication from two amazon Alexa games. In *Proceedings of the Interaction Design and Children (IDC '21)*, June 24–30, 2021, Athens, Greece. ACM, New York, NY, USA. DOI:https://doi.org/10.1145/3459990.3465195

Du, Y., & Tekinbas, K. S. (2020). Bridging the gap in mobile interaction design for children with disabilities: Perspectives from a pediatric speech language pathologist. *International Journal of Child-Computer Interaction*, 23, 100152.

Du, Y., Sheng, L., & Tekinbas, K. S. (2020). "Try your best" parent behaviors during administration of an online

language assessment tool for bilingual Mandarin-English children. In P*roceedings of the Interaction Design and Children Conference (IDC'20)*, 409-420, June 21 - 24, 2020, London, United Kingdom.

Du, Y., Abbas, H., Taraman, S., Segar, S., & Bischoff, N. (2019). In-home speech and language screening for young children: A proof-of-concept study using interactive mobile storytime. AMIA Joint Summits on Translational Science proceedings. *AMIA Joint Summits on Translational Science*, 722-731.

Edwards, J. & Dukhovny, E. (2017). Technology Training in Speech-Language Pathology: A Focus on Tablets and Apps. *Perspectives ASHA SIGs*, *2*(SIG 10), 33–48. doi: 10.1044/persp2.SIG10.33

Gosnell, J., Costello, J., & Shane, H. (2011). There isn't always an app for that!. *Perspectives on Augmentative and Alternative Communication*, *20*(1), 7-8.

Heyman, N. (2018). Identifying features of apps to support using evidence-based language intervention with children. *Assistive Technology*, 1-11. doi: 10.1080/10400435.2018.1553078

Lam., H, & Zhang, K. Liu, Y., Du., Y. CC, (2021). Alexa, open Animal Cctions: Exploring children's interaction with voice assistants, 1-hour Oral Seminar at the *2021 Association Annual Convention American Speech-Language-Hearing*, Washington DC, U.S.A.

Liu, Y., Tang, Y., Fong, KK., Du, Y., & Sheng, L. (2021). Parental adherence to test protocols: Exploratory study on a remote, web-based Mandarin-English receptive language assessment. Paper presented at the 2021 *Annual Convention of the American Speech-Language-Hearing Association*, Washington DC, District of Columbia, United States.

Radville, K. M., Larrivee, E. C., Baron, L. S., Kelley-Nazzaro, P., & Christodoulou, J. A. (2022). Online training modules for teaching assessment skills to graduate student clinicians. *Language, Speech, and Hearing Services in Schools*, *53*(2), 417-430.

Sauermilch, W. (2022). Plugged in: Screen-based device use among U.S. public school speech-language pathologists and associated clinical characteristics. *Journal of Special Education Technology*, *37*(2), 253–265. https://doi.org/10.1177/01626434211003026

Sheng, L., Wang, D., Walsh, C., Heisler, L., Li, X., & Su, P. L. (2021). The bilingual home language boost through the lens of the COVID-19 pandemic. *Frontiers in Psychology*, 3012.

Sheng, L. (2019). Introduction to the forum: Innovations in clinical practice for dual language learners, part 1. *American Journal of Speech-Language-Pathology*, *28*, 929-931. DOI:10.1044/2019_AJSLP-IDLL-19-0143

Song, L., Luo, R., & Liang, E. (2021). Dual language development of Chinese 3- and 4-year-olds: Associations with the family context and teachers' language use, *Early Education and Development*, DOI: 10.1080/10409289.2020.1865746