

Envisioning Collective Communication Access: A Theoretically-Grounded Review of Captioning Literature from 2013-2023

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Abstract

A significant body of human-computer interaction accessibility research explores ways technology can improve communication access. Yet, this research infrequently engages other fields with complementary expertise – namely disability studies, Deaf studies, disability justice, and communication studies. To facilitate interdisciplinary communication access research, we synthesize thinking from these four fields into a framework of collective communication access. We then analyze human-centered accessibility-focused captioning research published between 2013 and 2023, investigating how collective communication access principles are or are not employed. We find that, while the majority of captioning research does not demonstrate a collective communication access approach, it reaches a baseline of targeting change toward inaccessible technical infrastructures and engaging d/Deaf and hard of hearing people as captioning experts. The small body of work that aligns with our framework, however, demonstrates that designing to change discriminatory social conditions and engaging conversation partners in access is a promising direction for future work.

CCS Concepts

• **Human-centered computing** → **Empirical studies in accessibility**.

Keywords

Collective Access, Captioning, Disability Studies, Deaf Studies, Disability Justice, Communication Studies

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1 Introduction

Rapidly changing communication technologies and digitally mediated communication bring both new accessibility barriers and

new opportunities to make communication accessible (e.g., [32, 94]). Human-computer interaction (HCI) researchers have done significant work in this area, with 16% of accessibility research papers between 2010 and 2019 focusing on communication access [95]. Yet, as accessibility research matures as a field and begins to integrate more interdisciplinary critique (e.g., [18, 98, 152]) we identify an opportunity to reflect on how we study communication and what perspectives are or are not included in current practice.

Communication accessibility sits at a unique nexus of related fields—fields that are infrequently used to inform communication technology research. Disability studies provides mechanisms to identify and realign how disability is conceived of and designed for [74, 89, 105, 112]. Deaf studies is deeply engaged in what it means to value and support marginalized communication styles (e.g., [16, 43, 61, 138]). Disability justice activists provide a new vision of how and with whom access ought to be arranged (e.g., [68, 108, 121]). Finally, the communication studies concept of models of communication provides a more capacious sense of what comprises communication (e.g., [14]). In this paper, we combine key concepts from these four fields to create a *framework of collective communication access*.

We then identify how, if at all, a collective communication access approach manifests in one specific body of HCI communication access work: captioning research. Captioning, or representing language or audio in written text, is a technology that has undergone significant change in recent years. Automatic speech recognition (ASR) is newly viable [2], videoconferencing platforms now make automatic captioning omnipresent [3–5], and user-generated videos are increasingly captioned by their creators [29, 34, 134]. Furthermore, captioning is designed for d/Deaf and hard of hearing (DHH) people but, as a tool primed to support spoken communication, is less tightly connected to Deaf culture than signed languages such as American Sign Language (ASL) [84]. Given the rapid evolution of captioning technologies and less-determined connection to political understandings of accessibility, we chose to analyze captioning literature published between 2013 and 2023 to identify how it aligned with or differed from our collective communication access framework.

We were guided by the following research questions:

- (1) How can disability studies, Deaf studies, disability justice, and communication studies thinking inform a theoretical framework of communication accessibility?
- (2) What is the state of last decade of human-centered, accessibility focused captioning research and how, if at all, does it align with that framework?

First, we synthesized thinking from disability studies, Deaf studies, disability justice, and communication studies into a framework



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for *collective communication access*. We then applied our framework to the 73 human-centered accessibility-focused captioning papers published at ACM-, SIGCHI-, and SIGACCESS- sponsored venues between 2013 and 2023. We find that most captioning research published in this time frame does not take a collective communication access approach, though the field has quietly enacted some activist demands. Most published papers demonstrate a focus on improving access by improving technologies, aiming to change neither DHH nor hearing people's current practices, and implicitly situate DHH people as experts on captioning technologies. Yet, the small body of research aligned with collective communication access demonstrates that engaging conversation partners in developing more accessible norms better matches captioning's realistic context of use, enacts a more political understanding of accessibility, and identifies novel directions for technology development.

In this paper we contribute 1) a framework and rubric for collective communication access, 2) critical reflections on the past decade of captioning research, and 3) directions for future collective communication access research.

2 Related Work

While this paper's key contributions come from engaging theoretical work from disability studies, Deaf studies, disability justice, and communication studies to then analyze the past decade of captioning research, we begin by briefly situating our work to other relevant bodies of research.

2.1 Critical Perspectives on Disability in Accessibility Research

We are not the first to translate critical perspectives on disability into the design of technology and draw from foundational work introducing critical disability research to HCI and from research that puts these ideas into practice.

Disability studies was first introduced into the space of HCI accessibility research by Mankoff et al. in 2010 [98]. Their paper introduces key disability studies concepts then applies them to assistive technology case studies, illustrating the potential for disability studies to transform current practice. Nearly a decade later, Bennett et al. [18] introduced interdependence to HCI, citing primarily disability activist sources to introduce and expand interdependence as an approach and mode of analysis.

In recent years, accessibility research has seen a significant turn toward disability studies and activist-informed work. For example, critical disability analysis has driven studies of how mixed-ability teams collaborate remotely [94], how blind and sighted teams co-write [37], and novel approaches to data visualization [64]. Critical perspectives on disability have also been central to calls for greater consideration of race in accessibility research [58], identifying ways to make methods more accessible [96], and frameworks for reckoning with and preventing ableist harm in research [152]. Autoethnographies by disabled researchers [62, 97] have also used disability studies and community perspectives to guide and contextualize their findings. Beyond the rise in published work that engages critical perspectives on disability, it has also been a central part of workshop conversations (e.g., [103, 136, 140]). We engage in this tradition of exploring new directions for technology design

by beginning with critical disability perspectives, expanding our grounding to combine multiple fields not often put in conversation with each other.

2.2 Literature Reviews in HCI Accessibility

One of the key contributions of this paper is a structured literature review of the last decade of captioning research, a method that is increasingly popular within HCI accessibility research.

Structured reviews of HCI accessibility literature can either take a broad focus on the field or track a specific disability group or kind of technology. Mack et al. [95] published the first comprehensive review of accessibility research, identifying that the field is growing rapidly and unevenly. For instance, 43.5% of papers from 2010 to 2019 focused on blind and low vision people and all other groups were significantly less studied. Other reviews have aimed to understand how specific populations have been studied within accessibility research, including children with 'special needs', [17], blind and low vision people [27], autistic people [92, 119, 135], older adults [146], and people with ADHD [137]. Notably, prior systematic reviews have not focused specifically on technologies designed primarily for DHH people, the focus of our paper.

Structured reviews tend to have two goals: to summarize and/or critically reflect upon a trend within the field. For example, Brule et al. [27] focus on the kinds of technologies studied and research methods employed with people with visual impairments, aiming to identify best practices for quantitative, empirical evaluations with this group. Vines et al. [146], on the other hand, perform a discourse analysis on literature around ageing, identifying the often-stereotypical discourses around older adults and age that are embedded in HCI research and drawing on critical gerontology to set directives for future work. We opt to use this method in a manner similar to Vines et al. [146], reading the last decade of captioning research through a lens of critical perspectives on disability and communication.

3 Theoretical Roots of Collective Communication Access

In this section, we engage key sources of critical thinking around communication and accessibility: disability studies, Deaf studies, disability justice, and communication studies. We chose to engage these bodies of work because they provide foundational theorizing about disability and access (disability studies), specific insight into communication-focused access needs (Deaf studies), cutting edge thinking on access and community (disability justice), and a framework for understanding communication (communication studies). From this scholarship, we produce a framework—collective communication access—to guide the design of communication technologies aligned with critical Deaf and disabled perspectives on communication and access.

3.1 Disability Studies

Disability studies is the academic field interested in understanding disability as a social phenomenon. While disability studies often researches and draws from disability activist movements, we discuss disability justice theorizing in subsection 3.3.

3.1.1 Foundational Concepts. Disability studies provides several mechanisms for understanding and countering discrimination against disabled people. Lewis defines 'ableism', a "a system of assigning value to people's bodies and minds based on societally constructed ideas of normalcy, productivity, desirability, intelligence, excellence, and fitness"[89]. Ableism emphasizes that discrimination on basis of ability is systematic and pervasive [6]. Another key analytical framework is Oliver's models of disability [111, 112]. The *medical model* describes the view that disability is a problem in individual bodies that ought to be fixed if possible, hidden otherwise, and eventually eliminated. Disability studies scholars propose the *social model* as a way of envisioning a better future [19]. Under the social model, disability is not a product of faulty bodies but is a social arrangement that fails to anticipate the natural diversity of human ability. Therefore, disability could be solved for by changing policy, attitudes, and infrastructure to build an accessible world. Recently, scholars have critiqued the idea that disability would disappear in a fully accessible society [51], proposing new models that maintain a focus on political causes of ableism but have a more embodied understanding of disability (e.g., [74]). Disability studies has also expanded its understanding of the kinds of access needs people have, moving beyond a narrow focus on physical and sensory access infrastructure [120] and developing theories such as *crip time*—the idea that disability often manifests in a different pace of life [74, 125]—and integrating perspectives from groups with access needs not well-met by current practices (e.g., psychiatric survivors [69], neurodivergent communities [133], chronically ill people [151]).

3.1.2 Disability Studies and Technology. Disability studies scholars argue that we must challenge the exploitation and eugenics that define historical disability technology. Medical model ideologies are often embedded in technologies, ranging from the explicitly eugenic drive to eliminate disability via gene editing and selective abortion [126] to the more subtle belief that disability is a shameful, private thing, which is translated into the design of 'discreet' assistive technologies [147]. Mills argues that there is a long history of technology development under an "*assistive pretext*", wherein technologies (e.g., sound recording and visualization technologies) are developed with the stated purpose of improving access for a given group (e.g., DHH people), but that once developers identify a more lucrative general purpose for a tool, the disability application is abandoned [105]. Additionally, Hamraie highlights that while accessibility efforts have historically been central to universal and inclusive design movements, too often projects that claim to serve *all* users simply better obscure the many people they exclude [55, 56].

Yet, activists have also identified ways that technology can advance disabled people's lives. The disability rights movement often saw creating accessible technologies as a key strategy for expanding rights [120]. Hamraie and Fritsch [57] propose 'crip technoscience', a framework for designing, implementing, and critiquing disability technologies that is aligned with disability justice principles. Crip technoscience elevates the design work disabled people do to survive in an inaccessible world and calls for an accessibility practice that sees design as a way to enact a political vision and uses technology to disrupt the status quo.

From this review of disability studies thought, we identify the following imperatives that can guide the design of accessible communication technologies:

- (1) Interventions should work to change built environments and social worlds to encompass the current practices of disabled people, rather than supporting disabled people in assimilating to nondisabled habits
- (2) Accessible technologies ought to embody an actively anti-ableist politic, as doing otherwise risks reifying existing systems of oppression

3.2 Deaf Studies

Deaf studies is the academic field that studies and theorizes about Deaf people's lives and is highly intertwined with Deaf history, culture and signed languages [84]. Deaf studies research tracks how the Deaf community has come to proudly claim a cultural identity in the face of audism, or systemic discrimination on basis of hearing ability [15].

3.2.1 Foundational Concepts. Deaf studies scholars focus on access to language and the harms of language deprivation. Contemporary audism has its roots in the oralist movement of the late 19th and early 20th century, which saw international opposition to teaching Deaf people signed languages [109], causing irreparable damage to sign language use and acquisition [123]. Sign languages were not recognized as full languages until the 1960s [138], and the fight to educate DHH people using signed languages is ongoing [139]. In the face of this history, Henner and Robinson propose *crip linguistics* [61], emphasizing that no way of communicating is disordered or wrong. Crip linguistics argues that all forms of communication ought to be respected because efforts to normalize language are steeped in ableism, audism, racism, and many other forms of prejudice.

Responding to centuries of discrimination, Deaf communities have built a strong culture of self-determination and valuing Deafness. A key example of the move to replace hearing paternalism with Deaf self-determination is the 1988 *Deaf President Now* movement. Gallaudet students protested until the Deaf-serving university hired its first Deaf president, setting precedent for decades of Deaf leadership on issues that impact the Deaf community [42]. Many people identify as culturally Deaf, seeing membership in the Deaf community as akin to a linguistic minority, rather than a disability [87, 139]. Scholars increasingly question the impulse to separate Deafness from disability, noting its ableist and eugenic roots [123], and movements such as disability justice have taken a nuanced approach to building coalition with Deaf communities [68, 124]. Deaf studies scholars counter deficit approaches to Deafness via theoretical frameworks [16, 85, 87]. For example, Bauman and Murray's concept of Deaf gain [16], highlights the skills and community that Deaf people gain, countering narratives of hearing *loss*.

3.2.2 Deaf Studies and Technology. Deaf studies and Deaf culture have a contested relationship with technology developments 'for' the Deaf community. Technology was a core component of the oralist movement, and the modern inconspicuous, unobtrusive design of assistive listening devices stems from a belief that Deafness is undesirable and that emulating the behavior of a hearing person

is ideal [147]. Cochlear implants, surgically implanted devices that promise better performance than hearing aids, have been highly controversial within the Deaf community, particularly as they are now approved to be implanted in young children who do not have the agency to consent to the procedure [33]. In contrast, Deaf-led design practices affirm Deaf ways of being in the world. For example, the architectural approach termed 'DeafSpace', pioneered at Gallaudet University, has guided the principled redesign of campus spaces to support signed communication (e.g., prioritizing clear sight lines, choosing high contrast, low eye-strain paint colors, optimizing for natural light) [43].

A Deaf studies informed approach to communication accessibility requires understanding:

- (1) It is unethical to attempt to correct communication to a hearing and spoken norm
- (2) Deaf communities ought to be centered as leaders in technology design, as they are already experienced in designing Deaf worlds and there is a long history of destruction by hearing technologies

3.3 Disability Justice

Disability justice is an activist movement led by disabled people who are queer, trans, Black, indigenous, and/or people of color, building from and critiquing the disability rights movement of the 20th century. Rather than centering legal frameworks and emphasizing the needs of white, physically disabled men, disability justice focuses on intersectional cultural change, believing that the state will, ultimately, not save disabled people [68]. In organizing for a new world, disability justice activists, often working through the performance collective Sins Invalid¹, have done significant theoretical work in naming current practices within disability communities and imagining a new paradigm for disabled futures.

3.3.1 Principles of Disability Justice. Of the ten key principles of disability justice [67], two are particularly relevant to the design of accessible communication technologies: interdependence and collective access.

Theorists of interdependence emphasize that all people are dependent upon each other and that viewing dependence as characteristic of disability is a tactic of ableism [108]. Mingus argues that valuing and designing for mutual reliance is key to "*practic[ing] an accessibility that moves us closer to justice, not just inclusion or diversity*" [108]. Within HCI, Bennett et al. [18] emphasize that interdependent design challenges the idea that nondisabled people's approaches are necessarily better and ought to be the default. Valuing interdependence can redirect the focus of design from independent solutions toward technologies people use together.

Collective access provides a framework for putting interdependence into practice. Sins Invalid defines what it means to take a collective access approach: "*access needs can be articulated and met privately, through a collective, or in community, depending upon an individual's needs, desires, and the capacity of the group*" [68]. In essence, while access needs are sometimes best met privately,

groups should also seek ways to build access into their core practices. Disability justice organizers highlight how organizing collective access allows for a pragmatic balancing of access capacity and makes the experience of needing to negotiate accessibility feel communal, rather than isolating [106, 121]. The invitation to think about access as something that groups have a shared stake in—rather than something that is provided for an individual—produces new imagined users of accessible technologies.

3.3.2 Nuanced Understandings of Access. Disability justice thinking also dwells in the nuances inherent to the process of creating access in a group. Mingus coined the term 'access intimacy', described as "*that elusive, hard to describe feeling when someone else 'gets' your access needs*". Mingus reflects that she, and the broader disability community have "*experienced access that has left us feeling like a burden, violated, or just plain shitty*", but that there is an alternative—a way of negotiating access that feels freeing—that requires trust and mutual understanding to experience [107]. Piepzna Samarasinha reminds that the impulse to point to interdependence, access intimacy, or other forms of care as a panacea to address all forms of ableism, while understandable, is a naive view [86, 121]. It takes skill and a deliberate unlearning of ingrained social norms to make interdependent, collective access a viable approach—that nuance must also inform the design of future technologies.

While disability justice goals can never fully be achieved in the hegemonic space of the academy, the following imperatives can guide more just technology research:

- (1) Access is something that happens between people, and access solutions can be collective and interdependent
- (2) Collective access approaches rely on a deep attention to a group's specific context and broader power dynamics and cannot be understood or produced in a vacuum

3.4 Communication Studies

Finally, though not focused specifically on accessibility, we draw on a foundational concept from communication studies—models of communication—to add nuance to how we discuss communication.

3.4.1 Models of Communication. Interpersonal communications scholars have created theoretical models of communication to understand and analyze instances of conversation. The initial model of communication, the linear model of communication, focused on the actions of a sender, communicating a message to a receiver. While the linear model conceptualizes asynchronous communication (e.g., email) well, scholars quickly realized that it was deeply inadequate for understanding synchronous communication [153]. After several intermediate iterations, Barnlund proposed the *transactional model of communication*. Barnlund begins with the premise that people cocreate meaning through communication and that communication is dynamic, continuous, circular, unrepeatable, and complex [14]. Central to the transactional model is the notion that interpersonal communication is not simply a process of trading information, but a complex, situated act that is fundamentally shaped by the interlocutors' social, relational, and cultural contexts [73]. Therefore, to study how people are communicating, it is inadequate to study only one party or assume that communication approaches are independent of communication partner—communication is highly

¹<https://www.sinsinvalid.org/>

contextual and all parties co-create meaning together. Bringing the transactional model of communication to the design of communication technologies, we see that conversational partners are a key stakeholder in determining the kind of communication that accessible technologies help mediate. Further, communicators' instinctual attunement to their interlocutors could be leveraged to improve communication access.

The foundations of communication studies remind that:

- (1) The context communication occurs within and relationships between interlocutors fundamentally shape how people communicate
- (2) We should study and build access technologies that engage all communication participants

3.5 Collective Communication Access: A Theoretical Framework

Combined, these bodies of theory provide a comprehensive way of thinking about communication and access that can reshape how researchers approach technology design, which we articulate as a **framework for collective communication access**. We present this framework as both a practical set of considerations and a call to action, inviting future researchers to ground their communication access technology research in critical perspectives on disability and communication. This framework is oriented toward technology and intended to be useful in analyzing and guiding human-centered accessibility research, but draws entirely from other fields. The imperatives we derive from disability studies, Deaf studies, disability justice, and communication studies have significant overlap, and therefore we synthesize these imperatives into five key tenets of collective communication access, as follows:

- (1) **Research approaches access as a collective process, where all communicators engage in crafting access.** We combine both imperatives from disability justice and both imperatives from communication studies to highlight that communication is definitionally collective and, therefore, collective access approaches are particularly well-suited to communication access. When we design access technologies *only* for DHH communicators, we make the task of providing communication access harder than it needs to be by not considering key stakeholders – conversation partners.
- (2) **Interventions prioritize and protect Deaf and disabled people's norms, targeting change toward dominant social worlds and technical infrastructures.** Synthesizing imperative one from disability studies and both imperatives from Deaf studies, we highlight that the goal of interventionist research into communication access ought to be to change social norms and technical infrastructures to prioritize Deaf and disabled people's existing communication styles, given the history of technical interventions that aim to redirect Deaf and disabled people toward nondisabled norms.
- (3) **Research sets out to counteract historical harms.** We combine our second imperatives from disability studies, Deaf studies, and disability justice—all emphasize that systemic discrimination impacts Deaf and disabled people's ability to access conversations, and that conversations about accessibility are deeply political. To conduct collective communication

access technology research and not perpetuate the history of technology's harm toward Deaf and disabled communities, research should be *explicitly* oriented toward dismantling harm.

- (4) **Research active centers the knowledge and expertise of impacted communities.** Imperative one from disability studies, imperative one from Deaf studies, and both imperatives from disability justice stress that the expertise of communities who face communication access barriers must be centered. While this may seem counterintuitive to a focus on collective access, we stress that an anchoring in Deaf and disabled people's expertise is crucial to ensuring that technologies support access practices that are substantive rather than performative.
- (5) **Research considers the role of relational, social, and environmental context in shaping access practices.** We combine imperative one from disability studies, both imperatives from disability justice, and both imperatives from communication studies to highlight the role that context plays in determining how accessible communication can be. Researchers need to study communication as situated and determined by its relational, social, and environmental context.

4 Methods

Through our theoretical synthesis we developed five tenets of a collective communication access approach. To assess how these tenets appear in HCI communication accessibility research, we developed a rubric with to apply to research papers. We used this rubric to analyze one specific body of communication accessibility technology research: captioning research. We identified a dataset of all captioning research published between 2013 and 2023 that took a human-centered, accessibility lens on the captioning of audio into text. We then used our theoretical rubric to code all 73 papers in this dataset. We do not report quantitatively on scores generated by our rubric, but rather used it to structure a qualitative analysis of captioning literature.

4.1 Identifying Relevant HCI Captioning Papers

To systematically assess the current HCI accessibility approach to communication and how it aligns or diverges from a collective communication access approach, we defined a dataset of relevant recent research. We scoped our analysis to a specific communication technology frequently studied by HCI researchers: captioning. We chose to focus on captioning because it is a common form of communication access that is necessarily technologically mediated and has been studied extensively within HCI literature and in myriad contexts, including synchronous communication. We reviewed recent research, scoping to the most recent decade of published research, a practice that has been used in other reviews of accessibility literature to study recent trends in depth [95].

While captioning has many forms, we opted for a permissive definition that still maintained focus on using captions as an assistive tool. There are several terms, often used interchangeably, to refer to the practice of representing audio in text, notably: "captions", "open captions", "closed captions", and "subtitles". By studying captions

generally, we include both open (i.e., captions burned into a video) and closed (i.e., captions displayed in an overlay that can be toggled on and off) captions [38]. While subtitles are often seen as synonymous to captions, they are relevantly different. Within a North American context, captions are intended to serve DHH audiences who cannot access underlying audio, and therefore contain speech transcription and audio information (e.g., ‘music’, ‘wind blowing’, [softly]). Subtitles, in contrast, are intended to provide linguistic access to those who are not fluent in English and provide only speech transcription [148]. We therefore did not include subtitles within the scope of our study. Captions can also serve different roles: access to synchronous conversation or to rerecorded media. While these contexts of use are different, there are many shared considerations. For instance, research on how to best style and place captions for real-time videoconferencing can draw heavily from research into television captions, and vice versa. Further, while it may be less obvious how collective communication access would apply to research into prerecorded media, prior work finds that choices made by people generating captions for prerecorded media can impact caption utility [90, 93, 134]. Therefore, we included captioning research for both synchronous conversation and prerecorded media in our literature review, noting differences and similarities between the two contexts when relevant.

We first searched the Association of Computing Machinery’s Digital Library² for all entries in the ACM Full-Text Collection that contain the stem “caption”³ in the title, abstract, or keywords published between 2013 and 2023. Note that, while this spans 11 years, we refer to it as the past decade of captioning research. Our initial query returned 765 results, many of which focused on developing a text summary of video content (known in computer vision as a caption), or on image captioning techniques to facilitate access to images for blind and low vision people. Therefore, the first author manually reviewed all initial results, deeming them relevant, irrelevant, or questionable. *Relevant papers* were defined as original research that 1) study captioning in the context of representing audio in text, 2) study captions as an accessibility tool, and take a 3) human-centered approach. We defined a human-centered approach to captioning research as one that studied caption use or user-facing design, and excluded papers that solely focused on generating captions (including both algorithmic and crowd-computation methods). We also scoped our literature review to publications written in English, as it is the only language all authors read fluently. Publications that did not present original, peer-reviewed research were also excluded, including workshop abstracts, doctoral consortia, newsletter or magazine articles, and student design competition entries. We included conference papers, posters, extended abstracts, journal papers, and other reviewed formats.

After a first pass, we discussed and further narrowed down the dataset. Throughout this process, we applied a high threshold to deeming a paper irrelevant and a relatively low threshold to deeming papers relevant, as they would be re-reviewed during coding. Initially, the first author identified 122 papers as relevant, 31 papers questionable, 26 of an excluded format and 586 papers irrelevant.

We lightly discussed the initial relevant and questionable set, updating inclusion and exclusion criteria to be more specific about what constituted ‘human-centered’ and filtering for papers whose full text was written in a language other than English. After the second pass over relevant and questionable papers, the first author identified 97 relevant, 14 questionable, and 42 irrelevant papers. We then met to discuss the remaining 14 questionable papers, settling on a dataset of 101 relevant captioning papers. We then reviewed the venues these papers came from, including only papers that were published at ACM⁴, SIGCHI⁵, or SIGACCESS⁶ sponsored conferences. This resulted in a candidate dataset of 93 publications, which we further narrowed in the process of applying the theoretical framework to a final dataset of 73 papers (see subsection 4.2 for a full description of this process).

4.2 Applying the Theoretical Framework

To analyze relevant captioning papers, we developed our framework for collective communication access (see section 3) into a rubric. Inspired by Williams et al.’s [152] rubrics for counterinterventional criteria, we translated our theoretical framework into a tool for our own analysis and to enable others to more easily take up a collective communication access approach in the future. In this rubric we identified what it would mean to strongly meet, strongly fail, or land in the middle for each tenet of collective communication access. When appropriate, we also identified what would make a criteria non-applicable (e.g., criteria A is not applicable to research that does not study interactive communication). Taken together, these constitute a rubric for collective communication access, shown in Table 1.

The first author coded 15 papers using a rubric draft and then the second author reviewed a random subset of five of those papers. Authors met and discussed differences to further refine and finalize the rubric, at which point the first author analyzed the rest of the dataset by coding each paper using the final rubric. While this coding step may resemble more quantitative coding methods common to literature reviews (e.g., [95, 137]), we conceptualized it as similar to a deductive codebook used in qualitative analyses of interview data. Acknowledging the subjectivity and nuance inherent in our rubric, we do not use this coding process to produce data we can summarize quantitatively (i.e., reporting the distribution of scores for each rubric criteria). Instead, we used this coding pass as a data familiarization and sorting process, to enable our qualitative analysis of how the last decade of captioning literature does or does not engage criteria of collective communication access. After coding, the first author then went through the dataset, integrating each paper into the findings guided by its scores on our rubric (e.g., a paper that strongly met the “considering context” criteria was discussed in that section).

During this analysis, the first author identified more papers that did not meet the inclusion criteria for our dataset. Of the 93 papers included in this coding step, the first author identified 20 more *irrelevant* papers, which the second author reviewed before the

²<https://dl.acm.org>

³this ensured that the search would return results that contain “caption”, “closed caption”, “captioning”, “captioned”, “captioner”, etc.

⁴<https://dl.acm.org/conferences>, <https://dl.acm.org/jouranls>

⁵<https://sigchi.org/conferences/>

⁶<https://www.sigaccess.org/assets/related-conferences/>

Criteria	Fails to Meet	Neither strongly meets nor fails to meet	Strongly Meets	Not applicable
A. Approach to Collective Access	Research treats the Deaf/disabled person as the only party that needs to consider communication access	Research recognizes the impact of nondisabled communication partners on communication access, but does not engage or design for them	Research engages all communicators, Deaf/disabled and nondisabled alike, as having an impact on communication access	Research does not study interactive communication (e.g., perspectives on algorithmic confidence measures)
B. Target of Change	Intervention places the burden of change on Deaf/disabled people to change towards nondisabled norms	Intervention tries to support access into unchanged social worlds by putting the burden of change on technologies	Intervention puts the burden of change on nondisabled people to adapt to Deaf/disabled people’s current practices	The paper does not describe an intervention (e.g. foundational empirical research)
C. Historical Harms	Research is actively engaged in perpetuating historical harms (e.g., has explicitly oralist, eugenicist aims)	Research does not perpetuate historical harms, but does not actively challenge or reckon with them	Research sets out to challenge historical harms	
D. Whose Knowledge and Expertise	Proxies or researcher expertise stand in for the perspective of the impacted community	Paper includes perspectives from impacted communities, but does not frame this as a way to center marginalized expertise	Paper uses participatory/member researcher methods to center and empower the impacted community	Not user research
E. Considering Context	Research does not account for the role context plays on communication in either study design or results	Research considers the role of context, but does not account for it in either study design or results	Research centers the role context plays in communication access, in both study design and results	Research does not study interactive communication (e.g., perspectives on algorithmic confidence measures)

Table 1: Rubric for Collective Communication Access

papers were excluded from final analysis. Ultimately, 73 papers constitute the final dataset and informed the paper’s findings.

4.3 Coding for Trends in the Dataset

We also conducted a secondary analysis to systematically identify high-level themes in research scoping and design decisions. The first author coded for an initial set of trends, and then the second author coded a random subset of ten papers using that codebook. At that point, authors had 80% raw agreement and discussed and arrived at consensus over the 20% of codes they applied differently. This drove the refactoring of some codes, which the first author then reapplied to the entire dataset. The second author then coded another random subset of 10 papers. After the second pass, authors achieved an average Krippendorff’s Alpha inter-rater reliability score of 0.88 (range .45-1), indicating satisfactory agreement [99]. Our

lowest agreement came in identifying participant groups engaged in research.

Final codes for trends fell into two categories: binary and categorical. For some trends, we developed binary codes to capture whether or not papers contained a user study, if they had an explicitly educational focus, and if they studied head-mounted displays (HMDs), videoconferencing, or television captioning. Other data was better-captured by categorical codes, selecting all options that applied for participant type, caption source and communication style. For participant type, we tracked if papers’ participants were DHH, hearing experts, hearing generally, or other. We coded for the following caption sources: CART, C-Print, automatic speech recognition (ASR), crowd sourced captions, pre-generated captions, unspecified source, and other. Finally, we tracked if papers studied the following communication styles: live interactive conversations, live lectures, prerecorded media, unspecified style, and other. We

calculated basic summary statistics for this data, reported in subsection 5.1.

4.4 Positionality

This work is profoundly shaped by authors' positionality and research experience. As a hearing disabled person, the first author has been working in the space of collective communication access for over five years, motivated to explore how technology can support an empowered party in an interaction to see access as something they too are responsible for. In working with d/Deaf and hard of hearing communities as a hearing person, they have been learning ASL, advocating for communication access across personal and professional contexts, and anchoring their work in Deaf critique. They have received graduate education in both HCI and disability studies. The second author, also a hearing person, has conducted and advised research into communication accessibility technologies for approximately a decade.

5 Findings

In this section we analyze the body of captioning research defined in section 4 through the lens of our theoretical rubric. We begin by summarizing the dataset, providing a high-level overview of the last decade of captioning research. Then in subsection 5.2 we combined findings around papers' **collective access approach** and **targets of change** to highlight how captioning researchers conceptualize and aim to increase communication access. Next, in subsection 5.3 we identify the extent to which captioning research situates its goals and findings in the context of historical harms and exclusions, combining analysis around how papers engage **historical harms** and **whose knowledge and expertise** is centered. Finally, in subsection 5.4 we identify how papers do or do not engage **broader relational, social and environmental context** in captioning research.

5.1 Summary Of Dataset

The decade of captioning research we analyzed (2013-2023) spanned varied venues, research foci, and types of captioning studied.

Overall, there was a consistent increase in number of papers published on captioning over time, ranging from three papers published in 2013 to 12 in 2023 (see Figure 1), aligned with the overall growth of accessibility publishing over this time period [31, 95, 117]. Papers in our dataset came from 16 different ACM, SIGCHI, and SIGACCESS sponsored conferences. Three venues dominated the dataset, with 34.2% (25/73) of papers published at ASSETS⁷, 23.3% (17/73) of papers published at CHI⁸, and 15.1% (11/73) of papers published at W4A⁹. The remaining 27.4% (20/74) of papers were published across 13 other venues¹⁰.

Most research in our dataset engaged participants, with 84.9% (62/73) of papers containing a user study. Of the papers that conducted user studies, 85.5% (53/62) involved DHH participants, 24.1%

Captioning Papers Published Per Year

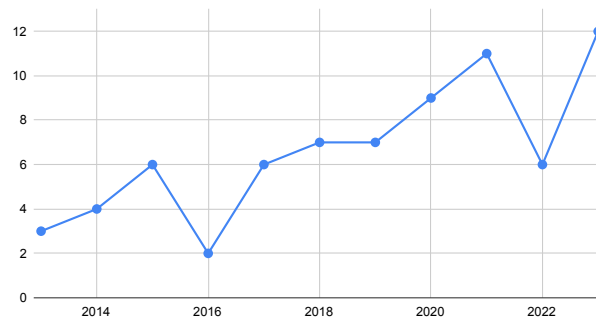


Figure 1: The number of captioning papers published per year steadily increased, going from 3 papers in 2013 to 12 in 2023

(15/62) engaged hearing people generally, 4.8% (3/62) recruited hearing experts, and 4.8% (3/62) recruited frequent subtitle users, independent of hearing status. Outliers included studying caption use by people with ADHD [134], recruiting people who speak English as a second language [65], and not reporting on specific demographics of the group engaged in the user study [13, 25, 52, 63, 66, 116]. Note that only one paper explicitly identified captioning as an access tool for people who are not DHH [134]. Throughout our findings we discuss how captioning research regards DHH people, because that is the focus of the last decade of research, but it is important to note that DHH people are not the only people who use captioning as an access tool.

Research studied a range of captioning styles and contexts. 35.6% (26/73) of papers studied caption users' experiences with captioned videos, often not specifying how those videos came to be captioned. 54.8% (40/73) of papers studied ways of providing real-time captioning: 41.6% (30/73) used automatic speech recognition (ASR), 13.7% (10/73) used CART¹¹, and 6.8% (5/73) used crowd-sourced captions. Some papers did not specify caption source or employed multiple caption sources. Researchers also studied a range of communication contexts, researching caption use during live, interactive conversation (42.5%, 31/73), live lectures (10.9%, 8/73), while viewing prerecorded media (42.5%, 31/73), and while watching live television (5.5%, 4/73). There was, sometimes, a difference between the intended type of communication studied and research instruments – 17.8% (13/73) of papers aimed to study live forms of communication but showed participants prerecorded videos. There were also specific communication environments that received notable attention by researchers who tailored their captioning interventions to these contexts: educational captioning (19.1%, 14/73), head mounted displays for captioning (15.1%, 11/73), television captioning (13.7%, 10/73), and use of captions while videoconferencing (8.2%, 6/73).

⁷<https://dl.acm.org/conference/assets>

⁸<https://dl.acm.org/conference/chi>

⁹<https://dl.acm.org/conference/w4a>

¹⁰See Supplementary Materials for a full list of papers and venues

¹¹CART, or Communication Access Real-time Transcription refers captions provided by expert human transcriptionists, using specialty equipment and software to transcribe in near real-time [1]

5.2 How Captioning Research Aims to Make Communication Accessible

We identify two key approaches for improving communication access used throughout the last decade of captioning research. Most commonly, researchers aim to improve communication access by iterating on and improving the design of captions and caption form factors, without disrupting the social status quo. Yet, there is a smaller body of research that aims to alter the behavior of nondisabled communication partners, finding that a captioning tool's efficacy depends on the social context it is used within. We draw on our framework's sections on a paper's **approach to collective access** (Criteria A) and research's **target of change** (Criteria B) to analyze how our dataset envisions communication can be made accessible.

5.2.1 Improving Technology To Improve Access. The majority of captioning research we analyzed focused solely on improving captioning tools themselves to attain the larger goal of extending access. It is, of course, necessary and important to iterate on captioning technologies, but we identify limitations to approaches that only try to change technologies, not inaccessible communication norms.

One of the key targets for improvement is captioning interfaces—researchers aim to make them more readable or include more information. A significant body of research is dedicated to exploring what makes captions more readable and intelligible (e.g., [7, 20, 25, 26, 35, 49, 52, 53, 66, 75, 77, 82, 88, 115, 116, 149, 155]). These interventions aim to lower the cognitive load needed to use captions through approaches such as highlighting [77], formatting [53], and caption placement [25]. For example, Kushalnagar et al. developed a tool to allow Deaf, low vision students to better access lecture recordings while splitting their attention between magnified visuals and captions [83]. Other techniques include visualizing non-speech information dynamically alongside transcription (e.g., [7, 39, 60, 79, 101]), formatting captions to better identify speakers (e.g., [12, 25]), and making captioning tools customizable (e.g., [66, 104]).

Research on the most popular novel interface for captioning over the last decade, head-mounted displays (HMDs), often aimed to sidestep social factors that impact communication accessibility by introducing a new form factor. Research on HMDs aims to make captioning-mediated social interactions more naturalistic, citing two primary motivations: the difficulty of gaze management on the go (e.g., [70, 100, 114]) and a desire for more socially acceptable, discreet solutions (e.g., [24, 47, 54, 70, 72, 114]). HMD form factors tend to place all of the burden of change on DHH people, the only ones who don a new technology to communicate, one that is frequently reported to be burdensome (e.g., [47, 70, 100]). HMD captioning ultimately makes it easier for DHH people to meet hearing norms for spoken conversation rather than adapting communication settings to be more ideal for caption use. As new technologies become viable and promise a better form factor for viewing real-time captions, researchers should also consider who must do more of the work of access in this envisioned future.

The tendency of captioning research to focus on technology over social context can also be seen in the tendency to study and develop new tools only with and for caption users. Many tools designed for

interactive communication are neither studied nor evaluated in interactive contexts. For example, Berke et al. [20, 21] aimed to study how different algorithmic confidence visualizations could impact DHH people's experiences of one-on-one automatically captioned conversations. Rather than observing an interactive conversation between a DHH participant and a hearing person, they asked participants to view prerecorded videos and imagine they are part of a live conversation. This is a relatively common approach to studying new captioning technologies but abstracts away conversation partners' agency and capacity to mutually determine an accessible communication style.

5.2.2 Changing Social Norms to Improve Access. Though less common, we did observe another approach to increasing communication accessibility: engaging caption providers, third-party supports, and direct interlocutors. These approaches more closely align with our collective communication access framework.

When studying caption-generation ecosystems, research often translates insights from DHH caption users into guidance for professional or amateur caption creators. For example, Alonzo et al. [7] proposed novel sound visualizations and, after determining DHH captioning users' needs and preferences, tested their system with its intended users: hearing video creators. Other work provides guidance to professional caption providers, such as how to place captions during live television broadcasts (e.g., [9–12]) and how networks could design their caption systems for online sharing of broadcast content (e.g., [25, 35, 36, 52, 66]). Several papers studying user-generated video content provided guidance for both platforms and creators [23, 90, 93, 134]. For instance, Mack et al. [93] found that social platforms could "*gracefully teach*" Deaf norms to hearing users, relieving some of the burden of explaining communication etiquette. Other work begins with the assumption that online videos will not be well-captioned, and seeks to identify what should be prioritized to be captioned by outside providers [23, 132]. While there is truth to the notion that not all videos will be well-captioned, whether or not researchers see content creators as key participants in making communication accessible shapes the future possibilities they imagine.

Some research considered third-party stakeholders such as captioners, instructors, and university disability services in the design of captioning technologies. Particularly when researching captions in the classroom, lecturers and university access service providers are often implicitly situated as stakeholders and users of captioning technologies, though their perspectives are rarely represented in findings (e.g., [28, 77, 80]). However, when Kawas et al. [78] studied DHH students' experiences of captioning, they also engaged disability services professionals, captioners, and professors, finding that instructors need more support to best teach students using captions. There is an interesting tension at play – ultimately these captioning tools only succeed if they provide students access. Yet, by not engaging other parties, researchers miss the opportunity to explore how more accessible communication styles (e.g., lecturers' teaching styles) could coordinate with and be supported by technical systems to improve access.

While the last decade of captioning research infrequently engaged with direct conversation partners, the research that did so finds they have significant impact on conversation access. Seita et

al. focused on understanding hearing people's behavior changes while captioned [128] and DHH people's priorities for ideally accessible behaviors [129, 130]. They motivate this work in a vision of collective access: *"technology could more equitably distribute [conversational feedback] responsibility among all parties in conversation"* [129]. Other work has identified how DHH people's experiences of captioned conversations generally, [91, 102, 154], speechreading while using captions [40], and using HMDs [71] can be improved or made more difficult by their hearing conversation partners. While codesigning for mixed-hearing-ability groups, both McDonnell et al. [104] and Seita et al. [131] found that, even when communication access services are available, communication accessibility depends on all parties, DHH and hearing alike, adapting their norms and collaboratively developing a bespoke, situated communication style.

5.3 Reckoning with Historical Harms and Centering Community Perspectives

Disability studies, Deaf studies and disability justice all stress that the current state of discrimination that Deaf and disabled people face is a direct result of political, social, and cultural choices. Therefore, working to make the world more accessible ought to mean taking a political stance to counter ableist, audist, and eugenic forces. However, captioning research infrequently names or aims to counter the historical harms and biases that make communication access an ongoing concern. Yet, the current body of captioning research largely avoids significant harm. While not frequently linking to broader discourses on accessibility or disability activism, research does increase communication access. Furthermore, for decades, engaging disabled people in decision making about disability issues has been one of the key demands of disability activism [68, 120]. Human-centered accessibility focused captioning research overwhelmingly centers DHH people as experts on captioning technology, but does not link this practice to its activist history. The small body of politically-engaged captioning research, however, more powerfully names and addresses specific harms and does epistemic work to empower DHH technology users and researchers. In this section we synthesize our coding around **historical harms** (Criteria C) and **whose knowledge and expertise** (Criteria D) is considered in captioning research.

5.3.1 Ungrounded Captioning Research. Often, captioning research does not explicitly reckon with the historical discrimination and disenfranchisement that makes communication access a pressing issue for DHH people. Traditionally, activists and theorists emphasize the importance of developing a critical consciousness that can precisely address the root causes of historical harms [46]. While often not articulating a critical consciousness, the current body of captioning research does not reproduce the extreme harms discussed in section 3, suggesting that there is an unnamed politics undergirding the current practice of human-centered accessibility research. Here, we highlight that how researchers frame their broader mandate and engage with DHH communities is impacted by a lack of consideration of historical harm and bias.

Often, captioning research does not discuss the harms of inaccessibility and role of technology in increasing access. Papers

instead introduce captioning as a tool DHH people use and immediately dive into the problems with current caption provision that their work addresses (e.g., [59, 76, 79, 149]). The frequent lack of grounding in an accessibility or justice-based framework can leave research on captioning devoid of a connection to access as a political project.

While many papers implicitly identify DHH people as experts by testing captioning technologies with exclusively DHH users, most do not explicitly describe this as a way to place the direction of technical development in the hands of the DHH community. The majority of papers contained user studies, though some short form publications did not include them, often presenting preliminary technical work or summarizing an ongoing research project (e.g., [26, 59, 83, 115, 127, 156]). Yet, overwhelmingly, while most papers did engage caption users to shape the design of captioning, they did not frame this as an intentional or value-laden choice. Bringing disabled people into decision-making that impacts disabled people's lives, however, is the most famous demand of the disability rights movement [120]. It is notable that the current state of human-centered accessibility focused captioning research has naturalized this activist demand into a practice that does not require justification. In fact, there were two short-form publications [143, 144] within our dataset that had hearing people simulate being DHH. Yet, Tu et al. [143, 144] engaged with critiques of disability simulation (see [110, 113, 142]), emphasizing that not engaging DHH communities limits the applicability of their research.

5.3.2 Connecting Captioning Technologies to Historical Harms. There is also research that connects technology design to a broader historical and political context, sometimes driven by specific research areas and sometimes as part of a broader research ethos.

There are some areas of captioning research that are more likely to engage with historical legacies. When research is motivated to support DHH people with lower literacy, it sometimes situates lower literacy rates in the context of oralism and educational discrimination (e.g., [22, 93]), but other times simply states low literacy as a fact without context (e.g., [53]). Discussion of social acceptability of technology is also historically situated. Some research notes that the desire for technology to be socially acceptable is rooted in discrimination and builds to protect people from that discrimination, rather than challenging it. For instance, Olwal et al. [114] justify their focus on HMDs as follows: *"many people do not wish to call attention to their disability for fear of exploitation or discrimination ... for example, eyeglasses may be more desirable than hearing aids due to the perception that hearing aids are for older adults."* Others actively engage this tension, such as Findlater et al.'s [48] discussion of how to balance well-documented desires for socially acceptable assistive technologies with the Deaf community's commitment to distinctly Deaf visual communication styles. Educational captioning tools were more often studied in a context of historical discrimination [77, 80, 156], exemplified by Kushalnagar's [80] motivation: *"nearly fifty years after the first educational mandate for accessible services in the early 1970s, only 16% of DHH individuals complete a bachelor's degree or higher, far less than the graduation rate of 30% for hearing individuals."*

There is a final, smaller body of work that engages with Deaf and disabled history, activism, and culture as an intrinsic motivation.

Seita et al [128, 130] motivate their work by noting that “*communication barriers may lead to isolation, miscommunication, or reduced productivity or professional outcomes*”. Citations to Deaf community knowledge include citing Christine Sun Kim¹² as an authority for creatively conveying non-speech information in captioning [101] and citing the “#NoMoreCraptions” campaign [41] to motivate research into automatic captioning approaches (e.g., [90, 101, 102]). Desai et al. [40] grapple with the history of oralism in their research on speechreading and Simpson et al. [134] focus on captioning as an access tool for people with ADHD, noting a historical lack of research that engages adults with ADHD outside of a corrective focus [137]. McDonnell et al.’s work [102, 104] is framed by disability justice and Deaf studies, explicitly exploring collective access captioning approaches. This body of work provides its audience the opportunity to understand captioning technologies as connected to a broader politic and decenters technologists as the sole authority on captioning technologies.

5.3.3 Nothing About Captioning Without Captioning Users. From the disability rights rallying cry of “*nothing about us without us*”, to Deaf studies’ emphasis on self determination, to the disability justice principle of leadership of the most impacted, disabled and Deaf scholars and activists are clear: work that impacts Deaf and disabled people should not just include but cede leadership to impacted communities. A small body of work aims to do so, either by engaging participatory methods or by having Deaf-led research teams.

Though far from the dominant methods in the field, there is a body of research that puts the direction of captioning technology development in the hands of the DHH community using participatory methods, such as codesign [78, 104, 118, 131]. For example, Kawas et al. [78] first used a range of methods to understand DHH students’ current experiences of using captioning and then conducted codesign workshops to set directions for future improvement. Peng et al. [118], on the other hand, began with codesign workshops to guide the implementation and testing of their augmented reality (AR) captioning tool. More so than traditional user research, codesign methods move toward collective communication access by transferring power toward impacted communities.

Another form of community-engaged research is work done by DHH scholars who articulate the ways their lived experience shapes their technical expertise. When research is conducted by DHH researchers, even work that is not explicitly autoethnographic is often described as informed by the DHH author’s lived experiences (e.g., [40, 54, 60, 72, 154, 155]). For example, Jain et al. [72] describe determining specifications for a HMD from the hard of hearing first author’s experiences using and fine-tuning the system, using his preferences as defaults that could be customized for later participants. Jain et al [70] have also published explicitly autoethnographic work describing the experience of using HMD captioning. ASSETS experience reports¹³ provide a unique format for publishing the experiences of disabled technology users. In one, Loizides et al. [91] highlight the variety of use cases that both hearing and DHH authors had for on-demand access to automatic captioning via Google’s LiveTranscribe app. Additionally, Mathew et al. [100]

describe the experiences of two DHH authors using AR-captioning and AR-interpreting. Having member-researchers conduct captioning research provides opportunities to enrich findings and better align technology design with the lived experience of long-term captioning use.

5.4 Considering Communication Context

Finally, we explore whether research considers the role of relational, social, or environmental context in shaping access practices. We highlight that in captioning research, there are two major dimensions in which to consider context: in the design of the study method and in the design of implemented or proposed interventions. We observed both research that abstracted away context in their experimental design and research that deeply considered context when designing for and understanding caption use. This section draws solely from the **context** criteria of our framework (Criteria E).

5.4.1 Researching Without Communication Context. While research on captioning is often framed around matching the specific nature of different kinds of communication, some research abstracted away key contextual features in their study design.

While controlled experiments provide a very valuable form of knowledge around the efficacy of interventions, their necessary control of contextual factors limits the method’s viability for collective communication access research. We observed researchers frequently using prerecorded stimuli (e.g., [21, 22, 24, 39, 50, 81]) while aiming to study interactive communication, losing out on relational context or ability of conversation partners to mutually build accessible communication practices. Controlled experiments run during interactive conversations were often highly manufactured. For instance, Seita et al. [129, 130] had an actor repeat the same response multiple times in a row, with varied levels of a communication behavior, to measure hearing people’s impact on DHH caption users. While this allows for specific forms of measurement, it does not reflect how people would experience those behaviors in context, and could miss critical nuance (e.g., familiarity with a conversation partner). We did observe some controlled experiments in our dataset that more-closely replicate the conditions in which those captions would be used, such as Al Amin et al.’s research into optimal placement of TV captioning ([9–11]). The types of knowledge controlled experiments produce can be invaluable in advancing certain arguments – for instance, Berke et al. [22] demonstrated a statistically significant difference in DHH people’s ability to identify caption errors depending on literacy, providing impetus for future research to better design for DHH captioning users with less access to literacy. Yet, often the nature of controlled experiments can limit the strength of claims they can make about real-world communication contexts.

We also observed instances where, to try to isolate any varied understanding to an intervention in a controlled experiment, researchers either played videos with no audio (e.g., [39]) or would have their participants listen to white noise to fully equalize their hearing ability (e.g., [150]). While this may yield a more rigorous controlled experiment, it does not reflect how many DHH people communicate, combining their hearing abilities with assistive tools. Further, this impulse to remove participants’ residual sensory ability

¹²Kim is a famous Deaf visual artist: <https://christinesunkim.com/>

¹³<https://assets23.sigaccess.org/experience-reports.html>

has been criticized as a form of disability simulation [110, 113, 142] in the context of work with people with low vision [45, 122], while this choice often goes unremarked upon in research with people who are hard of hearing.

5.4.2 The Benefits of Considering Communication Context. When researchers investigate captioning technologies in ways that deeply consider the social, relational, and environmental contexts they are used within, it is clear that this context is integral to shaping how effective captioning tools can be.

Some research does not explicitly set out to understand the role context plays on caption use, but demonstrates the importance of context by designing for hyper-specific use cases (e.g., [44, 52, 156]). Some research demonstrated the need to pay close attention to the type of media being captioned. For instance, Al Amin and Hassan et al.'s [9–12] work on automatically placing captions during live television broadcasts found that, for instance, there are different on screen information demands for a sports game than a daily news broadcast. Other work was driven to match the cultural and linguistic context captioning tools are used within [30, 141]. For example, Takagi et al. [141] explored a combination of ASR and crowd captioning to caption Japanese, as complexities of written Japanese make fully human-generated captions very difficult to produce. Designing captioning tools for narrowly scoped use cases allowed researchers to engage with and leverage the context tools will be used within.

Some work has found that the places captioning tools are used within greatly shape the experience of using those tools. Research on HMDs has revealed that simultaneously reading captions and maintaining situational awareness is highly cognitively demanding [72] and that granular environmental considerations must be taken into account in AR interface design (e.g., how captions should appear if the speaker is not in the user's field of view [118]). The specific environment of the classroom was often central to educational captioning research. For instance, Kushalnagar highlights that classrooms must be well-configured to allow captions to facilitate access [80]. Kawas et al. [78] surfaced the extent to which students' experiences of captioning are impacted by seemingly minor constraints, such as the availability of outlets in a classroom.

Broader sociocultural factors also impact captioning tools. Findlater et al. [48] emphasize that DHH people's sound awareness preferences vary across social contexts, finding statistically significant differences in, for instance, people's concerns around social acceptability of technologies used with close others versus with strangers. People's communication backgrounds play a significant role in what kind of technology is the appropriate solution—Mathew et al. [100] emphasize that real-time captioning is a much more usable tool for a DHH person who prefers to voice for themselves. Captions only provide access for receptive, not expressive communication, and therefore do not provide access to all DHH people equally [100, 102, 104]. Loizides et al. [91] highlight how communication access is also shaped by broader global context, finding that masking and social distancing in the wake of the COVID-19 pandemic made automatic captioning a more important part of many DHH people's access practices.

Taking a more specific focus on context as a key determinant of communication accessibility, McDonnell et al. [102] propose that

caption use must be understood in the context of interrelated social, environmental, and technical factors. This framework has been taken up in their follow-up work [104] and by other researchers. Seita et al. [131] discuss their findings in the context of the social and environmental factors that shape both the communication that happened during the study and the designs participants developed and Desai et al. [40] emphasize social, environmental and technical impacts on people's decisions to either speechread or use captions.

6 Discussion

In this paper we first contribute a theoretical framework for collective communication access and then use that framework to assess the last decade of human-centered accessibility research on captioning technologies. We find that HCI captioning research does not perpetuate many of the harms technologists have historically caused, which prior literature reviews indicate is not true across all accessibility subdomains [135, 137]. Most captioning research engages DHH communities as the relevant authority on caption design and targets change toward technical infrastructure. However, the small body of work that is strongly aligned with our collective communication access framework shows that technology alone cannot create fully accessible communication. Work that treats access as a political project that hearing interlocutors should be a part of demonstrates the rich potential for future work in this burgeoning space. We now discuss two key considerations for future collective access captioning technologies: conducting future collective communication access research, and balancing social acceptability and social change.

6.1 Conducting Future Collective Communication Access Research

We envision exploring additional domains of communication access through the lens of collective communication access and other applications of our framework and rubric.

Captioning research provides an interesting domain within which to study collective communication access since it is necessarily technical and used to facilitate oral communication, potentially making it less likely that research will be engaged in Deaf culture and community than work that studies the use of signed languages. However, our framework is not specific to captioning technologies. A comparative analysis of the last decade of ASL research within ACM, SIGCHI, and SIGACCESS sponsored conferences could be illuminating (e.g., exploring whether ASL research is more grounded in historical context and harms) and is a promising direction for future work. Augmented alternative communication (AAC) devices frequently facilitate access for people with intellectual, developmental, or speech-related disabilities. Work in communication studies [8] and HCI [145] has identified that AAC technologies can be designed and deployed in ways that limit their users' agency and are primarily designed to support AAC users to engage in normative, spoken conversation. Bringing a collective communication access lens to AAC research could reveal ways to redesign AAC-mediated communication as a negotiation between communication partners. Furthermore, digital accessibility is, at its core, a question of communication access – can users communicate their inputs to a technical system and can they access the outputs of that

technology. Considering research areas such as making websites screenreader-navigable, providing high quality alt-text on social media, or ensuring documents are formatted accessibly through a lens of collective communication access could reveal new angles and approaches to address these long-intractable access barriers.

Our analysis of captioning research through this framework identifies practical considerations for future work. Currently captioning is overwhelmingly studied with DHH people, but there are other groups who use captioning for accessibility [134] and narrowly associating an access technology with a user group risks marginalizing many people who could benefit from that technology [97]. Further, research often does not engage with the fact that captioning technologies serve only a particular subset of DHH people well during interactive conversation – those who are comfortable voicing their contributions. Future work should explore how captions could better support DHH people who prefer not to voice. We also recommend that future research more often study all people communicating using captions, rather than only studying DHH captioning users. Finally, we identify that experimental methods are often conducted in a way that does not match real-world caption use. We recommend that future work complement lab-based findings with situated, qualitative analyses of novel tools in the contexts they will actually be used within.

While we used our theoretical rubric¹⁴ to assess published work, we envision it as a tool that could be used during research definition and study design to support researchers in reflecting on their approach and guiding them towards collective communication access framings. This could be particularly useful to researchers who are new to fields such as disability studies, Deaf studies, disability justice, or communication studies. We emphasize that interdisciplinarity is crucial to our analysis – the lead author of this work is both a disability studies scholar and HCI researcher. We hope that work such as this could provide a foothold into the long journey of learning and substantively engaging with other fields that hold crucial knowledge on disability, Deafness, and accessibility.

6.2 Balancing Social Acceptability and Social Accessibility

We identify collective communication access as an approach that both aligns research with Deaf and disability scholarship and produces cutting-edge technology designs. However, we must not ignore a main justification of research that designs technologies that preserve communication's status quo—socially acceptable technologies within this status quo can be necessary for and desired by DHH people navigating an inaccessible world.

This tension between the promise of collective access and the complexities of social acceptability is built into disability justice activism's conception of this principle. Sins Invalid stresses that collective access approaches should be arranged "*depending upon an individual's needs, desires, and the capacity of the group*" [68]. We do not create a more just future if access is **only** provisioned in spaces where caption users feel safe enough and have the time and capacity to guide their communication partners toward more accessible communication styles. Caption users may be more likely to communicate orally and or not be at a place in their lives to

want to change how they communicate with those around them. Yet, practices such as DeafSpace [43] show us that, by default, current design does not support DHH modes of communication that diverge from a hearing norm. The strong skew towards designing technologies that do not challenge inaccessible social norms fails to support many people's current or desired access practices. Furthermore, prioritizing designs that align with the social status quo limits our capacity as a field to change the ableism and audism inherent to current communication environments.

Captioning research and design could make collective access approaches to accessibility more socially acceptable. The technologies we use to communicate shape what we think normal communication is. Recent years have seen a substantial change in how hearing people interact with captioning, with the majority of young people preferring to watch captioned media [29], the rise of captioning practices on user-generated video content platforms [134], and a normalization of real-time automatic captioning on videoconferencing platforms [3–5]. Captioning researchers should not stop supporting people who would prefer technologies to be discreet and socially acceptable. However, there is an opportunity to commit to designing communication tools and platforms that make not only the availability of captioning socially acceptable, but make collective access approaches unremarkable and expected.

6.3 Limitations

Our work does have limitations, namely a scoped context and subjective analysis. While our analysis of a decade of research is aligned with methodological norms, we only queried the ACM Digital Library, and there are many other repositories of research that may hold human-centered, accessibility-focused captioning research. Furthermore, we take an American perspective on disability studies and Deaf studies and analyze HCI research published in English. Global disability studies scholars emphasize that local context matters, and our framework should not be assumed to be global. Our North American focus also translates into our language choices, as the difference we highlight between captions and subtitles is grounded in our cultural context. Finally, our research presents a taste of several vast disciplines, filtered through our perspectives as hearing technologists. Other researchers may have selected different bodies of work or takeaways and interpreted them differently.

7 Conclusion

In this research we articulate a framework for collective communication access, drawing from disability studies, Deaf studies, disability justice, and communication studies. We then translate that framework into a rubric to assess how prior captioning research has considered communication as a collective process, who or what is targeted for change, how research grapples with historical harms, whose knowledge and expertise is centered, and how communication context is integrated into research and technology design. From our analysis of captioning research from 2013 to 2023, we find that the current state of captioning research is not dire – research largely aims to improve technology to improve access and treats DHH people as experts on captioning. Yet, the work that is more aligned with a collective communication access approach reveals

¹⁴See Supplementary Materials

that attending to the social context of communication and designing to support accessibility as a collective effort produces research findings that are more aligned with the way captioning is used on a daily basis. We end by envisioning a future where technology makes collective access more socially acceptable and where collective communication access is extended to other technical contexts.

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