Evoking Empathy: A Framework for Describing Empathy Tools

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ABSTRACT

Empathy tools are experiences designed to evoke empathetic responses by placing the user in another's lived and felt experience. The problem is that designers do not have a common vocabulary to describe empathy tool experiences; consequently, it is difficult to compare/contrast empathy tool designs or to think about their efficacy. To address this problem, we analyzed 26 publications on empathy tools to develop a descriptive framework for designers of empathy tools. Based on our analysis, we found that empathy tools can be described along three dimensions: (i) the amount of *agency* the tool allows, (ii) the user's *perspective* while using the tool, and (iii) the type of *sensations* that are experienced. We show that this framework can be used to describe a wide variety of empathy tools and provide recommendations for empathy tool designers, as well as techniques for measuring the efficacy of an empathy tool experience.

CCS CONCEPTS

• **Human-centered computing → Interaction design theory, concepts and paradigms**.

KEYWORDS

Empathy, Empathy Tools, Design Strategies

ACM Reference Format:
Sydney Pratte, Anthony Tang, and Lora Oehlberg. 2020. Evoking Empathy: A Framework for Describing Empathy Tools. In *Salzburg '21: 15th Annual Conference on Tangible Embedded and Embodied Interaction, February 14–17, 2021, Salzburg, Austria.* ACM, New York, NY, USA, 15 pages.

1 INTRODUCTION

Empathy tools are physical or digital artifacts designed to help people understand the lived experiences of others [11]. First-generation empathy tools of note were used by product designers to understand challenges faced by end-users with physical impairments when using their products. As illustrated in Figure 1, such tools were aimed to provide designers with an intuitive understanding of how an end-user with physical impairments would see the world—this would help motivate and improve the design solutions to address those challenges. Similarly, a secondary wave of empathy tools was designed to help caregivers understand the challenges faced by those under care (e.g. caring for the elderly). While "empathy tools" were designed with such instrumental goals in mind, the term now describes a wide range of designed experiences that broadly aim to educate and inspire prosocial behaviours. Recent efforts, for example, shed light on the challenges faced by refugees escaping persecution [42], gender inequities in corporate workplaces [3], and racial inequities in travelling across the country [25]. Empathy tools are therefore important to help society build common ground.

As designers, we do not have a common vocabulary to label, describe, organize and discuss the range of empathy tools that have been produced by HCI researchers and designers. Without this vocabulary, each existing empathy tool is materially and phenomenologically distinct, existing as a point solution in a broad space of possible designs. Consequently, designers cannot learn from others' works, and thus needs to try to create empathy tools anew each time—potentially making the same mistakes, and unfortunately being unable to leverage the lessons learned from prior efforts. Gaines' [28] models the learning curves of novel information technologies by describing six stages, of which the first four are pertinent here: *breakthrough*—where inventors create a technology; *replication*—where others replicate this technology; *empiricism*—where practical designs are formulated based on previous successes and failures; *theory*—when sufficient empirical experience provided

Figure 1: Product designers use thick gloves to simulate users' experiences manipulating small controls with reduced dexterity and tactile sensations [38].

Salzburg '21, February 14–17, 2021, Salzburg, Austria

ACM ISBN 978-1-4503-XXXX-X/18/06…$15.00

is with inductively produced understanding. As designers, our understanding of how to develop empathy tools is—at best—very much in the space of early empiricism. Without a common vocabulary to describe empathy tool design efforts, it is difficult for this area of research to move forward beyond individual point solutions.

Our work aims to address this gap with a descriptive framework that captures these instance examples into a single vocabulary. To develop this framework, we systematically surveyed 26 examples of empathy tools described in the HCI and design literature. We inductively developed categories to capture the purpose of each empathy tool, the manner in which they were executed and experienced, and the lessons learned from these efforts (as discussed by the authors). Our synthesis reveals that:

(1) Empathy tools can be described along three major dimensions: (a) the type of *agency* they provide the user within the experience; (b) the *perspective* the user takes within the context of the experience, and (c) the *sensory* mechanisms through which the experience is delivered.
(2) Although there exists a vast amount of literature on empathy from the fields of psychology and sociology very few empathy designs have engaged with this literature to improve empathy techniques and measurement.

Based on these findings, we discuss several avenues for researchers engaged in empathy tool design and research. Specifically, we recommend targeting specific types of empathy, and developing and using methods for evaluating whether the empathy tool is effective in achieving the kinds of outcomes that are intended.

Our work makes two contributions: first, we present a descriptive framework of empathy tools developed in HCI; second, we provide recommendations for designers of empathy tools to aid them in honing their designed experiences. These contributions will aid the community to understand how to categorize, label, and compare different empathy tools, with the goal that we can ultimately learn from each empathy tool instance in a holistic way rather than considering them as instance point solutions.

2 EMPATHY AND EMPATHY TOOLS

Empathy tools exist within a broader set of user-centred design techniques designers use to gain insight into the challenges faced by their end users. For instance, common techniques such as interviews, surveys, field research, diary studies and so on are used by designers. What sets empathy tools apart from these techniques is that they are commonly designed as artifacts —digital or material— to be experienced by the user to inhabit the experience of a person from the reference population. The express goal of such tools is to give others an understanding of the lived and felt life experience of a member of the reference population: what it feels like to be that person and how they make sense of their situation [66]. Traditionally, empathy tools have been physical objects or tasks that when worn or held, simulate physical impairments or limitations so that designers can get a sense of what end users with said impairment might feel and experience. They help a user to understand the thought process and the problem solving that would need to be resolved in given situations. For instance, using the gloves in Figure 1, the gloves simulate a reduction of mobility and functional ability in hands—similar to arthritis (without the pain), and in the experience, users are asked to solve the problem of trying to accurately press small buttons. Recent advancements in tangible devices and immersive technologies, such as virtual reality (VR), give designers the capability to create empathy tools that also address complex social issues (e.g. gender and racial inequities, etc.).

Empathy tools are designed to create an empathic response, which is the first step toward attitude change, behaviour change, and helping behaviours directed at others. Batson's empathy-altruism model describes this as the relationship between empathic concern, which creates altruistic motivation [4]. Further, he suggests that empathy directed toward one person from a representative population can lead to an empathetic response and prosocial behaviour toward the entire representative population [5]. This resonates with prior research that shows that improved attitudes toward individuals in a group improves attitude toward an entire group [23, 24].

Psychologists distinguish between two types of empathy—cognitive and affective—and relate them through the concept of empathetic accuracy [29]. Cognitive empathy is *knowing* or understanding what a person is feeling by imagining the internal state of another [47]. This is distinct from affective empathy, which is *feeling* what another is feeling [12, 20, 47]. Hoffman suggests that affective empathy is first learned in infancy by mimicking emotions through mirroring [35]. People then later develop perspective-taking abilities and are then able to imagine the feelings of others, resulting in a more cognitive process of empathy [35]. Both the emotional response (affective empathy) and cognitive process (cognitive empathy) contribute to empathic accuracy, which in turn allows people to respond appropriately and compassionately to another person's distress [47]. The psychology literature deliberately makes this distinction since assessing the efficacy of measures to create empathy (or to evaluate their outcome) is of utmost importance in their work (e.g. [36]); however, as we will see, the extent to which it has been taken up by HCI and designers is less clear.

In reviewing prior work on empathy tools from the HCI and design community, we observed that the literature could reasonably be divided into three categories of tools based primarily on historical audiences of empathy tools: designers, caregivers, and the public. As we will see, this audience (and the motivation for the design of such empathy tools) creates emphasis on different kinds of strategies for designing the empathy tools themselves.

2.1 Empathy Tools for Designers

Empathy tools have traditionally been described as tools that allow a product designer to feel the effects of an impairment so they can better understand and empathize with people with an impairment, and design more inclusive products [21]. Within the context of User-Centred Design and Empathetic Design philosophies, designers use empathy tools as a research and learning tool to empathize with a more inclusive population of target users (traditionally, these are physically impaired end-users), since everyone has a unique relationship with the designed product [57].

A common approach has been to use empathy tools in product testing because of the associated costs with having a large number of test subjects of varied types. For instance, some of the first noted

empathy tools came from the design group IDEO. They used empathy tools during the design process to evaluate the usability of their prototypes for users with special needs and disabilities [38]. For example, when evaluating a design for a home-health monitor, IDEO designers wore thick gloves while pressing buttons to simulate users with reduced dexterity and tactile sensation, similar to Figure 1. When redesigning a voting booth for Los Angeles County, designers consulted people with disabilities and created disability simulations to understand the variety of intended users. For instance, designers would perform tasks with the prototype while wearing blindfolds to experience what a blind user might experience [39]. Of note is that relatively simple, non-technical interventions could be used to understand challenges faced by the broader populations. The project resulted in a voting booth prototype with an angle-adjusting touch screen that helps with accessibility for people in wheelchairs. Voters with visual impairments or reading disabilities have the option to use audio and a physical controller to navigate the process. Another example is the AGNES (Age Gain Now Empathy System) suit worn by students, product developers, designers, and others to better understand the physical challenges associated with ageing [2]. The AGNES suit simulates the approximate motor, visual, flexibility, dexterity and strength of a person in their mid-70s [2]. For example: mobility is limited through the use of neck and wrist guards; bungee cords attached from a helmet to the hips limit upper body movement; gloves reduce tactile sensations and goggles, and earplugs simulate diminished sight and hearing.

It is also important to note that while this use of empathy tools is common, it has been critiqued as a process that limits the voices of those that are being represented [6]. Research in co-design proposes that instead of using empathy tools to simulate the experiences of a reference population during the design process, designers should design *with* a reference population to create more empathetic designs [44, 46, 58, 61]. As a result, empathy tool designers have moved away from their use in the design process, and instead toward designing tools to create more general understanding and awareness.

2.2 Empathy Tools for Caregivers

A large class of empathy tools have focused on providing caregivers with the phenomenological experiences of a reference population (e.g. older adults). Here, the empathy tools do not promote a specific design solution; instead, the focus is on simulating the physical, cognitive and perceptual experience of the reference population. These tools expose caregivers such as family, nurses, doctors, etc. to the lived experiences of the people they are interacting with. This exposure allows the caregiver to gain a deeper understanding of their patients' needs and challenges so the caregiver can provide better care.

A more sophisticated version of an age simulation suit is the GERonTologic simulator (GERT). The GERT age simulation suit allows the wearer to experience age-related impairments such as opacity and narrowed vision, high-frequency hearing loss, head mobility restrictions, joint stiffness and reduced strength, grip and coordination [50]. The GERT suit uses similar techniques to the AGNES suit but also limits mobility in the ankles, knees, elbows and includes a weighted vest. However, the GERT suit is specifically marketed to medical staff and students to create empathy for ageing patients.

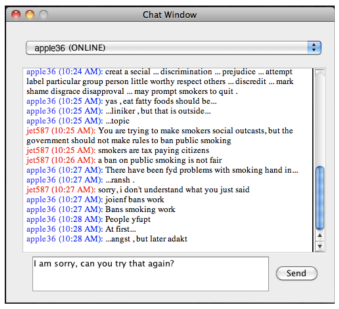

Figure 2: Aphasia Characteristics Emulation Software (ACES) emulates the effects of aphasia, an acquired language disorder that impairs expressive and receptive language, though an instant messaging application designed to evoke empathy in caregivers and speech therapists. [32].

These types of empathy tools are not just limited to simulating physical experiences, some also have focused on the cognitive experience of a reference population. For example, the Aphasia Characteristics Emulation Software (ACES) addresses aphasia, an acquired language disorder affecting written and spoken word recall, sentence fluency, articulation, and language production/output [32]. The tool is an instant message system that emulates the effects of aphasia by distorting the text typed by the participants (Figure 2). The tool illustrates the challenges of living with a language disorder and was used to raise awareness, teach and increase empathy for people who interact with this population (e.g. family, friends, doctors, etc.) [32]. In particular, beyond creating empathy among family and friends, it was designed to serve as a training tool for physicians, nurses and speech-language pathologists [32]. Empathy tools for cognitive disorders are valuable for bringing understanding and awareness to others because unlike many physical disabilities, cognitive disabilities are unseen and less detectable.

Finally, another class of empathy tools for caregivers focuses on the perceptual experience of a reference population. The Alzheimer's Eye Challenge is a mixed reality game that simulates symptoms of Alzheimer's by manipulating the user's view with real-time visual filters and headphones for auditory effects [45]. With these filters activated, the user attempts to complete a variety of tasks, such as locating specific items and navigating a space within a time limit. Similar to Hailpern et al. [32], the goal of this game is to increase awareness of Alzheimer's disease and to train caregivers.

2.3 Empathy Tools for the Public

A more recent trend has been to target the public with empathy tools, where the intention has been to shed light on the plight of a disadvantaged, marginalized or otherwise underrepresented population. These experiences seem to persuade the user to a particular perspective and have been sometimes called "empathy-oriented persuasive games" [42]. The recent popularity and accessibility of immersive technologies have increased the reach of such tools, as

a common theme in these experiences is to 'step into the shoes' of someone else. Chris Milk (co-founder and CEO of a virtual reality technology company), for instance, in a TED Talk in 2015 called virtual reality (VR) the "ultimate empathy machine" [1].

In its most benign form, such tools can shed light on injustices inherent in everyday domestic environments. Martin Nerurkar's persuasive game Wheelhouse shows the public how difficult it is to navigate a house when bound to a wheelchair [53]. Here, a player sits in a physical wheelchair, wearing a VR HMD, and moves around the virtual house to complete tasks such as getting a cup of coffee. This task is made difficult because the player moves the wheels of the wheelchair to move, bumps into virtual obstacles, and cannot reach high enough to get the cup. This type of experience helps to engender a deep empathy for the situations that those with physical disabilities face in everyday contexts.

Whereas Wheelhouse focuses on physical navigation and one's exploration of the environment, other empathy tools focus primarily on how others see the user, where empathy arises out of one's experiences of others' treatment towards them. For example, Muller and colleague's Through Pink and Blue Glasses allow users to experience gender stereotypes for both male and female characters [51]. In a VR environment, users can experience different scenarios as a male or a female character, making choices to react to situations where sexism frequently occurs: in a bar, in the office, and a toy store. The authors argue that perspective and participants' willingness to react affect empathy. Participants reported that being able to switch characters (and perspectives) increased their awareness of sexism, and many stated they would now try to do something about it when they encounter sexism in their daily lives.

Finally, more recent examples have taken advantage of immersive technologies to create experiences that engage the user in a multi-sensory experience. A Breathtaking Journey [42] creates awareness of the plight of refugees fleeing from their home countries. Its approach is to provide a first-person perspective of a refugee's journey. In the VR experience, the user sits in an orange truck that is used to smuggle them out of the country; physically, the user sits in an orange crate, and actual oranges are dropped on the user, and smells are simulated to stimulate the olfactory senses (Figure 3). The stated purpose of this design is to bring awareness

Figure 3: A Breathtaking Journey, a first-person, multi-sensory, mixed reality experience bringing awareness to the plight of refugees fleeing their home countries aimed to evoke empathy in the public [42].

to the cost of war on ordinary civilians. Immersive technologies provide a new avenue through which designers can transport users to new realities and others' lives to evoke empathy. In this work, as with the previous examples, the authors create the tools with the goal of creating awareness of a specific issue in the user of the tool and seemingly have no other design purpose but to evoke empathy.

Synthesis. While all of these examples aim to create a sense of empathy, the purpose of the empathy in each case is different since they target different kinds of users: targeting designers can be instrumental (i.e. for testing a design), or to create a deeper empathy during the design process; targeting caregivers helps them understand the challenges faced by patients, and finally, targeting the public is to promote awareness and prosocial behaviours. When we focus specifically on the empathy tools themselves, we see that each is a tool designed for a particular situation to achieve a particular goal—i.e. a case study. Given a novel situation, a designer still faces the same challenges each time: we do not yet have a clear, overarching perspective of how to design empathy tools, nor a specific understanding of what aspects of these tools evoke empathy in a deep, lasting way.

2.4 Empathy Research in TEI

Empathy in the TEI community has explored different technologies in a variety of methods to evoke empathy in the user. Many of the efforts have gone into developing empathy or understanding for things that go beyond known human experiences. Flanagan and Frankjaer, for example, designed a device that mimics the sensations of insects in the wild to explore empathy in users for other-than-human entities [26]. The two phases of this project aim to create an immersive, interactive, haptic, audio-visual sensation so that the wearer can experience an environment from an alternative mind set—an awareness technique to remind us that we share space with other beings. Similarly, Hamidi and Baljko created a living media interface using mushrooms to motivate adults and children to engage with nature and create awareness for the effects of urbanization [33]. The living media installation uses a live mushroom colony as a part of the display. The growth rate of the mushrooms corresponds to the amount of attention through interaction that the interface receives. By encouraging attention for the living display the authors aim to create an empathetic response for nature in turn.

The TEI community has also looked at how eTextiles [8] and design methods [61] can be used to help children develop empathetic behaviours. This work can help better empathetic responses to all kinds of situations by aiding future generations in developing the awareness and understanding needed in empathy. For example, Berzowska et al. explore the design of full-body, soft tangible interactions with toys that respond to the physical treatment it receives from a child [8]. The aim of this work is to explore emotional empathetic development in children through the use of these soft interactive toys over traditional hard toys.

Other kinds of empathy research in the TEI community include a framework for kinesthetic empathy—the phenomenon of experiencing a first-person sensation of observed movement [18]. Exploration into kinesthetic empathy yields interesting considerations into the design of interactive systems by gaining a deeper understanding of the effects different forms of movement can have on the user

Table 1: Distribution of papers from our corpus by target audience.

Designers	[3], [10], [17], [27], [34], [57], [62], [64]
Caregivers	[7], [9], [32], [45], [56], [60], [68]
Public	[13], [16], [30], [42], [48], [51], [52], [54], [59], [63], [67]

and therefore the experience with the system as a whole. Research has also explored devices designed to create self-awareness in social interactions [69]. Zuckerman and Hoffman present Empathy Objects that respond to human behaviours through physical, non-verbal expressions of their emotional state with the intention of creating self-awareness in people and promoting non-aggressive human-to-human interactions.

3 SURVEY OF EMPATHY TOOLS

Without a common vocabulary to describe prior empathy tool designs and efforts, each empathy tool is designed without the benefit of previous success and failures. Such a vocabulary would allow designers to identify techniques being used to evoke empathy, similarities between the tools in the literature, effective strategies for various issues or lessons, and how to evaluate the effectiveness of a design.

To address this problem, we conducted a survey analysis of empathy tools previously described in the HCI and design literature. Our focus was to identify, catalogue and categorize the specific mechanisms and strategies used by previous authors in their empathy tools. Our goal was to group these efforts into related categories and to consider the effectiveness of strategies in creating empathy.

3.1 Corpus Construction

To construct a corpus of papers reporting on empathy tools, we searched the ACM Digital Library for papers that included the term "empathy." The papers returned were examined to identify works describing empathy tools. Through snowball sampling (forward and backwards citations), we examined the cited works from the papers added to the corpus to identify other papers that fit the criteria of an empathy tool. For each paper, we asked the following criteria questions:

(1) Was the goal of this work to create empathy in the user for others (i.e. a reference population)?
(2) Was the intended audience of the paper the HCI or design community?

The first criterion excluded a number of papers that otherwise had "empathy tool" in its body. For example, papers that referred to evoking empathy for non-human entities, such as plants [19, 33] or machines [22] were not included. We also excluded works that explored the use of empathy to change the user's behaviours to their own actions, such as smoking [15] or self-awareness [69]. Similarly, we excluded works discussing empathic design since empathic design refers to understanding the user's feelings towards a product rather than another group.

The second criterion was to focus our attention on the breadth of the techniques and approaches used by the HCI and design community to evoke empathy. This community has generally focused on designing novel types of artifacts that generate empathy, and we were interested in how the community has advanced the study of such artifacts. In contrast, social psychologists studying empathy and altruism sometimes introduce artifacts into their experiments, but the artifacts themselves are rarely the focus of the investigation.

The final corpus of 26 papers is not intended to be an exhaustive list, but to represent a range of examples showing the diversity of empathy tools.

3.2 Analysis and Coding

We used an iterative, inductive approach to explore and analyze our corpus. Our initial goal was to understand the nominal aspects of the different empathy tools described in each paper, where we coded each paper based on a set of questions. On subsequent iterative passes, we developed through an open-coding process [14] categories to describe the various artifacts. These categories were refined through successive passes, and then we performed axial and selective coding to distill a spectrum of design strategies.

Our initial coding rubric explored the basics of each paper:

(1) Who is the target audience of the paper?
(2) Who is empathy directed towards?
(3) How is empathy experienced?
(4) What techniques are used to evoke empathy?
(5) Was an evaluation conducted and how was the tool evaluated for effectiveness?
(6) How was the tool deployed?
(7) What was the tool doing?
(8) Was a specific type of empathy targeted?

Based on this, we then focused our efforts on the empathy tool itself, where we coded for the mechanisms used by the empathy tool to evoke empathy. This coding schema was derived and iteratively revised as we reviewed papers in our corpus [14]. Based on our analysis, we identified three "principal" design strategies commonly used across a variety of empathy tools: (1) the amount and type of *agency* given to the user; (2) the *perspective* given to the user of the empathy tool, and (3) the type of *sensations* that the user experiences with the empathy tool. Table 1 summarizes the design strategies as they relate to our corpus.

3.3 Description of Corpus

As mentioned above the final corpus used in this work contains 26 papers of literature on empathy tools. Of these papers, 8 are tools targeted for designers (3 of which are aimed at communication system designers), 7 for caregivers, and 11 for the public. Table 1 shows the reference distribution of the different targeted users from the corpus. The literature contains 12 full papers, 1 journal article, 7 extended abstracts, 5 short papers, and 1 pictorial.

We observed a high variance in terms of how authors evaluated the empathy tool. 22 of the 26 papers conduct some form of evaluation, only 8 of which directly evaluate for an empathetic or

Table 2: Distribution of papers from our corpus by primary technologies used and primary design strategies.

	Agency	Perspective	Sensation
Worn Devices			[27], [9], [57]
Object Devices		[68]	[52], [30], [67]
Visualizations			[17], [48], [34]
Video	[59]		
360°Video	[3]	[10]	
Mixed-Reality			[45], [42], [64]
Virtual Reality	[51], [63]	[16], [7]	[62]
Kinect Game		[60]	
Text/Chat Application	[13]	[32]	
Mobile-Geolocation	[54]		

compassionate response in the user from the tool. A wide variety of evaluation types (and combinations of types) have been used in the literature: 5 semi-structured post-study interviews, 6 pre-post study questionnaires, 9 comparative studies, 3 post-study questionnaires, 2 system evaluations, 1 pre-post-followup study, and 2 behavioural responses. The empathy tools explored in this work use a variety of mediums (some tools using multiple mediums) such as virtual/mixed reality (9), video (3), physical object (5), text/chat base (4), mobile (3), Kinect motion tracking (2), visualizations (3), worn (4) and desktop application (4). Table 2 summarizes the primary technologies used as they relate to our corpus. The majority of empathy tools (14) have been deployed in a lab setting, others in the field (4 field studies, 1 workshop), and a few in less conventional settings such as installations (2), performances (1) and open houses (1).

4 FRAMEWORK

We propose a descriptive framework of empathy tool design strategies that we have observed in the literature. This framework provides a vocabulary to describe *how* the empathy tool artifacts themselves aim to evoke empathy. This framework outlines design strategies that designers have used and is illustrated in Figure 4. Based on our analysis, tools will select a primary strategy, and then supplement the primary strategy with others to a lesser extent. We observed design strategies grouped into three major dimensions: *agency*, *perspective*, and *sensation*.

4.1 Agency

Agency refers to how much freedom of choice the empathy tool allows during the experience. The goal of tools utilizing agency is to evoke empathy in the user either by giving them the freedom to explore the experience created by the tool or strategically limiting agency for the desired effect. Providing more agency with the tool allows the user to gain a deeper understanding of the experience, and provides new insights through exploration. Limiting the user's agency while using the tool allows the user to feel the frustrations and challenges of the reference population themselves, also creating a deeper understanding. From our set of empathy tools, we see that agency can be affected in two different methods: (1) interaction agency, utilized in some way by 23 papers from our corpus, and (2) narrative agency (26 from our corpus).

4.1.1 Interaction Agency. Interaction agency refers to the amount of freedom the user has in any interactions with the tool and surrounding elements that can be manipulated during the tool experience. Interactive agency can appear as navigational (8 instances from the corpus), object (5 instances from the corpus), character (13 instances from the corpus), and visual (11 instances from the corpus).

Navigational agency refers to how much freedom the user has to physically explore during the experience and how it can affect empathy. Allowing free exploration of a space while using an empathy tool can give the user a deeper understanding of the lives of the reference population. For example, Beuthel et al. [9] create a wearable garment that simulates the effects of chronic knee pain. The user is allowed to freely move about the study space to get a feel for the empathy tool. By having the agency to walk, sit, jump and freely move, participants gain a better understanding of how knee pain affects what would otherwise by everyday normal movement. Limiting navigational agency can also have a potential effect on empathy. In the mixed reality game, A Breathtaking Journey [42] the user is placed in a simulation of a refugee fleeing a war-torn country and must hide among orange crates in the back of a truck. By not allowing the user to freely move, to possibly be afraid to move and be "caught", the user gains empathy for the struggle of a refugee.

Object agency refers to how much the user is allowed to manipulate objects within the experience while using the tool. Agency with object manipulation can help create empathy similar to navigation, by allowing the user to try to function in a normal manner but cannot, may create a deeper understanding of the reference population. The wrist-worn haptic hand tremor device presented by Rosati et al. [57] simulates tremors from neurological disorders such as Parkinson's disease, where the sensations are created from recordings and playbacks of tremor signals from motion capture. Participants while wearing the device were free to handle basic objects (Figure 5). By allowing the participants to manipulate/handle objects they normally would but now with the added difficulty of fighting an uncontrollable tremor, the user gains empathy for the struggle of people with neurological disorders.

Character agency appears in two forms: (1) how much freedom exists to socially interact with other characters, whether real or virtual people and (2) how much freedom exists to choose the character the user embodies within the experience. The work by

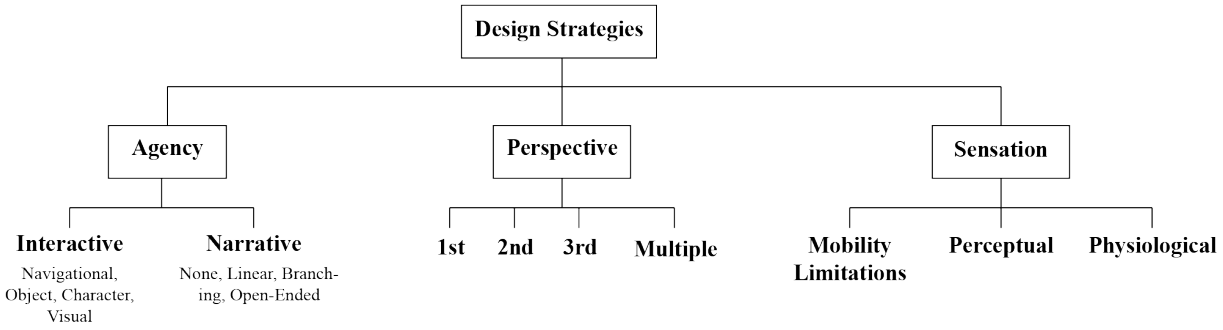

Figure 4: Visual overview of the empathy tool design strategies framework.

Muller et al. [51] is a good example of both types of character agency. This empathy tool is a VR game where the user plays through different scenarios where sexism frequently occurs. In each scenario, the user can interact with different characters in the game. These characters make sexist comments and the user is allowed to respond as they wish to the character's actions and remarks. Allowing the character to interact with others in a free manner gives them insights into the lived experiences of the reference population they are embodying. Also, throughout the game, the user is allowed to choose between 8 different characters to appear as, four female and four male. The character they embody will result in different treatment from the virtual characters. By allowing the user to choose their appearance they gain different perspectives that they can compare and contrast the scenarios.

Visual agency refers to how much visual exploration is allowed during the experience and how it can affect empathy. The main goal with empathy tools that utilize visual agency is, in some way, to look through the eyes of the reference population and see the world in their way. The work by Bindman et al. [10] explores free visual agency and its effect on empathy. The user wears a head-mounted display and visually explores a film about aliens arriving on Earth and interacting with animals. The user sees through the eyes of one of the characters and has to try to figure out what creature they are (a bunny) by looking around and observing how other characters interact with them. Participants that saw themselves as the character reported higher levels of engagement and empathy. Limiting visual agency may also affect empathy.

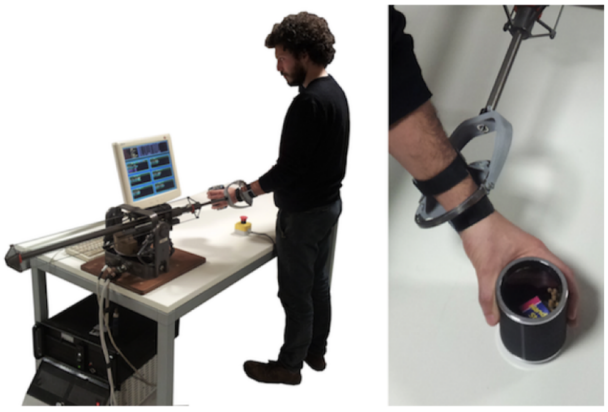

Figure 5: Wrist worn haptic-hand tremor device that simulates the recorded tremor patterns from people with neurological disabilities [57].

4.1.2 Narrative Agency. Narrative agency is the amount of choice the user has in controlling the experience with the empathy tool. The amount of choice the user has over the experience can affect the empathetic response depending on the intention of the tool. Narrative agency appears as a scale with either no narrative (9 papers in the corpus), linear (4 papers in the corpus), branching (9 papers in the corpus), and open-ended (4 papers in the corpus).

No narrative is a tool that does not guide the experience. By not guiding the experience with the tool the user can have free exploration and experience it their own way, like in the above-mentioned work of Beuthel et al. [9]. During this experience, while the user is wearing the device to simulate either a migraine or chronic knee pain, they are not given any tasks to complete nor any information on what they are meant to experience. The researchers wanted to see if the users would come to understand the design of their tool simply by experiencing the reference populations' struggles.

With *linear narrative*, the user follows the experience in a set series of events with no choice from the user. An example of an empathy tool with a linear narrative is the work by Aitamurto et al. [3]. In this work the users sit in a swivel chair, wearing a head-mounted display and watch a 360 video of a dramatized situation of gender inequality in the workplace. The user can switch between the female characters' side of the story and the male's by turning 180 degrees. The story progresses regardless of which view the character is in and they have no influence over the narrative.

Branching narrative gives the user more agency and choice in the experience. The user is still guided through the experience but is allowed to make decisions and change the outcome based on the decisions. An example of a branching narrative is the game developed by Braley et al. that aims to change the way the users view people who live in poverty and have more empathy for them [13]. This is a mobile game where the user interacts with other characters through fictitious messaging and email applications. They gain story elements through these apps as well as through news and media apps. The choices the user makes throughout the game will affect their financial and social capital. The options give the user

a sense of control but the limiting of options provided is meant to create stress, similar to real life, and result in empathy.

Finally, *open-ended narrative* provides the user with a guide through the experience but free choice within it. An example of an open-ended narrative is the Dyslexperience project created by Yong et al. which is a book using projection mapping to simulate different variations of dyslexia in an exhibit (Figure 6) [67]. The user can follow the book in a guided experience and they are free to explore it in whatever manner they wish, how they look through the book does not affect the overall experience of the tool.

Synthesis. The amount of agency an empathy tool allows the user to have in the experience can change how it resonates with them. By allowing the user to have agency in interactions with the space, objects and others the tool can create a deeper sense of realism, and ideally, a deeper understanding of the reference populations real lived experiences. Similarly with narrative agency, if the user feels in control of the narrative surrounding the experience with the tool they can understand that the issues the reference population faces are not through their own actions but the circumstances around them.

4.1.3 Technologies for Agency. As shown in Table 2, the most common mediums for empathy tools that utilize agency as the primary design strategy are virtual reality (2) and video technologies (1 standard video, 1 360°video). Virtual reality creates simulated environments and situations that the user can interact with in different ways (without real-life consequences). This allows designers of empathy tools to explore different ways of supporting or limiting the user's agency in a more controlled way through different interaction techniques within the environment. The work described above by Muller et al. [51] is an example of how virtual reality can be utilized for agency. Designers can also explore all forms of narrative agency using VR by either creating a space to move freely without guiding the experience (no narrative agency) or providing a guided experience that is linear with little narrative agency to a more open-ended experience. Video too can be used to explore interactive agency, especially through visual agency, as seen in the examples from the corpus. Video also provides designers with a means to a more linear narrative—as in the work by Aitamurto et al. [3] described above.

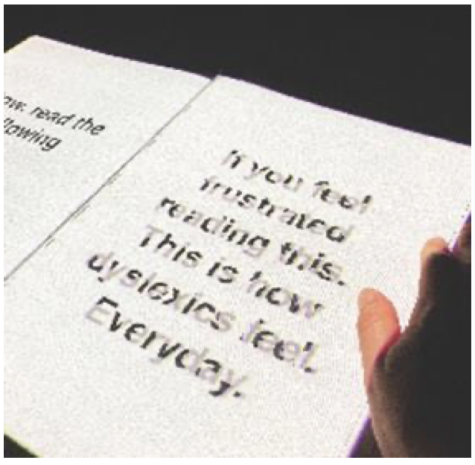

Figure 6: The Dyslexperience project uses projection mapping to simulate the effects of dyslexia presented in an exhibit [67].

4.2 Perspective

Perspective refers to how the user views the experience created by the empathy tool: is the user a member of the reference population, or do they observe an interaction involving the reference population? In our corpus, we observed: 18 instances of first-person perspective (the user is a member of the reference population), 4 instances of second-person perspective (the user "stands" immediately next to a member of the reference population), and 2 instances of third-person perspective (the user observes a member of the reference population). The remaining 2 examples from our corpus use a combination of perspectives.

The most common perspective in the literature is *first-person perspective* because most empathy tools attempt to place the user in the shoes of the reference population. The main idea for these tools is to evoke empathy by placing the user directly into the experience of the reference population the designers are trying to create empathy for. The most obvious example of an empathy tool with a first-person perspective is empathy tools created with immersive technologies. These tools utilize mixed and virtual reality to put the user in the body of the reference population to 'see through their eyes'. However, immersive technologies are not the only way to accomplish this perspective. For example, the wear.mascha project by Beuthel et al. [9] presents a wearable device that simulates the effects of a migraine by using elastic straps and styrofoam balls in a headpiece to create tension and pressure. The device also includes vibrating disks beside the ears to simulate tinnitus. With this tool, the user experiences the effects of a migraine while remaining in their own "body".

Empathy tool designs have also explored the *second-person perspective* to evoke an empathetic response in the user. The second person perspective is where the user is interactive within the experience but does not directly experience what the reference population does. An example of an empathy tool in the second person perspective is the live-action interactive VR experience Injustice created by Cho et al. [16]. The user wears a head mounted display and plays through a scenario at a bus stop where they encounter a young African American man on his way to the gym. The user has a conversation with the character that flows around the user's responses. During the encounter two police officers approach the young man, stop him and frisk him, the user has the choice to comment, observe or do nothing, changing the story based on the response. The user does not necessarily experience the injustice of the African American character (the reference population in this example), but bears witnesses to it and is an active participant in the experience (Figure 7). The goal of empathy tools in the second perspective is to still evoke an empathetic response by witnessing first hand the plight of the reference population.

The *third-person perspective* aims to evoke empathy in the user for a reference population but the user is a part of the experience as an observer. An example of empathy tools from the third-person perspective is the work of Liu et al. [48]. This work explores the

Figure 7: Injustice uses second-person as a design strategy to evoke empathy in the user by witnessing unjust racial profiling [16].

effect of visualizing heart rate data of an interviewee from a stigmatized group. The user reads through a transcribed interview of a convicted drug addict while viewing visualizations of the interviewees' heart rate data. The user experiences the interview with the visualizations but does not interact with the interviewee or directly experience what the interviewee experiences.

Finally, some empathy tools have explored the use of multiple perspectives to evoke empathy for a reference population. These tools use a combination of first, second or third person perspectives to create an empathetic response.

Synthesis. The perspective of the user can affect how the user reacts to the experience. Kors et al. [43] describe how different perspectives in persuasive games create different experiences for users. A first-person, 'victim' perspective brings more understanding to the 'victim' of the scenario and draws the user to the question of, "What would I do myself, in this situation?" However, this can potentially cause the user to empathize with only themselves. A second person, 'partaker' perspective allows the user to interact with the victim in a face-to-face interaction. In this more real-life scenario, the user is stimulated to question their own attitudes towards the affected group. A third person, 'observer' perspective gives an overall outsider view without social interaction. This perspective allows designers to portray situations that have multiple standpoints on an issue. Depending on the experience, the designer of the empathy tool is creating the point of view chosen will help create an empathetic response.

4.2.1 Technologies for Perspective. Empathy tools that use perspective as the primary design strategy for evoking empathy have used a variety of technologies to give the user different perspectives. We expected more immersive technologies to be used because they can place the user in different perspectives the most easily, like in the example described above by Cho et al. [16]. In this example, the designers use virtual reality to place the user in a situation where they witness racism, without having to either have actors on hand during the study to create the experience or have participants read about it. However, as seen in Table 2, virtual reality was only used in two cases from the corpus and one with 360°video. The others use desktop and Kinect games, text/chat applications, and a tangible object, showing that different perspectives can be achieved through many different kinds of technologies. Yoo et al. [68] created a tangible device designed to place a parent in the perspective of their child during a conflict. A camera is worn by the child and begins recording from their perspective when a conflict is detected, the parent can then see themselves through their child's eyes to gain understanding and empathy for the child's point of view.

4.3 Sensation

Sensation refers to the creation/generation or limiting of sensorial input to the user from the empathy tool. From our set of empathy tools, we see that physical sensations can be simulated in the wearer in three different methods: (1) mobility limitations, (2) perceptual limitations/augmentations, and (3) physiological. In our corpus, we found 4 instances of mobility limitations, 8 instances of perceptual limitations/augmentations, and 5 using physiological measures.

4.3.1 Physical Limitations. Mobility limitations refer to designs in the empathy tool that physically restrict the mobility of the users. Restricting movement in the user allows them to gain a deeper understanding of the daily experiences and struggles of others. For example, Gerling et al. [30] created a persuasive game to evoke empathy for people in wheelchairs and accessibility issues where the user controls an avatar in the game with a physical wheelchair. In the game the player uses the wheelchair to control a character navigating a city, completing errands and arriving at a birthday party on time. During the game, the player encounters common obstacles such as stairs and has to find alternate routes. By placing the user in common situations that are not typically obstacles for them, empathy can be created through a better understanding of these challenges. We have also seen other kinds of mobility limitations: for example, the wear.x project by Beuthel et al. [9] are two wearable garments that simulate the effects of a migraine (wear.mascha) and of knee pain (wear.giovanni). This project aims to create empathy for people with chronic pain that is typically unseen. Wear.giovanni physically limits the users by placing a can behind the knee, simulating limited mobility caused by knee pain. Similar to [30] the user gains an empathetic understanding for the reference group by having normal functions restricted.

4.3.2 Perceptual Limitations/Augmentation. Perceptual limitations and augmentations refer to designs in empathy tools that alter the user's senses such as hearing, vision, speech, smell, and tactility. These tools aim to evoke empathy by altering the user's perceptions by either removing or augmenting them in various ways. The most common occurrence of this design strategy in the literature has been to simulate auditory and visual impairments. As mentioned above, the mixed reality game Alzheimer's Eye Challenge [45] is an example of this design strategy. In this game, the user completes tasks in a timed event while experiencing visual effects similar to cataracts, muscular degeneration and glaucoma with visual filters in real-time (Figure 8. The user's hearing is also affected by audio filters simulating reduced hearing and tinnitus. The goal of this tool is to allow users to experience the symptoms of Alzheimer's and gain a better understanding of the lives of this population and the ageing population in general, and in turn, provide better care.

Another example of perceptual alterations being utilized to create empathy is in another mixed reality game, A Breathtaking Journey [42]. As described above, the goal of this game is to place

the user in a simulation of refugees' experience fleeing a war torn country. In the simulation, the user sits in an orange crate, and the tool uses orange scent to stimulate the olfactory senses, making the experience feel more real. The author's idea in this tool is to increase the sense of presence in the game, allowing the user to step into the shoes of the reference population. In this example, we can see that sensory limitations and augmentations can be used for not only reference populations with physical impairments but also for social issues.

4.3.3 Physiological. Physiological sensations refer to affecting biosignals in the user's body such as breathing, heart rate, galvanic skin response, etc. to evoke an empathetic response in the user. Biosignals are the automatic or involuntary responses of the body, such as breathing and heart rate, which are affected by emotional responses. An example of how biosignals can be utilized to create empathy is in the Breeze project by Frey et al. [27]. In this work, the authors create a wearable pendant that measures breathing patterns and sends the biofeedback to another user. The idea is to evoke empathy for another's emotional state and create a sense of connectedness between people over a distance. They show that the user's breathing rate will change to match the pace of the biofeedback pace, without instruction to the user to do so, creating a shared reaction can help the user to understand the feelings of the other person.

4.3.4 Technologies for Sensation. As expected, empathy tools that use sensation as the primary design strategy mostly use tangible technologies, such as worn or object devices (Table 2). Tangible devices can influence sensations the most easily due to the physicality of such devices. In the above example by Gerling et al. [30], the user's mobility is affected easily because the designers chose to use a physical wheelchair as the controller in their tool. Visualizations are also used in empathy tools that utilize sensations. These tools are recording physiological sensations such as breathing, heart rate and electro-dermal activities of a reference population and are displaying it back to the users to create an empathetic response. Hassib et al. [34] for instance, created a mobile chat application integrated with a real-time heart rate data visualization as a cue to increase awareness and empathy between correspondents.

Figure 8: The Alzheimer's Eye Challenge mixed reality game simulates the effects of visual aging symptoms such as (1) normal vision, (2) cataracts, (3) muscular degeneration, and (4) glaucoma [45].

5 DISCUSSION

The design strategies framework helps us to understand certain design choices that empathy tool designers have made. We illustrate this by relating the design strategies framework with the earlier framing of empathy tools in relation to target audiences and deconstructing a case study of an empathy tool using the framework. Finally, based on our findings, we provide several recommendations for the design and evaluation of empathy tools based on research from the field of psychology.

5.1 Empathy Tool Design Strategies for Different Audiences

In this work, we have presented two different ways of categorizing empathy tools: (1) the target audience of the tool (designers, caregivers, and the public), and (2) the techniques utilized by the tools (agency, perspective, and sensation). As illustrated in Table 3, while this relationship is not 1-1, we observed three trends: empathy tools for designers tended to rely on sensation strategies; empathy tools for caregivers tended to rely on perspective strategies, while empathy tools for the public relied equally on agency and sensation.

Empathy tools for product designers primarily use sensation design strategies to evoke empathy, and this is likely related to *how* they were used. Many of the empathy tools in our corpus were designed to limit mobility—both as a way to evoke empathy, and also as a way to simulate how certain populations might experience products or experiences (e.g. [2, 38, 50]). Such empathy tools thus gave designers a way of rapidly testing out product designs.

Empathy tools for caregivers tended to use perspective as the primary strategy in their designs. An important aspect of training caregivers (particularly those functioning in an institutional capacity, where they may be working with patients with a variety of conditions) is to deinstitutionalize the caregiving, personalizing the treatment of patients. As such, the goal of tools aimed at caregivers is to help the user gain a better understanding of the lived experiences of patients to provide better care to the reference population. Caregivers may also be loved ones, but when conditions are difficult to describe or understand, a first-person perspective may be the most logical way to understand the experience.

Empathy tools for the public, particularly those focusing on social issues, tended to use agency and sensation to evoke empathy. This could be because designers targeting the public want to create awareness of the plight of a reference population, and affecting the user's agency in familiar situations can help create this awareness. This reduces the possibility of "victim-blaming" in such situations because it helps to illustrate the futility (or the absence) of various choices that privilege provides. Empathy tools for the public also have a high number of tools that primarily utilize sensation as a strategy. We had expected perception to be higher since the purpose of evoking empathy in caregivers is more closely related to the public. However, sensations in these tools typically aim to make familiar situations seem more real similar to how agency is used in tools for the public.

5.2 Case Study: Through Pink and Blue Glasses

In this section, we will discuss in more detail the above mentioned empathy tool experience designed by Muller et al. called Through

Table 3: Distribution of papers from our corpus by target audience categorization and primary design strategies.

	Agency	Perspective	Sensation
Designers	[3]	[10]	[17], [27], [34], [57], [62], [64]
Caregivers	[56]	[7], [32], [60], [68]	[9], [45]
Public	[13], [51], [54], [59], [63]	[16]	[30], [42], [48], [52], [67]

Pink and Blue Glasses [51]. This discussion focuses on how our framework can be used to describe this example of an empathy tool and design implications.

Muller's Through Pink and Blue Glasses allow users to experience gender stereotypes for both male and female characters [51]. In a VR environment, users experience different common sexism scenarios as various male and female characters. The user is free to choose what character of the eight they wish to embody but is directed back to the 'dressing room' throughout the experience so that they can gain perspectives from both a male and female character. Users are free in making choices to react to situations where sexism frequently occurs: in a bar, in the office and a toy store. The design objective of the experience is focused on realism, which the authors argue may increase believability and therefore the empathetic response of the user [51]. For example, in the bar scenario as a male character, the user will not be allowed to enter, if the player decides to react, the doorman character will accuse the player of being drunk and aggressive. From the female character perspective, the user will be allowed into the bar but experiences cat-calling and unwanted attention from a male patron, again if the user decides to react the result is another offensive comment from the male character. Participants reported that they found it easier to see the other gender's point of view, and results indicated an increase in awareness of sexism and willingness to act against sexism.

This example of an empathy tool uses several design strategies: first-person perspective, navigational agency, and character agency. The user experiences the VR game through the eyes of the character they are embodying as if they are in the situation themselves. They only see their appearance in the game in the 'dressing room' mirror where they choose their character. Therefore, the entire game is seen from a first-person perspective. When the user leaves the 'dressing room' stage, they move through the other scenarios where the character is allowed to explore the scene. The user is allowed to interact with the virtual characters, including the option to choose their responses, however, their responses are limited to predefined options. Finally, the user is given character agency by being allowed to choose who they are embodying from the eight characters provided. Their agency is limited to a degree by being forced to change characters throughout the game, a design choice made so they experience sexism from both points of view.

Our framework suggests generative opportunities for this work: what happens if certain aspects are removed, changed or added? For example, what would be the effect on the experience of this empathy tool if the perspective is changed from first person to second? Now instead of experiencing sexism firsthand, the user witnesses sexism happening and is given the option to intervene. Or how would the experience be affected if the perspective was in third-person, where the user can only observe sexism occurring? Unfortunately, we do not yet know in detail how these different techniques affect empathetic responses in the users; however, the framework presents a starting point for comparing and contrasting design strategies and their effectiveness.

5.3 Recommendations for HCI Research on Empathy Tools

A primary challenge faced by designers of empathy tools is how to make choices between alternative designs to elicit empathy. Given two alternative designs A and B, which will be more effective? Anecdotally, we know that many of these decisions are made today because of budget constraints, technology constraints (or opportunities), or artistic decisions. Yet, we argue that if the goal of an empathy tool is to increase empathy, then we should take a principled approach toward making these decisions.

To aid in the development of this "science" of empathy tool design, we distill findings from empathy research in social psychology to articulate different types of empathy, and to provide methods for measuring the impact of a tool.

5.3.1 Design implications of different kinds of empathy. Distinguishing between cognitive and affective empathy raises a contentious issue in empathy research (i.e. is empathy best understood as an affective construct, a cognitive construct or both?) [40]. Most researchers agree that both aspects are important, there still exists a debate over the definition and the measurement of empathy [49, 65]. Measurement scales of empathy typically include both affective and cognitive aspects so that researchers can evaluate and compare results independently.

Our analysis revealed that reflecting on the empathetic experience that designers wish to create for participants will impact not only the design of the tool but also the study methodology. Of the 26 papers in our corpus, only 8 state the type of empathy they aim for their tools to evoke.

Affective Empathy. Affective empathy is the capacity to respond appropriately to another's emotional state. Empathy research has shown that affective empathy can be difficult to manipulate because it relies on perceived similarities between oneself and the other person [37]. Such similarities might include gender or race, and can also include certain personal experiences (e.g. having faced discrimination) [37]. When evoking affective empathy in participants, designers should emphasize similarities between users and the reference population (or, de-emphasize differences). For instance, Muller et al. [51] evoke empathy for opposite genders by placing participants in contexts they can both relate to, such as a bar, the office and a toy store, and show the other's encounters with gender stereotyping in these contexts.

While affective and cognitive empathy are considered to be different components of empathy, Plumm and Terrance [55] state

that the two facets of empathy are linked: if a person has affective empathy (i.e. similarities with the target) then cognitive empathy will be more likely to be induced (i.e. put themselves in the shoes of the target). This indicates that even if empathy tool designers wish to create a cognitive empathic response, they should still need to emphasize similarities between users of empathy tools and the reference population.

Cognitive Empathy. Cognitive empathy refers to the capacity to understand another's perspective or emotional state. Cognitive empathy is considered to be easier to induce and manipulate because it relies on the observer's ability to imagine themselves in the situation of the target [55]. Perspective-taking is considered to be the main component of cognitive empathy. In empathy research, perspective-taking has shown to be effective in inducing cognitive empathy by simply explicitly instructing the participant to think about the situation and imagine themselves in the situation or to imagine how the target felt (versus control groups) [5, 55]. Empathy tool designers can easily take this approach of being explicit about the intention. Virtual reality has become a very popular medium for creating empathy tools—many of those in our corpus explicitly took this approach of putting the user into another's perspective.

5.3.2 Measuring Empathy: Lessons from Social Psychology. Empathy has been an area of psychology research as a phenomenon, and in applied contexts (i.e. to create better outcomes for patients under care). We believe that empathy tool designers can benefit from the work of psychology by adopting more of their methodological approaches to measuring empathy to evaluate a design's effectiveness—both in terms of immediate effect, and in terms of lasting effects.

Assessing Immediate Impact of Empathy Tool. Similarly to the variety of definitions of empathy there is also a diversity of measures for empathy [29]. Empathy can be assessed in behavioural responses/observations (eg. prosocial actions), physiological measures (e.g. heart rate, skin conductance, facial mapping, etc.), neurological responses using fMRI, and self-reported measure scales for attitude change. The most common measures of empathy are Likert type, self-reported measurement scales because they are the easiest to administer. Davis's Interpersonal Reactivity Index (IRI) is an example of such a measure that includes both affective and cognitive aspects of empathy [29]. Another popular measure used in psychology is the Questionnaire for Cognitive and Affective Empathy (QCAE). The QCAE is a more recent self-report scale developed from a pool of items from several existing self-report scales (including the IRI) with the strongest validity [36]. The QCAE focuses more on understanding and mentally representing another's emotions while the IRI more broadly assesses perspective-taking in non-emotional contexts [36].

All of the works with explicit evaluations of empathy found in our corpus utilized some of these self-reported measurement scales. Some self-reported measures address only the emotional aspects of empathy, while others only the cognitive aspects [29]. From the corpus, 5 of the 8 papers that evaluate specifically for an empathetic response use the IRI scale or a subset of questions from it. Knowing which aspects of empathy a designer of an empathy tool wishes to evoke will help them decide on which measure will be the most effective for their goal. We recommend measures such as IRI or QCAE (in unabbreviated forms) to assess the immediate impact of an empathy tool.

Longer Term Effects of Empathy Tools. Social psychologists also assess the longer-term impact of an empathy-inducing intervention. One method is to employ the pre-post-followup design, where the user is evaluated using self-reported scales a few days to a week before the experiment, after the experiment, and again a week to several months after the experiment. This method evaluates for a persistent change in empathy, and therefore long-term effects on the participants. Conducting the pre-study days or weeks before allows the participant to forget their responses, and to respond honestly after the intervention. Given that our community is concerned with the long-term effects of empathy tools, adopting such methods would be appropriate to assess lasting effects.

Triangulating Empathy. Gerdes et al. argue that self-reported measures of empathy should be used along with other methods [29] for better empathic accuracy. For example, self-reported scales can be used with physiological measures such as heart rate or skin conductance for later comparison. Researchers from neuroscience use fMRIs to measure neurological empathetic responses, though this is considered as labour intensive in psychology studies [29]. However, given that many empathy tools from our community are made of worn objects (e.g. a suit, a headset), some of these other forms of measurement may be more easily integrated—for instance, skin conductance, heart rate, or even some forms of EEG. Therefore, we suggest empathy tool designers to also try incorporating these more technological measurements into their designs in addition to self-reported scales.

Methodological Considerations. In terms of deploying empathy tool experiences, several findings from the psychology literature may be useful to empathy tool researchers. First, Jones and Pittman suggest keeping the gender of the researcher the same as the participant to minimize cross-gender self-presentation concerns, where the opposite gender may act more reserved or how they want to be perceived instead of how they actually feel [41]. Second, it is suggested that researchers keep the gender of the participants as even as possible between study groups, as females have consistently rated higher than males on empathy measurement scales, which could lead to skewed results if one group has a higher number of female participants [36]. Third, Batson et al. suggest informing the participants to imagine themselves in the situation (of the reference population) before the experiment, because more perspective-taking can occur resulting in a more lasting empathetic response [5]. Finally, Batson also suggests telling the participants that the experience is based on a real person from a reference population before the experiment because believing the experience is fiction based has negatively effected empathy in participants [5].

How Much Discomfort to Induce. A recurring theme we observed in the corpus is how empathy tools create a sense of discomfort. Empathy tools place users into the challenges and issues that the reference population regularly encounters, therefore the user is likely to feel uncomfortable facing unfamiliar scenarios, experiencing stress, frustration, anxiety, concern, and so on. In the literature, we have seen three overall types of discomfort: physical, cognitive and social. Physical discomfort is when the user experiences physical issues (e.g. mobility limitations). Cognitive discomfort is when the user experiences issues that disrupt thinking

processes (e.g. Aphasia). Finally, social discomfort is when the user experiences a social issue (e.g. sexism). Goubert et al. [31] found that prior personal experiences with pain generally lead to more empathetic responses when observing someone else in a similar situation. In this way, empathy tools can prepare a user for similar situations in the future. In the IRI self-reported empathy measurement scale, affective empathy is described as being composed of personal distress—the tendency to feel pain or distress when seeing others in unhappy situations. While personal distress is a part of affective empathy, too much can have an adverse self-focused effect, resulting in the person feeling empathy towards themselves and taking action to better their own feelings instead of others [4]. This means that empathy tools that create an experience with too much discomfort can lean to the user feeling empathy for their own discomfort rather than empathy for the reference population which is the goal. Designers of empathy tools should be cautious of how much discomfort or personal distress the user of their tools are feeling to avoid self-focused effects. Therapist Carl Rogers states that when feeling empathy, the 'as if' aspect needs to be maintained. This means that while the user shares the experiences of the reference population there needs to be a self-other distinction maintained, this boundary between oneself and others is essential to empathy [31].

6 LIMITATIONS AND FUTURE WORK

The framework we have developed focuses on a specific type of empathy tool that we are interested in as HCI researchers and designers. Specifically, we are interested in designing interactive empathy tools for helping people understand the experiences of other people. This creates three types of limitations in our view and understanding.

Limitations of the framework based on sources. To keep the corpus a manageable size, we chose to only include the ACM DL, thereby focusing our search on HCI research from a "computer science" disciplinary perspective. This necessarily excluded other libraries and other disciplinary perspectives on empathy. However, HCI researchers may want to refer to literature from other fields (e.g. nursing, psychology) to gain a broader understanding of evoking empathy. We also excluded papers that did not mention empathy in the title, abstract, keywords or body of the paper, though papers mentioning persuasion, behaviour and attitude change might have yielded interesting insights. In future work, the framework can be expanded to include research that aims to effect these other behaviour manipulations that also influence empathy.

Limitations of the framework based on our perspectives as HCI researchers. Our corpus only included examples from academically published sources and therefore are missing other examples from games, persuasive journalism, installations, etc. and could be missing other modalities. By excluding these forms of empathy tools from the framework we could be missing other design strategies and methods for evoking empathy. Future work can explore these empathy tools and expand our framework to incorporate the findings.

Limitations of the framework based on the reference population. We also chose to focus on works relating to empathy for other groups of people. This excluded fascinating forms of empathy tools that consider empathy for self and non-human entities. Thus, our exploration misses out on some particularly creative approaches for mapping between these experiences and human experience. In the future, the framework can be expanded or derived to explore examples that look at other important issues such as animal rights, environment, and personal behaviour changes (mental and physical welfare).

Future Technologies. Future revisions to the framework will likely need to account for new types of interactive technologies that we cannot foresee at this moment, as well as new types of challenges and reference populations that still do not have a voice. As this work is primarily about classifying empathy tool work that exists today, it serves as a basis for future iterations of the framework.

7 CONCLUSION

In this work, we systematically evaluated 26 examples of empathy tools described in the HCI literature. We present a descriptive framework that aims to create a single vocabulary to help create a common understanding of these tools. Empathy tools are technological devices designed to help people understand the lived experiences of others. Empathy tools have been designed with three target audiences in mind: for designers to understand their end-users and improve designs, for caregivers to understand their patients and provide better care, and for the public to gain a deeper understanding of other's lives. Our framework found commonalities in three different techniques for designing empathy tools. How much agency the user has, what their perspective is, and what sensations they experience. However, this framework only provides a way for designers to describe and begin a discussion of empathy tools. This framework can help guide future research in empathy tools to evaluate the most effective techniques for evoking empathy. This work also provides recommendations for designers of empathy tools to aid them in honing their designed experiences by pulling from research on empathy in psychology.

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