OUTLINES - CRITICAL PRACTICE STUDIES

• Vol. 17, No. 1 • 2016 • (05-38) •
http://www.outlines.dk

Mapping Communicative Activity: A CHAT Approach to Design of Pseudo-Intelligent Mediators for Augmentative and Alternative Communication (AAC)

Julie A. Hengst, Maeve McCartin, Hillary Valentino, Suma Devanga, and Martha Sherrill

Department of Speech and Hearing Science, University of Illinois at Urbana-Champaign

Champaign, Illinois, USA

Abstract

The development of AAC technologies is of critical importance to the many people who are unable to speak intelligibly (or at all) due to a communication disorder, and to their many everyday interlocutors. Advances in digital technologies have revolutionized AAC, leading to devices that can "speak for" such individuals as aptly as it is illustrated in the case of the world famous physicist, Stephen Hawking. However, given their dependence on prefabricated language (and constant management by teams of people), current AAC devices are very limited in their ability to mediate everyday interactions. We argue here that the limits of AAC are firstly theoretical — grounded in prosthetic models that imagine AAC devices as replacements for damaged body parts and in transmission models of language production as communication. In contrast, our multidisciplinary team aims to design pseudo-intelligent mediators (PIMs) of communication by blending strengths of human mediators with features of current AAC technologies. To inform the design process, we report here our initial situated studies focusing on the distributed nature of everyday communicative activities conducted with potential AAC/PIM users. Our analysis focuses on the discursive alignments of these participants and their interlocutors, attending especially to the various ways their personal aides function as human mediators. Specifically, we focus on mapping the communicative activity around each of these differently-abled individuals (the majority of whom have cerebral palsy) as they navigated a university campus. We profile the everyday interactional patterns within functional systems and across settings, and present close discourse analysis of one

interaction to highlight the diverse roles personal aides adopted in mediating communication. Finally, we argue that attending to differently "abled" bodies as they move through everyday communicative environments pushes CHAT to more fully theorize physicality, individual mobilities, and the roles of bodies in the laminated assemblage of functional systems.

Keywords

Disability; Discourse analysis; Functional systems; Cultural-historical activity theory (CHAT); Augmentative and alternative communication (AAC); Participatory design; Communication disorders.

Introduction

Advances in digital technologies have revolutionized devices for Augmentative and Alternative Communication (AAC), providing users a means of spelling out what they want to say, as well as offering access to thousands of stored words, phrases, and texts and the means to select different computerized voices to "speak" their chosen words. We only have to think of Stephen Hawking giving lectures on physics[1] to glimpse the potential of such devices. However, given their dependence on prefabricated language (and the constant work of teams of human mediators), current AAC devices are quite limited in their ability to mediate the fleeting and mundane interactions typical of everyday talk. We argue that the limits of AAC are not simply technological, but firstly a question of theoretical frameworks. AAC design has largely been grounded in a prosthetic approach that imagines an AAC device as a replacement for damaged body parts/functions and in transmission models that take language-as-a-system to be the key to communication. We argue that a CHAT approach (e.g., Cole & Engeström, 1993; Luria, 1972; Rogoff, 2003; Wertsch, 1991) offers a richer theoretical framework for the design of AAC devices.

Our team, which includes computer scientists and engineers, communication researchers, disability specialists, and participant users, has been collaborating on the development of communication technologies (Robo-Buddies) that will function as pseudo-intelligent mediators (PIMs) of interaction, improving communication among diverse communicators by blending strengths of human mediators with features of current AAC technologies. The first step in our participatory design process – and what we report on here – has been to better model everyday communicative activity in a university setting by collecting interactional data from young adults who are potential AAC/PIM users. Taking a functional systems perspective, we report observations of six participants as they navigate campus settings. Our analysis focuses on the discursive alignments of these participants and their interlocutors, attending especially to ways their personal aides (PAs) function as human mediators of communication.

Drawing on Goffman's microsociology, our analysis provides a mapping of communicative activity around each of these differently-abled individuals (the majority of whom have cerebral palsy), presenting profiles of their everyday interactional patterns across settings and a close discourse analysis which highlights different roles taken by

[1] To see examples, go to http://www.hawking.org.uk

PAs in mediating these interactions. In conclusion, we suggest that a CHAT approach can aid AAC design by understanding devices as mediators of activity rather than as prosthetic extensions of individual bodies and by understanding communication as distributed and dialogic rather than simply the transmission of lexical-syntactic information. We also argue that attending to differently "abled" bodies as they move through everyday communicative environments pushes CHAT to more fully theorize physicality, individual mobilities, and the roles of bodies in the laminated assemblage (Latour, 2005; Prior & Schaffner, 2011) of functional systems.

AAC and Clinical Practice

The iconic image of physicist Stephen Hawking speaking to an audience epitomizes the potential of modern speech-generating AAC devices. Hawking has used a computerized AAC system since 1985 as his Amyotrophic Lateral Sclerosis (ALS)[2] has progressively robbed him of voluntary muscle control. By all appearances, his digital voice gives him a remarkable freedom to speak publicly: In recent years he has hosted his own TV special/documentary, made guest appearances on TV shows (e.g., *StarTrek*), and delivered an untold number of professional lectures and public speaking engagements around the world. The *WordsPlus*[3] software Hawking uses allows him to select, store and speak words he wants to say. However, Hawking's success is supported by much more than the AAC software. Mialet's (2012) research highlights the extended systems of people, practices, institutions, and artifacts that constitute Hawking's identity, as she offers "*a thick description of the network of competencies – the computer/the synthesizer/the personal assistant/the graduate assistant/the nurses – that transforms a man deprived of speech and movement into 'the genius we all know'*" (p. 6). Mialet describes how Hawking accesses his AAC system with a switch by scanning and selecting preprogrammed words and phrases or spelling words one letter at a time. Although the computer can quite fluently voice pre-programmed speech (such as a lecture) and although he is extremely efficient at using his system to produce such messages, Hawking can at best produce spontaneous conversational speech at a rate of 15-20 words per minute in contrast to a typical speaking rate 10 times that. Thus, when Hawking addresses questions at the end of a lecture or in an interview, the questions are almost always provided in advance so his answers can be prepared ahead of time. Otherwise, it takes minutes of laborious work to produce even a short answer to an unscripted question. Moreover, maintaining the computer system takes teams of people – from students and personal assistants who help daily to maintain his AAC systems (e.g., making sure computer batteries are charged and access switches correctly connected) to the computer engineers who designed and have continuously updated the hardware and software that make up his AAC system[4]. In everyday interactions, Hawking relies on a network of familiar people (his family, friends, assistants) to be able to carry on a conversation with him by reading

[2] ALS is a degenerative neurological disease that destroys nerves controlling movement, ultimately leading to total paralysis and death.

[3] http://www.words-plus.com

[4] Mialet points to the tremendous amount of specialized work that has gone into stabilizing Hawking's distinctive voice as digital technologies have advanced and components of his original system have disappeared. Much "better" voices are now available, but Hawking has been determined to maintain his trademark voice.

his subtle gestures and understanding his routines and preferences, and in many mundane matters he relies on them to simply act for him. As the title of her book (*Hawking Inc*.) suggests, Mialet concludes: "*Contrary to the solitary genius depicted by the media, Hawking resembles a manager at the head of a company, a company that has explicitly become his extended body*" (p. 22).

Clinically, AAC began as a practical tool to support communication for individuals who had difficulty using spoken language, including children with developmental disorders (e.g., cerebral palsy) and adults with acquired disorders (e.g., brain injury). Based on demographic research, the American Speech-Language-Hearing Association (ASHA, 2004) estimates that at least 1% of the US population could benefit from AAC support. For example, cerebral palsy (CP) is one of the most common causes of physical disabilities in childhood with a relatively stable incidence of about 2.11 out of 1000 live births (Oskoui, Coutinho, Dykeman, Jette, & Pringsheim, 2013); currently an estimated 14-17 million people worldwide are living with CP[5]. Researchers in Norway estimate that at least 35% of people with CP would benefit from using AAC devices, but at best only half of that number are doing so (Andersen, Mjøen, & Vik, 2010).

Before computers, AAC depended on graphic and gestural means (e.g., the ability to write/draw, to make hand signs, to point with eye gaze or body movements at boards with words and letters, to blink Morse code). Typically, these early solutions relied less on specialized devices than on someone learning to read/translate idiosyncratic utterances of the disabled individual. Speech-language pathologists (SLPs) and other clinicians have focused on matching the affordances of AAC devices to the embodied affordances of individual users, on training users to use their device, and on training users' aides (family, friends, assistants) to customize the AAC systems for specific settings (e.g., greetings at church, answering questions in class). As computer technologies emerged, so did a new range of options for speech-generating devices that include complex graphics and customizable dynamic displays. However, AAC systems have continued to be designed to function as the external linguistic system for individual users. Technological advances have focused on increasing the linguistic capacities of devices (e.g., vocabulary and message storage and access), on improving ease and speed of message production (e.g., word prediction, identifying the most efficient means of scanning), on creating more effective and powerful speech generating capabilities, and more recently on customization for individual patient use in specific social settings, such as different rooms at home or school, routines for the doctor's office, and so on (for historical review see Zangari, Lloyd, & Vicker, 1994).

Although AAC devices have been conceptualized as prosthetic devices for individuals who cannot "talk", the complexity of the distributed support systems required for use and their limited capacity to produce fluent language on-the-fly in face-to-face interactions have led to high rates of device abandonment or rejection. An early review (Huer & Lloyd, 1990) of the SLP literature documented AAC users' frustrations with the complexities of devices, the lack of technical skill by all members of the team, limited opportunities to use the devices for everyday communication, and a sense of stigma associated with using such devices. Identifying actual rates of successful use or

[5] https://cpirf.org/facts-about-cerebral-palsy/

abandonment of AAC devices is difficult. In a more recent survey (Johnson, Inglebret, Jones, & Ray, 2006), SLPs (who had on average worked with 100 AAC clients) reported that only about 40% of their clients were successful AAC users (defined rather minimally as using the device in multiple settings for one year or longer), while almost 30% completely abandoned their devices (a figure that did not include clients who rejected or never tried an AAC system). Similar to responses from AAC users themselves, the SLPs reported that factors impacting success included availability of support networks, cultural attitudes about devices and AAC communication, and the fit of the technology with user needs. In a recent observational study of the use of speech-generating-AAC devices by three children in elementary school classrooms, Mellman, DeThorne, and Hengst (2010) identified significant challenges to optimizing AAC use for communicative interactions. Although the children had been using their devices for 7-36 months and everyone in the setting was familiar with the devices, the most prominent barrier to effective use was simply not having the device available – e.g., devices were often left at home, in closets, or on shelves out of the children's reach. The AAC literature has long acknowledged the critical role of routine communication partners in supporting successful AAC use, stressing in particular the need for family involvement in the process of selecting AAC devices and for proactive family/patient/caregiver education on device programing and use (Bailey, Parette Jr., Stoner, Angell, & Carroll, 2006; Beukelman & Mirenda, 1998; Glennen & DeCoste, 1997; Schlosser & Lee, 2000).

We believe that the prognosis for computerized AAC devices to support everyday unscripted interactions across the varied settings of daily life will remain poor as long as those devices are grounded in the combination of a prosthetic approach to speech production and models of language as an abstract system. We expect that abandonment and rejection will continue to be pervasive problems for AAC despite continuing improvements in digital technologies. In contrast with the current AAC paradigm, a CHAT perspective on AAC would begin with a different set of premises: That communication is embedded in activities; that language and other semiotics are not abstract systems of words and rules but living dialogic histories of use; that people's identities and goals are complex, emergent, and dynamic; and that any device will depend on distributed networks of people and tools necessary to optimize systems. The ability of current AAC approaches to give someone like Stephen Hawking a voice is a remarkable achievement, but it remains a very narrow and specialized accomplishment. This sense that a different theoretical framework is needed to understand communicative practices and to design for dynamic, mobile, fast interactions led our team of computer scientists and engineers, communication researchers, disability specialists, and participant users to undertake the Robo-Buddies project.

Communicative Activity within Functional Systems

To examine the fluid communicative activities of individuals with disabilities, we have adopted functional systems as our unit of analysis. Anchored broadly in Cultural-Historical Activity Theory (CHAT) perspectives, functional systems are defined as the distributed alignments of people, objects, environments, and histories woven together in activity (Bateson, 1972; Cole & Engeström, 1993; Hutchins, 1995; Luria, 1979; Newman, Griffin, & Cole, 1989). Conceptualized as dynamic arrangements, functional systems fluidly shift with activities, a point eloquently captured in Bateson's (1972) now famous example of a blind man:

> If what you are trying to explain is a given piece of behavior, such as the locomotion of [a] blind man, then, for this purpose, you will need the street, the stick, the man; the street, the stick, and so on, round and round. But when the blind man sits down to eat his lunch, his stick and its messages will no longer be relevant – if it is his eating that you want to understand (p. 459).

Canonically, this example has been cited to highlight the ways that behaviors are only understandable as parts of functional systems and that meditational tools such as the cane are relevant to, and fluidly adapt with, the needs of the activity. However, equally important to us is the way this example begins to point to where there is flexibility in functional systems and where there is not. In this case, for example, the "blindness" of the man is a more durable feature, one that impacts all functional systems he engages and operates within, whether walking on public streets or eating in restaurants. And because of this embodied affordance, he will align across functional systems in different and often disrupted (but patterned) ways with cultural artifacts (e.g., stop lights, signage, menus) and communicative resources (e.g., gestures, facial expressions) designed for, and emergent from, typical human visual systems.

Drawing on Bateson's account, Hutchins (1995) took functional systems as the basic unit of analysis in his research on how the repeated activity of calculating a ship's location was distributed among tools and sailors on the bridge of a U.S. Navy ship. His analysis traces the contributions of people acting together at the time of the calculations, but also the long histories of others' past actions that are embedded in the artifacts, tools, and resources the sailors are using. He notes the heterochronicity of navigational practice as the functional system draws on resources like the sexagesimal number system developed in ancient Mesopotamia, the mathematics of Mercator projection developed centuries ago, and various maps and charts produced and annotated in the preceding years, months, weeks, and days. His analysis also highlights ways that functional systems on the bridge can and do reorganize, depending on environmental demands, the skills of specific sailors, and available navigational tools. On one occasion he was able to observe how the functional system adapted to a dangerous disruption, the unexpected loss of the ship's power (along with several critical tools) as they were navigating into port—a situation that called for rapid adjustments in the team's actions, patterns of communication, means of calculation, and even goals (as they abandoned sailing safely into port and aimed instead to anchor the ship offshore). From such detailed analyses of the cognitive dimensions of activity, Hutchins (1995) concludes that:

> [T]he real power of human cognition lies in our ability to flexibly construct functional systems that accomplish our goals by bringing bits of structure into coordination. That culturally constituted settings for activity are rich in precisely the kinds of artifactual and social interactional resources that can be appropriated by such functional systems is a central truth about human cognition (p. 316).

Hutchins' account of functional systems is central to our project; however, its focus on calculation in a single setting offers relatively few resources to account for communication

within, or the mobility of, functional systems. Thus, our interest in tracing an individual's trajectories through multiple settings led us to other approaches to activity.

To focus on communicative activity within functional systems we turn to the work of Goffman (1974, 1981, 1983). Grounded in Bateson's concept of "frames", Goffman focused on the physical and discursive alignments among people in social situations. Primarily interested in face-to-face interactions, Goffman (1981) defined *social situations* as "*any physical area anywhere within which two or more persons find themselves in visual or aural range of one another*" (p. 85) and referred to the group of co-present people as a *gathering.* The terms *social situation* and *gathering* do not presume any particular relationship among people, but simply highlight for us the importance of attending to people's ongoing management of social co-presence as a necessary dimension of any situated analysis of communication. Such alignments are visible as people physically coordinate their bodies, movements, and attention within and around joint activities, objects of interest, and patterns of discourse. Goffman (1983) used the term *interaction orders* to describe highly recognizable alignments among people engaged in routine activities. Describing interaction orders typical of public spaces, he included ambulatory patterns such as people walking alone as *singles* or in pairs or small groups as *withs*; people waiting in *lines* for an event or forming *processions* as they walk with the same purpose or to the same destination; and groups milling around in a *semi-private event*, such as a family picnic in a public park. Goffman also described more structured or planned arrangements such as *platform events* that involve people aligning as audiences and performers. Evidence of *interaction orders* is apparent in the architecture of our built environments, such as the formal stage and audience seating built into an opera house or theater, or mobile stages temporarily erected in city parks for outdoor summer concerts with audiences sitting in areas on the grass marked off by ropes; or the even more fragile spaces constructed by a street musician as she performs along a wall in a subway station.

In addition to these wide-angle accounts of alignments within and around social interactions, Goffman (1981) also described complex ways people align communicatively to specific moments of talk. He described *participation frameworks* as people's complex alignments around their hearing and uptake of talk. For example, people may be framed as *ratified addressees* active in conversational exchanges, as *overhearers*, as more distant *bystanders*, or as *eavesdroppers* working to hide their participation from others. He described *production formats* of talk as the complex ways people can be involved in *animating* and *authoring* strips of talk, as well as the complex ways they align to *principalship* (whose interests and perspectives are represented by that talk) and project *figures* (or identities) on the world. In everyday interactions speakers routinely animate words spoken or authored by others, signaling their alignment with or distance from the message of that talk. For example, friends casually share and editorialize messages from others (e.g., "John said he will be late – again!") and employees formally prepare press releases representing the company's perspective on an event (e.g., an oil spill). Goffman (1981) used the term *footings* to describe the work of assuming and displaying stances, and argued that managing footings is fundamental to communicative activity:

> A speaker's budget of standard utterances can be divided into functional classes, each class providing expressions through which he can exhibit an alignment he takes to the events at hand, a footing, a combination of production format and participation status. What the speaker is engaged in doing, then, moment to moment through the course of

> the discourse in which he finds himself, is to meet whatever occurs by sustaining or changing footing (p. 325).

He noted as well that people routinely manage multiple footings simultaneously in interaction[6]. Thus, within social situations and among gatherings, people are fluidly navigating layers of overlapping alignments within production formats, participation frameworks and interaction orders. As participants and researchers alike, we attend to, "read", and act in relation to the social alignments around us in moments of talk and in the larger frameworks of interaction orders.

Goffman's account of gatherings not only highlights alignments of people around moments of communicative activity within functional systems, but also points to the dynamic, laminated, and mobile flows of talk, action, and people. Consider, for example, the seamless way a couple conversing on a park bench may pause briefly to greet an acquaintance passing by, while all along listening to street musicians performing in the distance. If we return to Bateson's blind man, we are interested in following the mobile flows of functional systems, in attending to the way the embodied affordances of being differently abled in normatively built social worlds shape each functional system. Critical to this is identifying the semiotic, material and human resources involved in the communicative management of activity across chains of functional systems. Understanding functional systems in this sense guides the design parameters for reimagining AAC devices.

The overarching goal of this study then was to explore the distributed communicative activity of our participants (i.e., potential AAC/PIM users) and their interlocutors in everyday settings. Specifically, data collection and analysis were guided by the following questions:

1. What discourse patterns do participants and their interlocutors display as they establish, sustain, and change discursive frames in and across functional systems? Do the functional systems of different participants display similar or diverse discourse patterns?
2. How do different discourse resources cluster temporally within functional systems as participants move through and across activities and settings?
3. What communicative roles do routine interactional partners (friends, personal assistants) play in mediating interactions?

The Robo-Buddy Project

Long standing traditions in artificial intelligence and assistive technologies argue for the importance of understanding the situated practices that technologies are designed to replace or support (e.g., Dreyfus, 1992; Kaptelinin & Nardi, 2012; Suchman, 1987). In keeping with such approaches, the first step in our design process – and what we are

[6] It is important to note that Goffman intended his account of production formats and participation frameworks to be nothing more than a generic first-sketch of complex and nuanced cultural potentials as Irvine (1996) insightfully elaborates in her fieldwork.

reporting on here – was to collect interactional data from people who might use a Robo-Buddy. Using ethnographic methods, we collected interview and observational data on 13 primary participants from the campus community (seven of whom used assistive technology because of physical or communicative disabilities and six of whom reported no known communicative or physical challenges). The observations also included secondary participants (friends or personal aides of primary participants) and incidental participants (unplanned participants who were captured on video during observations of target participants). We video-recorded a total of 42 sessions (13 interviews, 24 on-campus observations, and five lab sessions trialing device components). To focus on issues of designing AAC technologies, our analysis here reports on the 16 on-campus observations (over 11 hours of video) completed with six primary participants (who self-identified with disabilities that disrupted their everyday communicative activities on campus) along with seven secondary and 28 incidental participants. Our analysis included transcribing all sessions, coding sessions for specific interactional patterns, and completing situated discourse analysis of selected interactions. It is important to stress that, in keeping with a CHAT perspective, we are analyzing the communicative activity of functional systems, not individuals. Thus, all of the analyses, coding, and counts include the primary participants and their interlocutors in that setting. So, although we often identify the functional systems being analyzed by the primary participant pseudonyms[7] – e.g., "Artemesia" or "David" – none of our analyses focus on single individuals.

Characterizing Routine Activities on Campus

Students, faculty, and workers at the University of Illinois, a large campus (about 700 hectares), must navigate fairly complex public spaces. Our research team first began with general ethnographic observations, taking detailed field notes of common public indoor and outside spaces on campus, including the bus stop in front of the Main Library; the Activities and Recreation Center (a large building with meeting rooms, pools, tracks, exercise equipment, and spaces used for classes in yoga, martial arts, aerobic exercise, dancing and so forth); the large, multipurpose Student Union building with shops, eating venues, offices, study rooms, meeting spaces, and a hotel; the main quad, a grassy area surrounded by buildings that serves as a commons area for foot traffic, public events, and hanging out to study, play games or visit; and the Armory Building, which houses a track and large open floor used for various recreational activities as well as multiple computer labs and classrooms. In initial interviews with the primary participants, we used a static campus map to identify what places they knew about and frequented. Frequented areas identified by participants were diverse, including resident halls, the quad, and various buildings for classes and work. Although the Student Union did not emerge as a most frequented area, we selected it as a focal point for observations because all participants were familiar with its location and most had visited it at least once. It also provided opportunities to engage in multi-party interactions in a variety of public spaces (e.g., elevators, multiple food vendors, a coffee shop, a tech store, a computer lab, a bowling alley and pool hall, and study rooms) and allowed us to travel across the quad to get there.

[7] Pseudonyms are used consistent with our informed consent procedures approved by the University of Illinois Institutional Review Board.

Participants and Observations

At the time of this study, the six primary participants were young adults enrolled in, or recently graduated from, college. All six were native speakers of American English, self-identified with a disorder that made communication difficult, and reported using assistive technologies to accommodate physical needs (e.g., hearing aids, wheel chairs). Five participants hired personal aides to assist with daily activities (e.g., eating, shopping). One participant (Iris) had a hearing loss and the other five (Artemesia, David, Chip, Jessie, and Jester) had cerebral palsy, a congenital movement disorder usually caused by brain damage during or shortly after birth. The five with CP reported disruptions in motor control for speech (i.e., dysarthria) that made their speech difficult for others to understand, but none were using AAC devices to support face-to-face interactions.

As part of our initial interview with each participant, we negotiated activities and sites for their specific on-campus observations, and asked them to invite friends or personal aides to be secondary participants during the observations. Below is a brief description of each participant and their observations. The appendix provides further details on the number of participants and the activities involved in each of the 16 observations.

Iris, 38-years old, was a graduate student in the veterinary medicine program on campus. She reported having a congenital bilateral hearing loss[8] and used bilateral in-the-ear hearing aids to help her better understand speech and other sounds in her environment, and used closed captioning when watching television. She reported having trouble understanding people who do not speak clearly, who have an accent, or who do not face her when speaking, but reported that people seem to have no trouble understanding her when she speaks. Iris brought a friend to three on-campus observations, which included the student union, a local restaurant, and a campus-navigation activity.

Artemesia, 38-years old, was an undergraduate student completing her degree in art history. She reported that her CP had always made it difficult for her to control breathing especially for speech, and that her biggest communication problem was not being able to speak loudly enough for people to hear and understand her. She had tried using a personal amplifier, but found that it seemed to cause more problems (e.g., equipment noise) than it helped. Artemesia invited two different personal aides to her on-campus observations, two at the student union and one in the dining hall.

David, 18-years old, was an undergraduate student pursuing a degree in history. He reported that he had used a basic AAC device briefly as a child. He found opening and closing conversations difficult, especially in causal encounters around campus. He also found it is difficult to communicate with staff in the dining hall because it is a noisy setting and there is social pressure to move quickly through the line. Thus, he avoids the dining hall by bringing his own food or using a familiar personal aide to assist him. David participated in four observations with his personal aide, two at the student union, one in his dormitory, and one in the dining hall.

[8]ASHA estimates that from 1 to 6 per 1.000 newborns have some level of hearing loss and that across the U.S. 1.2% of students enrolled in public schools received services for hearing http://www.asha.org/public/hearing/Prevalence-and-Incidence-of-Hearing-Loss-in-Children/#_ga=1.116424965.288390674.1419890705

Chip, 28 years old, had recently graduated with a degree in English. He reported that in addition to his CP, he had a stuttering disorder, which made it difficult at times for him to speak quickly and clearly enough to get people's attention and to be understood. He preferred to communicate one-on-one with another person instead of in a large group, and while he does not avoid strangers, he does not approach strangers regularly. Chip completed two on-campus observations (one accompanied by a friend), both at the student union.

Jester, 22-years old, was an undergraduate student majoring in history and creative writing. He reported that maintaining a conversation and managing topics are the hardest part of communication, because "it is hard to keep a conversation relevant" for both partners. He also found it difficult to speak loudly enough for others to understand him, especially in groups or loud environments. He reported that communication is particularly fatiguing for him when he needs to continually repeat himself. Jester participated in two observations, one at the student union and one in his dormitory with his aide.

Jessie, 30-years old, was a graduate student completing his doctoral degree in disability studies. Although he used an AAC device when he was younger, he had not used one in recent years and did not plan on using one in the future. He reported that people often have difficulty understanding his speech and also have difficulty giving him the time and space to talk. Jessie attended two observations at the student union, one with his aide.

Analyzing Interactional Discourse Patterns

Our research questions focus on examining the common discourse patterns in these everyday interactions and how they were managed. We were particularly interested in understanding how participants navigated shifts in discourse patterns both within relatively stable settings, and as the functional systems shifted and moved across settings. Finally, we were interested in what communicative roles routine communication partners (friends, personal assistants) played in mediating the participation of target participants (e.g., potential AAC/PIM users) and unfamiliar communication partners in these settings. Drawing on earlier studies of the distributed character of communication in interactions including people with aphasia or amnesia, we focused on what we have come to call interactional discourse resources (IDRs). We have identified several common discourse types that function as highly robust interactional frames, including conversational narratives (Hengst, 2010), reported speech (Duff, Hengst, Tranel, & Cohen, 2007; Hengst, Frame, Neuman-Stritzel, & Gannaway, 2005), procedural discourse (Duff et al., 2008), and verbal play/humor (Duff, Hengst, Tranel, & Cohen, 2009; Hengst, 2006). Our findings document that IDRs are quite common in interactions that involve participants managing aphasia and amnesia, and indeed serve as interactional resources, providing all participants with familiar yet flexible ways of taking up and shifting footings in the moment-by-moment flow of everyday interactions.

Analysis involved a collaborative process of saturated review of the videos and concurrent transcription of all observations. We used a transcription system (see Hengst, 2003) designed to display the sequential and overlapping use of verbal and nonverbal resources by all participants within these interactions. That review led us to focus on seven types of discourse, the five we describe below and two (not reported here) that involved interactions with objects. We developed operational definitions for each type and then used a consensus-coding procedure in which a minimum of two researchers completed three coding passes of the video data, identifying strips of discourse fitting these

categories and marking codes on the written transcripts. As coding was done, we continued to discuss, question and refine the coding and the operational definitions of discourse categories. This continuous process built confidence in the five codes, but we found that coders struggled to come to agreement on the object-related codes because of the partial record of gestures and embodied actions the video data provided. In addition, for one code, contextual use of objects, we realized that the operational definition had led coders to identify episodes that involved both use of material objects and gestural interactions with virtual (or figured) objects. We concluded that this fascinating blurring of material and virtual objects as discursive framing of interaction should be explored in future situated discourse analyses, but not in this categorical mapping of communicative activity. Late in the process, we also began to seek a means of representing the temporal clustering of the five types of discourse, which eventually led to the density mapping we present below.

Thus, our analysis of communicative activity focuses on five types of discourse: playful episodes, conversational narratives, procedural discourse, trouble sources, and conversational repetition. Although operationally defined to be mutually exclusive categories, it was common in our data for a strip of talk to include two or more of these discourse codes. Table 1 offers a summary that describes the five discourse categories and gives an example of each from our data. Given our interest in how discourse patterns were functioning in interactions, our coding focused on *episodes*, defined here as strips of discourse including one or more contiguous or simultaneous interactional turns that share a common discursive frame. For example, because a narrative episode is defined as a contiguous strip, a broader story told in installments with breaks between would be coded as multiple narrative episodes.

The first category, *playful episodes* (P), broadly includes all forms of verbal play and humor, such as playing with the sounds and meanings of words through rhyming, punning, teasing, and telling jokes (Crystal, 1998; Sherzer, 2002) as well as playing with voices through impersonations of others or acting out characters in narrative (re)tellings (Basso, 1979). We are interested in the way verbal play marks interactional work people do to (re)frame potentially threatening, aggressive, or disruptive acts as something else, in this case "play". Observing animal behavior, Bateson (1972) argued that "*the playful nip denotes the bite, but it does not denote what would be denoted by the bite*" (p. 180). We operationally defined an episode of verbal play as a single or multiple contiguous interactional turns sharing a common playful theme; laughter often is part of an episode when it stood as a response to a playful utterance or action, but laughter alone was not counted as a playful episode (Hengst, 2006).

The second category, *conversational narratives* (N), broadly refers to episodes reporting actual or fictitious events typical in everyday conversational interactions (Bamberg & Georgakopoulou, 2008; Goodwin, 1990; Norrick, 2000; Ochs & Capps, 2001). We are interested in the way narratives frame both a temporal shift from the here-and-now of the event of narration to the then-and-there of the narrative events and a shift in participation by setting up a fleeting platform-like event, as participants organize around narrator and audience roles (Hengst, 2010). Narratives may be brief or elaborate, and take a variety of forms, including narratives of personal experience in which the story teller and protagonist are the same person, retellings of others' stories such as retelling the plot and events of a favorite movie, and hypothetical narratives as a teller imagines what might happen if something comes to pass (e.g., she moves to New York, fails her test, or gets offered a

job). We operationally defined narrative episodes as the verbal or nonverbal presentation of at least one event displaced from the moment of telling and linked to a second temporally-related event or evaluation. An episode also included any additional narrative features, such as background detail, transitions, evaluative or interpretive statements, and codas or epilogues. Any continuation or elaboration of the narrative that occurs after a change in topic was coded as a second conversational narrative episode.

Table 1: The five discourse patterns, descriptions and examples

Discourse Category Name and Description	**Example**
Playful Episodes (P): Verbal play and humor, including playing with sounds and meanings of words (e.g., rhyming, punning, telling jokes), teasing, and playing with voices (e.g., acting out characters); may include exchanges with laughter.	D: *I just don't see how I could teach high schoolers. They are so crazy these days.* K/M:[laughing] K: *That is true*.
Conversational Narratives (N): Reporting actual or fictitious events displaced from the time of the telling, background details, evaluations, and codas; may include narratives of personal experience, retellings of others' stories, and hypothetical narratives.	D: *It was the worst possible time because I actually um* [chuckles] *I have a bad habit of locking my keys in my closet, cause I'm just terrible and I was like "OK, can I loan a key," and like she was like, "Oh! I gotta take out the paper" and then the key.* S: [Laughs] *Oh gosh!*
Procedural Discourse (D): Establishing expert-novice relationship where the expert provides information, instructions, or plans, for doing something; may be presented as a series of steps (e.g., setting a trip itinerary) or a list itemizing or comparing services or products (e.g., listing brands carried in store).	S: *So, the next thing that we are gonna do is the actual-um- kinda fun part of it* D: *All right* S: *So, we are gonna walk over to the union and you are gonna have four choices to pick from. So you can choose any one of these, and um we are gonna bring back something tangible to show that we did it. So whatever you wanna pick.*
Conversational Repetition (R): Relatively immediate and visible repetitions of one's own or another's productions of open-class words; including the original saying and the repetition(s) that follow, with no more than 3 interactional turns between each saying.	D: *Um we were just wondering do you have an H-H-H-…* K: *H- HDMI.* T: *HDMI cables?*
Trouble Sources (T): A marked disruption in the flow of communicative activity among participants, which may or may not include repair sequences.	K: *I forgot, Artemesia, are a lot of your classes on the quad?* A: *No.* K: *No?* A: *Architecture.* K: *Art history?* A: *Yeah.*

The third category is *procedural discourse* (D), which broadly refers to episodes of novice-expert discourse that set up a frame of an expert providing information, instructions, or plans for doing something. Such discourse is often presented as a series of steps (e.g., baking a cake, outlining a meeting agenda, setting a trip itinerary) or an itemizing of services or products (e.g., outlining dinner choices, listing brands carried in store). We are specifically interested in the way procedural discourse shifts alignments among the participants, as they must acknowledge or establish a novice-expert relationship first and then shift into the more expert person telling the more novice how to do something (Duff et al., 2008; Hengst & Duff, 2007).

The fourth category is *trouble source* (TS), which is defined broadly as episodes with a marked disruption in the flow of communicative activity among participants. Classic work in conversational analysis (Sacks, Schegloff, & Jefferson, 1974) explored how trouble sources become the focus of attention and how repair patterns often frame participants' perceived roles in breakdowns. Recent case study research on conversational disruptions involving a dysarthric speaker (Rutter, 2009) categorized trouble sources as disruptions of poor intelligibility (by the speaker), reduced comprehensibility (by the listener), or context-related mismatch between conversational partners. The majority of trouble sources in that study were attributed to the dysarthric speakers' reduced intelligibility. Analyzing four types of repair sequences (self-initiated self-repair, other-initiated self-repair, self-initiated other-repair, and other-initiated other-repair), Rutter found that repair was achieved collaboratively, generally addressed the problems of trouble sources, and facilitated the continuation of communication. Bolden (2012) identified trouble sources in interactions among bilingual Russian-American immigrant communities and explored collaborative repairs, specifically the ways an interlocutor could take the role of a language broker to help overcome problems of understanding. We operationally defined trouble source episodes as strips of discourse that involved a conversational disruption or misalignment, which often involved participants' identification of the disruption and any repair work around the disruption. With this definition, trouble sources may or may not lead to a marked communicative breakdown.

The fifth category, *conversational repetition* (R), broadly includes repetition of sounds, words, and phrases characteristic of language use and social interaction (see Hengst, Duff, & Prior, 2008; Prior, Hengst, Roozen, & Shipka, 2006; Tannen, 2007). Patterns of conversational repetition can be described by the relationship between an original saying and its reproduction, including the temporal relationship (e.g., immediate or delayed); the source, or who is being repeated (e.g., repeating oneself or another); the form of what is repeated (e.g., sounds, words, phrases, prosody, meaning); and the exactness of repetition (e.g., verbatim or paraphrased). Interested in the way that clusters of repetitions worked to create fairly immediate and fleeting alignments of discursive frames among participants and across interactional turns, we operationalized our definition to focus on repetitions of open-class lexical items (that is, content words or phrases, not sounds, morphemes, or syntactic patterns), where the original and the first repetition or any subsequent repetitions occurred within five interactional turns and no more than three intervening interactional turns occurred between any repetitions in the episode.

Mapping Communicative Activity of Functional Systems

As we aimed to characterize patterns of discourse within and across participants and within and across settings, we began by considering the frequencies of these different

discourse codes in the functional systems of all participants and of specific participants. For AAC design, frequencies may indicate the relative importance of particular discourse resources and varied frequencies across individuals may suggest the degree of customization needed.

We began our analysis of communicative activity within these functional systems by describing how often these five discourse codes were identified in the dataset. Table 2 summarizes coding for all sessions with each of the six participants. As a reference point, the bottom row lists the raw counts for total number of words transcribed and number of codes identified in all 16 sessions combined. We transcribed 80,733 words and identified 3,272 episodes for the five targeted categories, with conversational repetition identified the most often (2,574), followed by playful episodes (220), conversational narratives (183), trouble sources (176), and procedural discourse (119). In order to make proportional comparisons across codes and participant sessions, the remainder of the chart presents frequencies of codes for every 1000 words transcribed. We identified the highest frequencies of all discourse categories in sessions with Chip (57.06 per thousand words) and Jester (45.32 per thousand words), followed by Iris (45.14), Artemesia (37.09), and Jessie (33.33), with David's sessions displaying the lowest frequency (32.40). We also identified episodes of all five codes in sessions for all six participants.

Table 2: Frequency of codes identified across all sessions with each participant, reported here as number of codes per 1,000 words. (R=repetition; P=playful episode; N=conversational narrative; T=trouble source; D=procedural discourse)

# of sessions w/ participant	Words/ 1000	All codes	R	P	N	T	D
2 w/ Chip	13.56	**57.06**	47.72	4.34	2.43	1.84	0.74
2 w/ Jester	4.69	**45.32**	35.53	1.70	2.34	2.34	3.40
3 w/ Iris	14.65	**45.14**	32.81	5.27	4.11	1.44	1.51
3 w/ Artem	12.75	**37.09**	27.17	4.17	2.05	2.28	1.42
2 w/ Jessie	16.77	**33.33**	27.02	0.36	2.74	2.02	1.19
4 w/ David	18.32	**32.40**	26.23	0.93	0.38	3.06	1.80
Mean (of six participants)	*13.45*	***41.72***	*32.75*	*2.80*	*2.34*	*2.16*	*1.68*
(Data Totals)	***(80,733)***	***(3,272)***	***(2,574)***	***(220)***	***(183)***	***(176)***	***(119)***

We were surprised that the frequency of trouble sources coded was relatively low overall (the second least coded discourse category) and low for all participants (1.44-3.06 per thousand words). In fact, trouble sources had been one of the first discourse patterns we identified to analyze. Many on our team were initially imagining technological solutions for fairly canonical word-level misunderstandings, but, as Table 2 shows, our analysis identified very few word-level disruptions that led to marked breakdowns in the interactions. Our impression that canonically defined trouble sources had a relatively small impact on these interactions seems to be supported by these low frequency counts. In contrast, we were struck by how often conversational repetition was identified. It accounted for three quarters of all episodes coded and was by far the most frequently

identified code for all participants – ranging from about six times as often as the next most frequent code in Iris' sessions to over ten times as often in Jessie's sessions.

We also used this coding to explore discourse profiles for the functional systems associated with each primary participant by considering the relatively frequency of each code across their sessions. Table 3 displays the frequency of codes in all observations with each participant, including both the average number of codes identified per 1,000 words and the rank order of frequency for each code. To aid comparison, the top row lists the averages across all six participants.

Table 3: Frequency of codes identified in all sessions with each primary participant presented by overall number of codes per 1,000 words and rank order list from most to least frequently identified. (Note: R=conversational repetition; P=playful episode; N=conversational narrative; T=trouble source; D=procedural discourse.)

All sessions with Primary Participant	# Codes per 1000 words	Rank order of codes (most to least frequent)
Average	***41.72***	***R > P > N > T > D***
with Chip	57.06	*R > P > N > T > D*
with Jester	45.32	*R > D > N = T > P*
with Iris	45.14	*R > P > N > D > T*
with Artemesia	37.09	*R > P > T > N > D*
with Jessie	33.33	*R > N > T > D > P*
with David	32.40	*R > T > D > P > N*

As noted above, repetition was identified most frequently across observations for all functional systems and was the only code with a common ranking (first for all participant sessions). The rankings for other codes differed across functional systems. Chip's profile was marked by the highest overall frequency of codes and by a rank order of codes that matched the average (*R > P > N > T > D)*. In contrast, David's profile was marked by the lowest average frequency of codes identified (32.40 per thousand words) and a rank ordering that differed from the average ranking in all but the first item (R). The variability in coding can be seen by tracing the ranks of specific discourse categories. Trouble sources, for example, was ranked second for David's profile, third for Artemesia's and Jessie's, tied for third/fourth place for Jester's, fourth for Chip's, and last for Iris'. In fact, all of the other codes (conversational narratives, playful episodes, and procedural discourse) were ranked from second to fifth place in the profiles.

Mapping the Density and Flow of Discourse Categories in Functional Systems

As we looked at the patterning of the five discourse codes across our data, we were struck by the complexity and co-occurrence of discourse episodes, leading us to more closely examine the ongoing management of simultaneous discourse patterns. Thus, we began to develop maps to help us see both the density and clustering of the discourse codes within sessions. Figure 1 shows three density maps that sample from: a) Artemesia's 3rd observation, b) Jessie's 2nd observation, and c) David's 4th observation. Each density map displays 45 consecutive pages of transcript, approximately 30 minutes of the observation, and lists all discourse episodes coded on each page. Each column represents

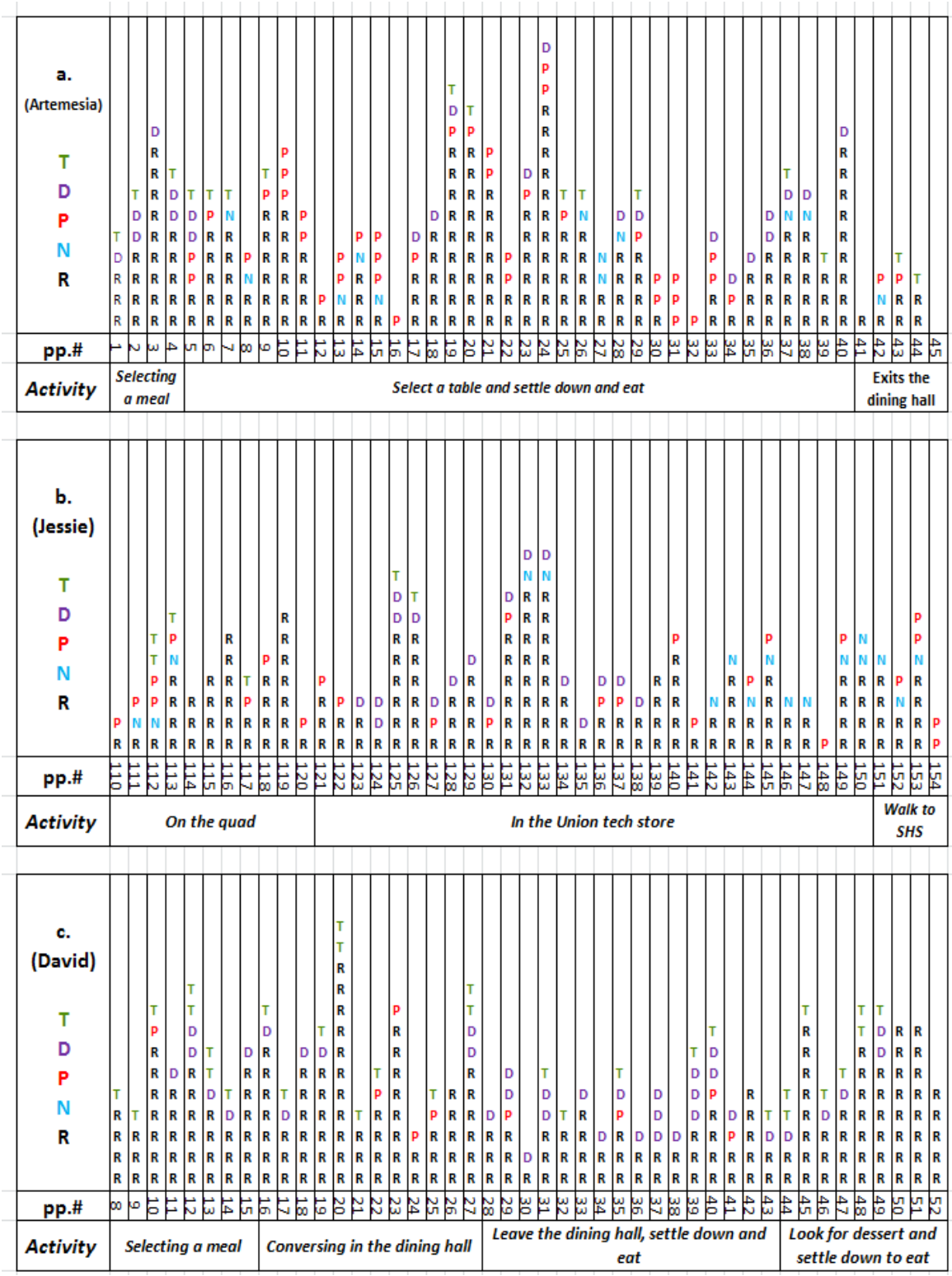

Figure 1: The density and flow maps of five discourse categories coded across 45 transcript pages from: a) Artemesia's 3rd observation; b) Jessie's 2nd observation; and, c) David's 4th observation. The bottom row describes the general activity; the next row labels columns by transcript page numbers (pp.#); and, the top row lists the number of discourse codes on that page, with one letter equaling one code (R=conversational

repetition; N=conversational narrative; P=playful episode; D=procedural discourse; T=trouble source).

one transcript page (approximately 50 words per page). The row below the page numbers provides a general description of activities. The column above the page numbers provides a listing of all items coded on each page. Each letter represents the presence of one coded item on that page; if a coded item (e.g., a conversational narrative) extended across two pages, then the letter representing that item (e.g., N) was listed in the columns for both pages. Letters are always listed in ascending order beginning with R for conversational repetition, followed by N for conversational narrative, P for playful episode, D for procedural discourse, and T for trouble source. An absence of a letter means that no episodes were coded for that category on that transcript page.

For AAC, it is critical to have a sense of how discourse resources are interactively deployed. The three density maps clearly display how much alignment work the participants were managing, both in terms of broad shifts of activity and in the more fleeting shifts in discourse frames associated with the discourse categories. As displayed on the bottom row, across the approximately 30 minutes represented on each map, the three groups of participants shifted locations and activities several times, with three to four broadly described per map. In addition, each density map includes over 200 codes, with a range of 1 to 14 codes representing up to 4 discourse categories listed on each transcript page. Although not captured in these maps, many of these codes were layered within the same strips of discourse (as, for example, when repetition occurred within a narrative). In addition, it is important to remember that these density maps only display the discourse codes and do not capture other alignment work among participants, such as the more fleeting footings around moments of talk (i.e., production formats and participation frameworks), the non-verbal alignments of joint attention (i.e., interaction orders), or the more sustained and durable alignments around identities and shared histories.

By comparing the distribution of codes on these short density maps to the overall frequency of codes identified across sessions for the participants (see Tables 2 & 3), we can further characterize the interactional profiles of these functional systems. Consistent with overall frequencies, these density maps display the pervasiveness of the five discourse categories, with codes listed in all columns except for the last page for Artemesia's map. Indeed, all five codes were identified during the thirty minutes represented on Artemesia's and Jessie's maps, and four of the codes on David's map. In addition, conversational repetition was the dominant code in all three maps, listed on all but four of the pages mapped, and usually listed multiple times per page. In many cases, there were striking consistencies with the overall rank order of codes for each participant (see Table 3) and the representation of codes on their density maps; for example, *playful episodes,* which was Artemesia's second most frequent code, occurred on 27/45 pages in her density map. However, the maps also pointed to ways that the codes differed in distribution. For example, *playful episodes* ranked last in Jessie's data, but were listed on half of the pages (23/45) of this density map.

Analyzing the density pattern of codes within each map in Figure 1, that is, whether codes were listed across activities (i.e., appeared evenly across the 45 pages) or concentrated within specific activities, allows us to characterize discourse profiles for these interactions. Artemesia's map is characterized by codes that are mostly dispersed – appearing across

activities and across pages. The exception is the first four pages, *selecting a meal*, which was striking by the absence of playful episodes (P) and conversational narratives (N). Jessie's map shows small concentrated bursts of trouble sources (T) in the first two activities, but never on more than two consecutive pages, and a longer streak of procedural discourse (D) codes when at the Tech Store. In contrast, those two codes (T, D) were dispersed widely across David's map, which seemed particularly striking given that these codes were not ranked very high in his data overall. Comparatively, we can see that a trouble source appeared on 25 of the 45 pages for David, compared to 16 for Artemesia and 5 for Jessie. It is interesting too to note how prevalent play was in the interactions for some participants: on 26 pages, including 2 where play episodes were the only codes, for Artemesia's map; on 23 pages for Jessie's map, and on only 9 pages for David. Conversational narratives were likewise spread throughout these temporal maps: on 11 pages on Artemesia's map, on 16 pages for Jessie, and on no pages in this stretch of interactions with David across 4 broad activities in a dining hall. While the multiple codes and the complex clustering in these maps point to the general complexity of communicative practices, the temporal pattern of codes and their density begins to suggest the typical communicative signatures of the functional systems with each of these participants.

Situated Discourse Analysis: Jessie's Visit to the Tech Store

The analysis of frequency, flow, and density of discourse codes provided above offers an initial characterization of how communication is distributed in the interactions with these participants; however, finer-grained, more contextualized analysis is needed to understand how these discourse resources functioned and who used them to mediate interactions. To provide a more contextualized representation of the communicative activities in these functional systems, we turn now to a close discourse analysis of a stretch of interaction during Jessie's visit to the Tech Store. We include a transcript of one key stretch of talk and pay particular attention to the shifting footings of his aide. This example points out patterns of conversational repetition, follows a canonical trouble source and its repair, and illustrates patterns of inter-animation among the codes in the flow of these interactions. Finally, we will relate this close analysis of Jessie's visit to the Tech Store with two observations at dining halls, one with Artemesia and one with David, to talk about the different stances the personal aides assumed as they mediated these interactions for their employers, the target participants. All three of these observations were types of service encounters that included the participant's personal aides.

The excerpt we analyze here comes from the second observation with Jessie, where Jessie's aide and the researchers went to the tech store at the Student Union (see Appendix). The transcript in Figure 2 came from pages 125-127 in the density map (Figure 1b). Jessie wanted to buy a presentation remote control device to use when he was teaching class or presenting at conferences. The transcript presented in Figure 2 displays speaking lines for four people – J for Jessie, PA for his personal aide, Z for the store clerk, and H for one of the researchers. This excerpt begins in the middle of transcript page 125 where Jessie is asking the clerk for help: "*I would wonder if you had uhm if you sold uhm the X to change the slides or change the pictures*." When the clerk says "*The wireless-*", Jessie interrupts him and says "*clickers*". After a two-second pause with no response from the clerk, Jessie shifts his gaze to his aide and repeats "*clickers*"; the clerk then guesses "*speakers?*" and Jessie shifts his gaze back to the clerk and again repeats "*clickers*". This

was one of the few instances in our data where there was a clear word-level trouble source. Jessie is trying to say the word *clickers*, but the store clerk apparently does not understand him. Jessie tries to clarify with two self-repetitions, but it is finally his aide who understands the word, which she signals by emphatically saying "*clickers*" twice. This short stretch shows the aide taking a role that fits with the dominant paradigm of AAC: She recognizes Jessie's unintelligible word and translates by restating it more intelligibly. However, as we see next, the intelligibility of words alone does not resolve the ambiguities, or misalignments, in this situation.

J:	I would wonder if you had uhm if you sold uhm the X to change the slides or change the
PA:	
Z:	
J:	pictures clickers [..2..] clickers Clickers.
	[looks at PA] [looks at Z]
PA:	CLICKERS! Oh clickers I'm
Z:	The wireless- speakers?
	[looks at J] [looks at PA, then back at J]
J:	No, when you have a presentation.
PA:	sorry. Oh yeah, if you're giving a presentation
	[clicking gesture]
Z:	The I-Clickers
	[Z looks at PA]
J:	yeah.
PA:	like [.1.] if you have power point up and you need to li- right? Actually I could
	[lifts hand as a screen] [clicking gesture]
Z:	
J:	
PA:	totally use one of those [.1.] do you guys sell those?
Z:	Uhmm I think we have them at the
	[points to back wall, shifts body]
J:	
PA:	oh I'm sorry What is THAT? I don't even know
	[points to display]
H:	sorry sorry
Z:	back [.1.] over here [.1.] uhm.
	[gathering walks to back of store]
J:	
PA:	what this stuff is anymore. [..2..] Yeah I see people who have those in class and like
Z:	
J:	Yeah.
PA:	Oh yeah totally
Z:	Presentation remotes. We have two [....4....] They're both uhh [.1.]
	[points to remotes on display] [picks up two remotes]
J:	Wh-what
PA:	
Z:	one's a Kensington one's a Targus [.1.] depends on what your preference is. [.1.]
	[looking at remotes]
J:	are the main differences? [laughing]
PA:	[laughing]
Z:	Well [..2..] one of them's green, one of them's red.
	[flips over remotes one at a time, looking at back of each]
J:	
PA:	Huh.
Z:	This one's the green [.1.] and this one's the red laser.
	[holds up the green remote, then the red remote]

Figure 2: Transcript of Jessie (J), his aide (PA), and the researcher (H) interacting with a clerk (Z) at the Tech Store in the Student Union (2nd observation, transcript pages 125-127). Talk is presented in black text, with gestures and actions as green italic text in brackets below the speaker's line.

The clerk now understands the word *clickers*, but guesses that Jessie is looking for an *I-Clicker* (a wireless device required in some large undergraduate classes that allow instructors to poll students' answers to questions during class). Jessie counters by saying "*No, when you have a presentation*", and the aide further clarifies what Jessie means by using words and gestures to demonstrate using a hand-held remote "*if you're giving a presentation like …if you have power point up and you need to li- right?*" Although this was also a word-level trouble source, it was not an issue of intelligibility; instead, neither Jessie nor the aide seem to know (or be able to recall) the name of the device he is looking for. Instead, the aide produces a nonverbal narrative-like performance: she enacts a figured scene where she is holding a (figured) remote with one hand and using the other hand to point toward an imagined screen, and gesturing with her hand to simulate clicking the remote to advance slides in this transposed indexical space. This embodied enactment works both to clarify Jessie's meaning (to confirm that he is looking for a presentation tool, not a student response tool) and to perform an alternative scene to the clerk, one where Jessie is the instructor or presenter, using presentation tools during his lecture. This complex performance points to a pattern of mediation typical in our data, especially by this particular aide, one that conventional approaches to AAC design would not imagine.

When Jessie confirms, the aide then adopts the role of co-shopper, enthusiastically saying: "*Actually I could totally use one of those…do you guys sell those?*" The clerk responds that he thinks they are in the back of the store, and the group moves to the back of the store to check them out, with the researcher and the aide bumping into each other along the way ("*Oh I'm sorry*" "*sorry sorry*"). Here again, by taking up the enthusiastic co-shopper role the aide was reframing the event as a joint shopping trip; this shift in agency and footing is again well outside the range of the prosthetic and transmission models.

Finally, at the end of the interaction while the clerk is showing Jessie and the aide the two brands of remotes the tech store carried ("*one's a Kensington and one's a Targus*"), Jessie asks the clerk what the difference is between the two brands. The clerk laconically replies "*well [..2..] one of them's green, one of them's red.*" In response, Jessie and the aide laugh together at this surprisingly non-technical and anti-climatic response, and the clerk repeats himself. At this point, the aide was taking up a stance as a social partner or friend as well as a co-shopper.

Communicative roles personal aides played in mediating interactions

In the short stretch of interaction presented above, we identified four patterns of alignment the aide used in mediating Jessie's interactions with the store clerk: she *translated* his unintelligibly spoken word "*clickers*," tried to *clarify* his meaning through an embodied enactment using an imagined presentation remote, *co-participated* in the activity (here taking on the role of an enthusiastic co-shopper), and *socialized* with Jessie (joining as a friend in a laugh of surprise). The rapidly shifting footings of the aide and her complex mediation of Jessie's shopping offer an image of the work that a PIM might be designed to help accomplish. However, only a small portion of the aide's mediation, the first word-

level trouble source, would be covered by a prosthetic and transmission model of AAC. It is also important to recognize that these are not the only patterns of mediation we identified among the aides in our observations.

Four other patterns we want to highlight come from the dining hall observations with Artemesia and David (see Figure 1a, c) and focus on mediating environmental control and choices. Campus dining halls are self-service; students move from station to station, selecting food and drinks, and carry their meals to tables where they eat. As Artemesia and her aide moved together from station to station, the aide adopted two noticeable meditational roles. Her dominant role during this activity involved *reading the environment* (naming items out of Artemesia's reach and view, reading signs posted at the stations) and *confirming* Artemesia's selections (repeating her choices and putting things on her tray). However, in several instances, the aide shifted to *challenging* Artemesia's choices, asking her "*is that [salad] wise for your stomach?*" and *reminding* her "*okay, you know your mom sent you an apple.*" David's aide also displayed these roles of *reminding* and *challenging*, and his interactions with her in the dining hall were characterized by negotiating control over choices, discursively marked by procedural discourse. For example, by following David's lead and directions, the aide knew what to feed him. At one point, when David said he was ready for another bite of food, the aide tried to *clarify* if he wanted the entire portion of bread in one bite and *challenged* that choice with repeated questions: "*Do you want this whole thing – will you be able to eat it all?" "So you want the whole thing? ...oh God,*" and "*Can you fit this whole thing in your mouth*." When David finally confirms "*yes,*" the aide complies and *reminds* him to chew slowly, at which point David chokes on the large bite of bread. David recovers quickly and then re-frames the incident as fooling around: "*I did that just for… theatrics*." The aide and David then begin *socializing*, jokingly debating whether or not he really choked: Aide – "*no you didn't,*" David – "*theatrics,"* Aide—"*you're a joker*." Multiple repetitions are used during this playful episode as well.

Overall, attending to the five discursive frames (i.e., repetition, narrative, play, procedural discourse, and trouble sources) in the situated discourse analysis of Jessie's visit to the tech store as well as of Artemesia's and David's interactions in the dining halls helped us discern complex and only partially predictable patterns of alignment and mediation. Jessie's aide did not simply repair a trouble source by articulating the right word, she launched into a performance to build common ground for referencing and, we would argue, helped humanize Jessie's relationship to the clerk by enthusiastically animating the everyday roles of co-shopper and friend. Artemesia and David's aides helped them see and navigate a physically difficult environment, but also took roles of reminding and challenging, by connecting their food choices to their histories, their health, and events outside of the immediate environment (e.g., past stomach upsets, packages, past choking hazards). Both Jessie's and David's interactions were also punctuated at key points with playful episodes. All together, the eight roles we have loosely identified the aides taking (translating words, clarifying meanings, co-participating in activities, socializing, reading the environment, confirming, reminding, and challenging) just in these three brief strips of interaction point to the need for PIMs that can manage the deeply laminated discursive frames and functional systems of activity typical of such mundane interactions.

Discussion: CHAT, AAC, and Social Practice

Our analysis aimed to map communicative activity in the chains of everyday functional systems with these six differently-abled individuals (5 with CP, 1 with a bilateral hearing loss). The five types of discourse resources we coded were robustly present across these functional systems, but quite variably and complexly configured. By moving between the three analyses (frequency of codes, temporal density mapping of codes, and situated discourse analysis), we begin to see the discursive signatures associated with the primary participants' functional systems and specific activities. Overall, the frequency counts showed the pervasiveness of repetition, the relative sparseness of trouble sources, and the considerable variation in frequency rankings for the codes across participants' sessions. The density maps, which tracked larger shifts in activity and clustering of discourse resources, made strikingly visible the amount of lamination characteristic of these everyday interactions. The situated discourse analysis let us track the detailed unfolding of interaction; the rapid, emergent calibration of frames; and the mediational roles of the aides. As our discourse analysis focused on how human aides mediated interactions with the six primary participants, a striking finding was that the role of providing linguistic translation (i.e., voicing words intelligibly) was relatively rare and often not sufficient to mediate the interactions. Other roles (e.g., co-participating, socializing, reading the world, reminding and connecting to histories) were common and widely dispersed. Overall, we would argue this kind of intense analysis of discourse is critical to empirically ground the design parameters for AAC.

The implications of a CHAT approach for conceptualizing AAC are profound. Where the dominant theory of AAC tells us that communication is about individuals deploying a language system to exchange information through the production and reception of discrete messages, a CHAT perspective understands communication to be about discursively and dialogically assembling and managing frames. CHAT shifts our unit of analysis from the deficits of a "differently embodied person" to the mediating activities of people and tools within functional systems. Drawing on our empirical examination of these communicative activities, we envision pseudo-intelligent mediators (PIMs) that actively read and shape the framing of talk (not just producing strips of talk), that have dialogic capacities (able to reference past histories and remind), and that engage as partners in discourse (participating in episodes of play, narrative, procedural discourse, and so on). Our analysis suggests a key design parameter is agility, the ability to recognize and navigate rapidly shifting discursive frames. Drawing on the roles of the human mediators, we imagine PIMs that are designed to co-participate and socialize with the user and others (as Jessie's aide did at the tech store) in order to draw less agile humans into appropriate interactional frameworks. PIMs do not need to reproduce the competence of accomplished human communicators, but need to be able to initiate frames and evoke the distributed work of people in the interaction, goals that sometimes can be achieved in quite simple ways (e.g., throat clearing to get joint attention). A CHAT approach then points toward PIMs that are aligned to facilitating communicative activity distributed in historically deep but locally assembled functional systems.

A CHAT approach also re-defines communication disorders as distributed physically and socially within and across functional systems (Hengst, 2015). CHAT has long argued against simplistic applications of deficit models that diagnose individuals through task-based assessments of individual cognitive-communication abilities, designing instead

context-dependent and dynamic assessments grounded in the method of double stimulation (Vygotsky, 1999). However, a continuing challenge in clinical fields has been to attend to atypical patterns of physical development without reducing individuals to specific deficits or diagnoses. Luria (1963) conceptualized the cognitive-communication disorders associated with physical brain injuries as disruptions to the various *functional systems* supporting patients' activities, and proposed *functional plasticity* as a theoretical concept to account for ongoing re-organization and to guide interventions. Also arguing for more complex understanding of disability, other researchers have drawn on a variety of social models to examine the complex ways social contexts shape disabilities. Ethnomethodological researchers (e.g., McDermott, 1993; Mehan, 1993) have examined critically the social and interactional production of identities of disability in school settings. Understanding disability as an incongruity between social and physical lines of development, Bøttcher (2010, 2012) has analyzed how this developmental dynamic plays out in school for children with severe developmental disorders (e.g., cerebral palsy). Bøttcher (2012) argues:

> Having a severe disability has an impact on the child's conditions for learning and cognitive development, for it leads to concrete instances of mismatch between the organisation of activities in learning practices and the child's motives and abilities for participation. Despite professional aims of decreasing the incongruence through the use of remedial activities and aids, the conditions for learning offered to children with severe disabilities are often much more strenuous than those met by typical children (p. 104)

Broadly, studies of the social conditions of disability reinforce the early intuition of Vygotsky that the consequences of different physical and cognitive biologies become deficits primarily through the disruption of access to, and participation in, the cultural-historical worlds where humans learn to be human. This tradition within CHAT then has argued for ensuring that differently abled individuals can engage fully with cultural-historical resources and practices. Extending this tradition, our goal is to reinvigorate the early attention that Vygotsky and Luria gave to the physicality of development, to deepen our analysis of the complex dynamics of communicative practices, and to expand attention to the mobile and laminated flows of functional systems as individuals navigate their everyday social worlds.

We also believe that taking up research with differently-abled persons has significant implications for CHAT. In spite of Vygotsky's revolutionary approaches to development in children with special needs and Luria's to the ongoing reorganization of functional systems for adults with brain damage, typical development and typical adult activity have dominated theory and research. Our sense is that CHAT has usually taken the normative body as the implicit, interchangeable subject of activity. Thus, attending to the varied disruptions of differently-abled bodies could push CHAT to take into account the persistent role of physicality in the operation and outcomes of functional systems. In our reading, Bateson's (1972) story of the blind man and the cane has always been taken up as a story of the changing relevance of the cane in different functional systems rather than of the persistent disruption of being blind, whether on the street or in the restaurant. Interested in the flexible and mobile dimensions of functional systems, we have also been

struck by how much of the CHAT literature seems anchored in repeated activity in some institutionally-given time and place rather than following the flows of people across dynamically emerging functional systems. Interested in remediating the communicative activities of people with disabilities, we have found CHAT offers more robust resources for considering distributed cognition and action than for theorizing and studying situated communication, for which applied linguistics, microsociology, and linguistic anthropology offer richer toolkits. We believe then that research on AAC can push CHAT to deeper engagements with theoretical and methodological resources for studying communicative activity (e.g., Goffman, 1981; Hengst, 2015; Irvine, 1996; Ochs & Capps, 2001).

Finally, we conclude with a question of the social implications of this work. Vygotsky (1993) noted that: "*Our entire culture is intended for a [person] who possesses certain organs—a hand, an eye and ear—as well as certain functions of the brain. All our instruments, our technology, all our signs and symbols are intended for a normal human being*" (p. 167). The implication is that individuals with strikingly different biologies are at a disadvantage at best, often isolated from the culturally fabricated tools, settings and practices developed by and for typically-abled bodies. AAC and varied special needs tools and pedagogies have made great progress over the past century, allowing people like Stephen Hawking to speak, supporting the formation of deaf communities of signers, allowing amputees to run on blades, and increasing architectural accessibility. We think we are historically at a stage where another strategy is possible. Consider how much easier it is today in many global cities for multilingual individuals to navigate social spaces that are accustomed to and intended for multilingual individuals than it is to navigate strongly monolingual spaces. In the same way, AAC devices that support diverse communicators in everyday interactions can begin to remake our sociocultural worlds as repeated and routine engagement accustoms the everyday worlds of dining halls, tech stores, homes, and workplaces to the communicative participation of differently-abled individuals.

References

Andersen, G., Mjøen, T. R., & Vik, T. (2010). Prevalence of speech problems and the use of augmentative and alternative communication in children with cerebral palsy: A registry-based study in Norway. *SIG 12 Perspectives on Augmentative and Alternative Communication, 19*, 12-20. doi:10.1044/aac19.1.12

ASHA. (2004). *Roles and responsibilities of speech-language pathologists with respect to augmentative and alternative communication: technical report*. Retrieved from Rockville MD: Available from http://www.asha.org/policy.

Bailey, R. L., Parette Jr., H. P., Stoner, J. B., Angell, M. E., & Carroll, K. (2006). Family members' perceptions of augmentative and alternative communication device use. *Language, Speech, and Hearing Services in Schools, 37*(1), 50-60. doi:10.1044/0161-1461(2006/006)

Bamberg, M., & Georgakopoulou, A. (2008). Small stories as a new perspective in narrative and identity analysis. *Text & Talk, 28*, 377-396.

Basso, K. H. (1979). *Portraits of "the whiteman": Linguistic play and cultural symbols among the Western Apache*. Cambridge, UK: Cambridge University Press.

Bateson, G. (1972). *Steps to an ecology of mind: The new information sciences can lead to a new understanding of man*. New York: Ballantine Books.

Beukelman, D. R., & Mirenda, P. (1998). *Augmentative and alternative communication: Management of severe communication disorders in adults and children*. Baltimore: P.H. Brookes.

Bolden, G. B. (2012). Across languages and cultures: Brokering problems of understanding in conversational pair. *Language in society, 41*, 97-121.

Bøttcher, L. (2010). An eye for possibilities in the development of children with cerebral palsy: Neurobiology and neuropsychology in a cultural-historical dynamic understanding. *Outlines: Critical Practice Studies, 12*(1), 3-23.

Bøttcher, L. (2012). Culture and the learning and cognitive development of children with severe disabilities: Continuities and discontinuities without disabilities. *Mind, Culture, and Activity, 19*(2), 89-106. doi:10.1080/10749039.2011.632050

Cole, M., & Engeström, Y. (1993). A cultural-historical approach to distributed cognition. In G. Salomon (Ed.), *Distributed cognition: Psychological and educational considerations* (pp. 1-46). Cambridge, UK: Cambridge University Press.

Crystal, D. (1998). *Language play*. Chicago: University of Chicago Press.

Dreyfus, H. (1992). *What computers still can't do: A critique of artificial reason*. Cambridge, MA: The MIT Press.

Duff, M. C., Hengst, J. A., Tengshe, C., Krema, A., Tranel, D., & Cohen, N. J. (2008). Hippocampal amnesia disrupts the flexible use of procedural discourse in social interaction. *Aphasiology, 22*(7-8), 866-880.

Duff, M. C., Hengst, J. A., Tranel, D., & Cohen, N. J. (2007). Talking across time: Using reported speech as a communicative resource in amnesia. *Aphasiology, 21*(6-8), 702-716. doi:10.1080/02687030701192265

Duff, M. C., Hengst, J. A., Tranel, D., & Cohen, N. J. (2009). Hippocampal amnesia disrupts verbal play and the creative use of language in social interaction. *Aphasiology, 23*, 926-939.

Fine, G. A. (1983). *Shared fantasy: Role-playing games as social worlds*. Chicago: University of Chicago Press.

Glennen, S., & DeCoste, D. C. (1997). *The handbook of augmentative and alternative communication*. San Diego: Cengage Learning.

Goffman, E. (1974). *Frame analysis: An essay on the organization of experience*. Boston: Northeastern University Press.

Goffman, E. (1981). *Forms of talk*. Philadelphia: University of Pennsylvania Press.

Goodwin, M. H. (1990). *He said, she said: Talk as social organization among black children*. Bloomington, IN: Indiana University Press.

Hengst, J. A. (2006). "That mea::n dog": Linguistic mischief and verbal play as a communicative resource in aphasia. *Aphasiology, 20*(2-4), 312-326. doi:10.1080/02687030500475010

Hengst, J. A. (2010). Conversational narratives and aphasia. In P. A. Prior & J. A. Hengst (Eds.), *Semiotic Remediation* (pp. 107-138). Houndsmill, UK: Palgrave.

Hengst, J. A. (2015). Distributed communication: Implications of cultural-historical activity theory (CHAT) for communication disorders. *Journal of Communication Disorders, 57*, 16-28.

Hengst, J. A., & Duff, M. C. (2007). Clinicians as communication partners: Developing a mediated discourse elicitation protocol. *Topics of Language Disorders, 27*(1), 37-49.

Hengst, J. A., Duff, M. C., & Prior, P. A. (2008). Multiple voices in clinical discourse and as clinical intervention. *International Journal of Language & Communication Disorders, 43*(s1), 58-68. doi:10.1080/13682820701698093

Hengst, J. A., Frame, S., Neuman-Stritzel, T., & Gannaway, R. (2005). Using others' words: Conversational use of reported speech by individuals with aphasia and their communication partners. *Journal of Speech, Language, and Hearing Research, 48*, 137-156.

Huer, M. B., & Lloyd, L. L. (1990). AAC users' perspecdtive on augmentative and alternative communication. *AAC, 6*(4), 242-249.

Hutchins, E. (1995). *Cognition in the wild*. Cambridge: MIT Press.

Irvine, J. T. (1996). Shadow conversations: The indeterminacy of participant roles. In M. Silverstein & G. Urban (Eds.), *The natural histories of discourse* (pp. 131-159). Chicago: University of Chicago Press.

Johnson, J. M., Inglebret, E., Jones, C., & Ray, J. (2006). Perspectives of speech-language pathologists regardingsuccess versus abandonment of AAC. *AAC, 22*(2), 85-99.

Kaptelinin, V., & Nardi, B. A. (2012). *Activity theory in HCI: Fundamentals and reflections*: Morgan & Claypool Publishers.

Luria, A. R. (1963). *Restoration of function after brain injury*: Pergamon Press.

Luria, A. R. (1972). *The man with a shattered world: The history of a brain wound.* New York: Basic Books.

Luria, A. R. (1979). *The making of mind*. Cambridge, MA: Harvard University Press.

Mialet, H. (2012). *Hawking incorporated: Stephen Hawking and the anthropology of the knowing subject*. Chicago: The University of Chicago Press.

Newman, D., Griffin, P., & Cole, M. (1989). *The construction zone: Working for cognitive change in school*. Cambridge UK: Cambridge Univesity Press.

Norrick, N. (2000). *Conversational narrative: Storytelling in everyday talk*. Amsterdam: John Benjamins.

Ochs, E., & Capps, L. (2001). *Living narrative: Creating lives in everyday storytelling*. Cambridge: Harvard University Press.

Oskoui, M., Coutinho, F., Dykeman, J., Jette, N., & Pringsheim, T. (2013). An update on the prevalence of cerebral palsy: a systematic review and meta-analysis. *Developmental Medicine & Child Neurology, 55*, 509–519.

Prior, P. A., Hengst, J. A., Roozen, K., & Shipka, J. (2006). 'I'll be the sun': From reported speech to semiotic remediation practices. *Text & Talk, 26*(6), 733-766. doi:10.1515/text.2006.030

Rogoff, B. (2003). *The cultural nature of human development*. New York: Oxford University Press.

Rutter, B. (2009). Repair sequences in dysarthric conversational speech: A study of interactional phonetics. *Clinical linguistics and phonetics, 23*(12), 887-900.

Sacks, H., Schegloff, E. A., & Jefferson, G. A. (1974). A simplest systematics for the organization of turn-taking for conversation. *Language, 50*(4), 696-735.

Schlosser, R., & Lee, D. (2000). Promoting generalization and maintenance in augmentative and alternative communication: A meta-analysis of 20 years of effectiveness research. *AAC: Augmentative and Alternative Communication, 16*(4), 202-226.

Sherzer, J. (2002). *Speech play and verbal art*. Austin, TX: University of Texas Press.

Suchman, L. (1987). *Plans and situated actions: The problem of human/machine communication*. Cambridge, UK: Cambridge University Press.

Tannen, D. (2007). *Talking voices: Repetition, dialogue, and imagry in conversational discourse* (Second ed.). New York: Cambridge University Press.

Vygotsky, L. S. (1999). Tool and sign in the develoipment of the child. (M. Hall, Trans.). In R. W. Rieber (Ed.), *The collected works of L.S. Vygotsky. Volume Six: Scientific legacy* (Vol. 6, pp. 3-68). New York: Kluwer/Plenum.

Wertsch, J. V. (1991). *Voices of the mind: A sociocultural approach to mediated action*. Cambridge, MA: Harvard University Press.

Zangari, C., Lloyd, L., & Vicker, B. (1994). Augmentative and alternative communication: An historic perspective. *AAC: Augmentative and Alternative Communication, 10*(1), 27-59.

Acknowledgements

Research funding was provided by a University of Illinois Graduate College IN3 grant, *Pseudo-intelligent mediators ("Robo-Buddies") to improve communication between students with and students without physical disabilities*, awarded to Mark Hasegawa-Johnson (PI), Julie A. Hengst, Laura DeThorne, Patricia Malik, Thomas Huang, & Tracy Gunderson.

Our thanks also to Professor Karrie Karahalios for consulting on this project and to student research assistants for their work collecting, managing, transcribing and coding data: Sara Small, Katie Lester, Monique Kammo, Shanthi Sivasankaran, Carissa Ernat, Jennifer Gerry, Carley Serena, Caroline Eichelberger, Gena Carpenter, Mariana Aparicio Betancourt, Christina Bronson-Lowe, Xuesong Yang, Yang Zhang, Dennis Lin, Pooya Khorrami.

An earlier version of this paper was presented at the ISCAR 4th Congress, October 2014, Sydney, Australia.

About the authors

Julie A. Hengst is an associate professor in Speech and Hearing Science at the University of Illinois. Her research draws on CHAT to detail everyday semiotic practices among individuals with communication disorders and their routine communication partners. She focuses particularly on the sudden disruptions in communication caused by acquired brain injuries (e.g., strokes, trauma) and the ongoing re-organization of functional communication systems.

Contact: Email: hengst@illinois.edu

Maeve McCartin was a research assistant on the Robo-Buddies project for three years, while completing her master's degree in Speech and Hearing Science at the University of Illinois. Currently employed as a Speech-Language Pathologist, she is working to apply CHAT perspectives to clinical practice.

Contact: Email: maeve.mccartin@gmail.com

Hillary Valentino was a research assistant on the Robo-Buddies project for three years, while completing her master's degree in Speech and Hearing Science at the University of Illinois. Currently employed as a Speech-Language Pathologist, she is working to apply CHAT perspectives to clinical practice.

Contact: Email: hillary.valintino@gmail.com

Suma Devanga is currently a doctoral student in Speech and Hearing Science at the University of Illinois. Her research examines the way communicative practices shape social approaches to the treatment of aphasia and aims to develop person-centered interventions that better support patients in re-building their communicative lives.

Contact: Email: devanga2@illinois.edu

Martha Sherrill is currently a doctoral student in Speech and Hearing Science at the University of Illinois. Her current research examines the communicative practices within Animal Assisted Therapy (AAT) programs, focusing specifically on how human-animal interactions impact the engagement of adults with aphasia.

Contact: Email: sherrll2@illinois.edu

Appendix: Description of Observational Data

Provided here is a description of the sixteen observations that comprised the dataset for this study. The heading identifies each observation by: the primary participant, the observation number for that participant, a label for the session, and the length (mins:seconds) of the recording. The number of people included in the video are listed by their participant roles: PP=primary participant, SP=secondary participant, RA=research assistants, and IP=incidental participant. The group refers to the PP, SP, and RAs involved in a given session, which was consistent within each session. However, across sessions the specific RAs and SPs varied. Each session ended with the researchers conducting a brief interview with the PP (and SP) about the just completed observation.

Artemesia—Observation 1: At the Student Union (48:53)

1 PP; 1 SP; 5 RAs; 3 IPs

Artemesia (PP), accompanied by her personal aide (SP), met five researchers (RAs) at the research office to plan the day's observation; the group then went together to the Student Union where they took the elevator down to the lower level and to go to the bowling alley. At the bowling alley Artemesia (PP) asked the service clerk (IP1) about prices and accommodations for people in wheelchairs, and the service clerk told her the information and gave her a pamphlet. Then the group took the elevator back to the first floor and walked to the technology store where Artemesia (PP) asked the service clerk (IP2) questions about several products. Artemesia (PP) also decided to go to the office for Registered Student Organization (RSO); so, the group took the elevator to RSO office on the second floor where Artemesia asked questions of a service clerk answers (IP3). The group took the elevator back to the first floor and walked together back to the research office.

Artemesia – Observation 2: At the Student Union (31:27)

1 PP; 1 SP; 4 RAs; 1 IP

Artemesia (PP), accompanied by her aide (SP), met the four researchers (RAs) at the research office, to complete an interview about the process of hiring aides in the residence halls in and to plan the day's observation. The group walked to the Student Union and first stopped to talk with two vendors (IP1; IP2) selling books at temporary station at the Union entrance. Artemesia and aide asked the vendors for directions to a garden on campus and about the their services. Artemesia and aide then decided to go to the technology store on campus and ask about a few products. Afterwards, the group walked together back to the research office.

Artemesia – Observation 3: Eating dinner in the Dining Hall (29:16)

1 PP; 1 SP; 4 RAs; 0 IP

Researchers (RAs) met Artemesia (PP) and her primary personal aide (SP) at her dormitory, and the group walked together to the dining hall. As the Artemesia (PP) swipes her meal card, the group enters the cafeteria area of the dining hall. Artemesia (PP) directs her aide (SP) on selecting a meal. After getting all of the food, Artemesia (PP) and the group select a table in the dining area and settle down to eat. The group converses and her aide (SP) assists Artemesia (PP) with her meal. When Artemesia (PP) is done eating, her

aide (SP) puts the tray away, and the group exits the dining hall and returns to the lobby of the dormitory.

Iris – Observation 1: At the Student Union (35:47)
1 PP; 0 SP; 4 RAs; 3 IPs

Iris (PP) met the researchers (RAs) at the research office. Additional questions that were not asked at the original interview were completed. She told the team how she uses compensatory strategies for her hearing loss. They discussed the activity, took the stairs downstairs, and then proceeded to the Union. The researcher is primarily guiding her with directions. Iris (PP) asks for a room on May 11th. They go to the Tech Store next to ask about an iPhone and how to update software. They walk back to SHS and discuss food and personal stories. They enter SHS and complete brief Q&A inside the research office. Iris (PP) discusses a few challenges she has with her hearing loss.

Iris – Observation 2: Getting lunch at a local restaurant (32:07)
1 PP; 1 SP; 2 RAs; 0 IP

Iris (PP) and her secondary participant (SP) met the researchers (RAs) at the research office for a brief interview. The protocol was the same for the first observation; however, the participants decided to do a different task and complete an errand that her colleague (SP) wanted to complete. They walk to a local restaurant and order food for her colleague's (SP) babysitter, who is at home. Consent could not be obtained from the workers at the restaurant, so data is not used from that portion. An informal interview is conducted on the walk back from the restaurant to SHS.

Iris – Observation 3: Navigating campus (38:08)
1 PP; 1 SP; 2 RAs; 0IP

Iris (PP) and the colleague from observation (SP) met the researchers (RAs) at the research office. The Scavenger Hunt protocol was read to both participants (PP and SP) in the lobby of the research building. They were instructed to find each building in the order on the list and to use whatever means necessary to do so. Her colleague (SP) uses her phone to locate the first building and guides the less familiar Iris (PP) to the location. She narrates their surroundings while they walk since she is more familiar with campus. Some discourse is not captured due to the windy weather conditions. They discuss using iPhones and Iris's (PP) personal life. They locate the first building, and her colleague (SP) guides Iris (PP) to the second building. Her colleague (SP) uses her phone to locate the third building, and then leads Iris (PP) to the final building. They return to the research office.

David – Observation 1: At the Student Union (35:24)
1 PP; 0 SP; 4 RAs; 3 IPs

Researchers (RAs) met David (PP) at Union and conducted a brief interview to answer additional questions that were not asked in the interview. Potential places to attend for the observation were discussed. David (PP) and researchers (RAs) take the elevator to the Registered Student Organization (RSO) office but cannot find it. They take a different elevator and end up going to the Leadership Office (IP1) for a brochure. They walk past the Registered Student Organization offices and no one is there. Then, they take an elevator to go to the bowling alley. They interact with a bowling alley clerk (IP2) for

bowling details. They take an elevator to the Tech Store (IP3) and look at HDMI cords. A brief Q&A is completed at the end inside the Union.

David – Observation 2: At the Student Union (79:32)

1 PP; 1 SP; 4 RAs; 3 IPs

Researchers (RAs) met David (PP) and his aide (SP) at the research office to conduct an interview with his aide (SP) about herself, her relationship with David (PP), the hiring process, using lifts, and being an aide. They look at a sheet of potential places to attend for the observation in the Union. His aide (SP) suggests buying a snack at a convenience store in the Union (IP1, IP2) and go to the Tech Store (IP3) to inquire about HDMI cords. They walk back to the research office and discuss the observation as a follow up.

David – Observation 3: Using a lift for transfers (9:48)

1 PP; 1 SP; 3 RAs; 0 IP

Researchers (RAs) met David (PP) and his aide (SP) at David's (PP) residence hall. The observation was focused around gathering procedural discourse using the lift, specifically to use the bathroom. His aide explains she will lift him into the bathroom chair and lift him back out. David gives her directions on using the lift as if it is her first time using it. He instructs her to take off his tray, remove the knee supports, to use the remote, and to put him into the lift with positioning preferences including use of a seat belt and leg supports. His aide moves him into position lowering him onto the toilet to mimic the entire process. His aide reminds David that he forgot to give instructions about the necessary support when on the toilet (e.g., chest strap and bar). David forgot to provide specific instructions on a few other occasions but since his aide was familiar with the lift procedure a breakdown did not occur. His aide uses the lift to lift him off of the toilet. David uses humor throughout the process when appropriate, such as playfully using bathroom humor.

David – Observation 4: Eating dinner in the Dining Hall (38:43)

1 PP; 1 SP; 3 RAs; 3 IPs

David (PP) and his personal aide (SP) met the researchers (RAs) at the resident dining hall. His aide encourages him to act as if he was by himself for third party interactions, although the researchers did not prompt this. David enters the dining hall with his University card for access, and the dining hall employee (IP1) asks if he needs assistance. David asks a nearby worker for a meal assistant (IP2) to help get his food. She has a hard time understanding him but calls someone else. He initiates a humorous conversation with a researcher while waiting. The meal assistant arrives with a supervisor (IP3). The meal assistant gets a tray but does not understand David's speech. The meal assistant looks to a nearby researcher for help saying that it is her first day. David asks the researchers to call his aide back (who had moved away from the interaction). The researchers get his aide, who approaches David acting as if she is an unfamiliar meal assistant. David (PP) selects a meal and his aide makes his sandwich. David converses in the dining hall with the previous researcher. His aide is busy, so the researchers (RAs) assist in positioning David (PP). Everyone leaves the dining hall and settles down to eat at David's regular table. His aide helps feed him. David uses humor throughout the conversation. The supervisor (IP3) returns and apologizes that the worker could not help David. David and his aide look for dessert in dining hall and settle down to eat again. The group exits the dining hall and

returns to the David's (PP) room in the residence hall. A few brief questions are asked as a quick follow-up.

Chip – Observation 1: At the Student Union (53:27)

1 PP; 0 SP; 5 RAs; 3 IPs

Chip (PP) met the researchers (RAs) at the research office and discussed plans for the day's observation. The group goes together to the Student Union. They spend some time determining what elevator is the right one to take to the bowling alley. At the bowling alley, Chip asks the service clerk (IP1) about prices and accommodations. The group then goes to the office of Registered Student Organization (RSO). A stranger in the elevator (IP2) asks the group where they are going, alerting them that there has been a recent change in wheelchair accessibility for certain floors of the Union, and directing them to the appropriate elevator. Chip asks for a brochure at the RSO office (IP3). The group goes back to the research office.

Chip – Observation 2: At the Student Union (65:25)

1 PP; 1 SP; 2 RAs; 3 IPs

Chip (PP) and a friend (SP) met the researchers (RAs) at the research office and conducted a brief interview and plan the day's observation. As the group goes together to the Student Union, Chip unexpectedly meets an acquaintance (IP1) on the quad and they talk for a few minutes. The group then continues to the Tech Store in the Student Union where Chip asks the clerk (IP2) about a few products and the prices. The group then goes into the convenience store where Chip purchases (IP3) a drink. After his roommate (SP) pays for the drink, the group decides to go back to the research office.

Jester – Observation 1: At the Student Union (25:35)

1 PP; 0 SP; 5 RAs; 4 IPs

Jester (PP) met the researchers (RAs) at Union where they first finalized plans the observation were discussed. Jester (PP) first asked stopped two people (IP1 & IP2) to ask for directions to the Tech Store, but they were not sure where it was. Jester (PP) and the researchers (RAs) wander around and find the Tech Store. Jester (PP) talked to the service clerk (IP3) about their tablet computers. Then the group takes the elevator down to the bowling alley. Jester (PP) asks the service clerk (IP4) about prices. The researchers (RAs) ask the final wrap up questions near the elevator in the student union.

Jester – Observation 2: Using a lift for transfers (8:32)

1 PP; 1 SP; 2 RAs; 0 IPs

Researchers (RAs) met Jester (PP) at the student residence hall. The secondary participant (SP) is an aide is a residence hall employee who is available to assist any students with disabilities. Two researchers (RAs) record the process of Jester (PP) explaining the lift procedure to the aide (SP). Jester (PP) had reported minimal communication difficulties in his initial interview but does present with some difficulty with breath support due to his body position in the lift. Jester (PP) forgot to provide specific instructions on two occasions but since the aide (SP) was familiar with the lift procedure a breakdown did not occur.

Jessie – Observation 1: At the Student Union (39:26)

1 PP; 0 SP; 4 RAs; 2 IPs

Jessie (PP) met the researchers (RAs) at the Student Union. A brief interview was conducted near the Art Gallery in the Union and the observation activity was explained. Jessie picked to find a place, which does not exist anymore in the Union. They decide to go to the nearby bowling alley instead due to convenience. He asked for details on bowling and received a brochure. They attempt to go to the Registered Student Organization offices (RSO) but cannot find it. They go back to the Art Gallery hallway to debrief and end the observation.

Jessie – Observation 2: At the Student Union (85:51)

1 PP; 1 SP; 3 RAs; 2 IPs

Jessie (PP) and his secondary participant (SP) met the researchers (RAs) where they planned the day's observation. The first activity was for Jessie (PP) sell back schoolbooks at the temporary station set up on the quad. They the group walked together to the quad where Jessie first sold his books (IP1). The group then walked on the quad toward the Student Union, At the Student Union they visited the Tech Store and Jessie asked store clerk (IP2) about presentation remote control devices. They talk about their personal lives on the walk to SHS.