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Examining Cognitive Empathy Elements within AI Chatbots for Healthcare Systems

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EXAMINING COGNITIVE EMPATHY ELEMENTS WITHIN AI CHATBOTS FOR HEALTHCARE SYSTEMS

By

Lamia Alam

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Abstract

Empathy is an essential part of communication in healthcare. It is a multidimensional concept and the two key dimensions: emotional and cognitive empathy allow clinicians to understand a patient's situation, reasoning, and feelings clearly (Mercer and Reynolds, 2002). As artificial intelligence (AI) is increasingly being used in healthcare for many routine tasks, accurate diagnoses, and complex treatment plans, it is becoming more crucial to incorporate clinical empathy into patient-faced AI systems. Unless patients perceive that the AI is understanding their situation, the communication between patient and AI may not sustain efficiently. AI may not really exhibit any emotional empathy at present, but it has the capability to exhibit cognitive empathy by communicating how it can understand patients' reasoning, perspectives, and point of view. In my dissertation, I examine this issue across three separate lab experiments and one interview study. At first, I developed AI Cognitive Empathy Scale (AICES) and tested all empathy (emotional and cognitive) components together in a simulated scenario against control for patient-AI interaction for diagnosis purposes. In the second experiment, I tested the empathy components separately against control in different simulated scenarios. I identified six cognitive empathy elements from the interview study with first-time mothers, two of these elements were unique from the past literature. In the final lab experiment, I tested different cognitive empathy components separately based on the results from the interview study in simulated scenarios to examine which element emerges as the most effective. Finally, I developed a conceptual model of cognitive empathy for patient-AI interaction connecting the past literature and the observations from my studies. Overall,

cognitive empathy elements show promise to create a shared understanding in patients-AI communication that may lead to increased patient satisfaction and willingness to use AI systems for initial diagnosis purposes.

1 Introduction

Empathy is one of the most important elements of human-human interaction as it helps to respond appropriately to the situation and understand how others may feel or think. There are many aspects of empathy, and it has been identified to have two main categories: Affective or Emotional Empathy and Cognitive Empathy (Gladstein, 1983). Emotional empathy is the capability of understanding the emotion we see another person experiencing, whereas cognitive empathy is the capability of understanding another person's point of view, reasoning, and concerns. Like any other social relationship, empathy plays a major role in patient-physician communication and research also shows that it leads to better healthcare outcomes if the patients perceive that the physician can empathize with their situation (Free et al., 1985; Kurtz and Grummon, 1972). Physicians are often exposed to high levels of negative emotions in a very stressful environment, thus emotional empathy may not be a great way to develop better communication with patients as it may influence the capacity of decision-making ability of the healthcare professionals (Figley, 2011). But cognitive components of empathy such as understanding patients' problems, and their perspectives, and responding to the situation based on that may go a long way. Based on an interview study with physicians, Alam (2020) found that physicians consider empathy as one of the important explanation elements in better patient-physician communication. Several empirical studies also reported that patients' perceptions of their physicians' empathy are positively related to more favorable health outcomes (Blatt et al., 2010; Bukowski et al., 2020).

As artificial intelligence (AI) is being deployed heavily to support healthcare systems at present days, it is important to ensure that patients are satisfied with the systems. As empathy has been considered to have multidimensional aspects (Davis, 1980), we suspect that the emotional components of empathy are not easy to incorporate within patient-AI communication. Cognitive components of empathy can potentially be incorporated into these communications by improving the aspects of artificial empathy and perspective-taking approaches within these. If there is a shared understanding of the situation and the patient and AI can comprehend each other's perspectives during this human-AI interaction, it will provide opportunities for effective communication (Klein et al., 2005) that eventually may lead to patient satisfaction. For this, we need a better understanding of the elements of cognitive empathy and how these elements can be utilized effectively and be incorporated into AI systems that may help improve patient perceptions of AI empathy.

For my dissertation, I look forward to addressing these issues. To successfully incorporate cognitive components of empathy into AI systems, we need to extract the cognitive empathy elements from patient-physician communication and mirror them in patient-AI communication. We also need to understand which elements of cognitive empathy are most effective during patient-AI interaction. In the next section, I would review the literature on the related research. In the following chapter, I would discuss the empathy scale I developed for understanding user perception of AI empathy and a small lab experiment for the psychometric assessment of the scale. Next, I will describe the methods and results of another lab study assessing the empathetic elements separately, one interview study with first-time mothers to extract the elements of cognitive empathy from patient-physician

interaction, and another lab study assessing cognitive empathy elements based on the analysis of the interviews. Finally, I will provide a conceptual qualitative model of the taxonomy of cognitive empathy based on the theoretical and experimental perspectives within the context of diagnostic AI chatbots and provide some design recommendations about how these chatbots may incorporate cognitive empathy elements for patient communication.

2 Review of Literature

In this chapter, I review relevant literature on empathy and its application in AI systems. This involves four main areas of investigation: i) Taxonomy of Empathy, ii) Empathy Scale, iii) Application of Artificial Empathy (Empathy in AI systems), and iv) Empathy in patient-centered care. To understand how we can integrate artificial empathy into AI systems, we first need to understand the elements of cognitive empathy and how they are evaluated. I will first provide a basic overview of the taxonomy of empathy.

2.1 Taxonomy of Empathy

The term empathy is common across a variety of disciplines, including psychology, philosophy, and sociology. Though there has been diversity in conceptual and operational definitions of empathy, most conceptualizations include an element of shared understanding of another person's feelings (Hall & Schwartz, 2019). Decety and Jackson (2004) define empathy as the ability to perceive, understand, and feel the emotional states of others that play a vital role in social interaction. For centuries, philosophers have pursued empathy and developed many moral theories (Hume, 1739; Mead, 1934; Smith, 2006). In the last century, empathy has mostly been pursued by developmental and social psychologists and has been an important topic within the context of cognitive science (Davis, 1980; Duan & Hill, 1996; Feshbach, 1975; Gladstein, 1983; Kestenbaum et al., 1989). Empathy has been identified to have two main categories: Affective or Emotional Empathy and Cognitive Empathy (Gladstein, 1983). Some viewed empathy primarily as an affective phenomenon (Allport, 1961; Mehrabian & Epstein, 1972), which means the

capacity to respond with appropriate emotion and to physically feel what other people feel. Others view the cognitive construct as the primary one (Deutsch and Madle, 1975; Rogers, 2001; Woodall and Hill, 1982). It refers to the ability to understand how a person feels and what they might be thinking. It pertains to interpersonal sensitivity and the ability to understand the position the other person is in. Cognitive empathy has often been linked with other concepts like perspective-taking and theory of mind (Davis, 1983; Leslie, 2001). There are also some other categories discussed in the literature. Morse et al. (1992) summarized the components of empathy under four key areas that have two additional areas than affective and cognitive empathy. They identified those as moral and behavioral empathy. In their definition, moral empathy is an internal altruistic force that motivates the practice of empathy and behavioral empathy is the communicative response to convey an understanding of another's perspective. Somatic empathy is considered another type of empathy which is the tendency to automatically mimic sensory output such as facial expressions and movements of others (Blair, 2005; Raine & Chen, 2018). Ekman and Goleman discussed compassionate empathy that goes beyond simply understanding others and sharing their feelings: it actually moves us to take action, to help however we can (Ekman and Goleman, 2007).

2.1.1 Affective or Emotional Empathy

Affective or emotional empathy is defined as one's emotional, sensorimotor, and visceral response to the affective state of another, and encompasses the efficient, automatic, and fast process with minimum involvement of consciousness (Yu and Chou, 2018). Affective empathy includes processes that are responsible for one's having a feeling more

appropriate to another person's situation than to one's own situation (Hoffman, 1984). Some theorists and researchers have defined empathy in solely affective terms (Feshbach, 1975; Hoffman, 1984; Mehrabian & Epstein, 1972). Some others have defined empathy as a person's vicarious matching of another's affective state (Feshbach and Roe, 1968; Stotland, 1969), but it is a different phenomenon from sympathy as it stems from another's emotional state or condition that is not identical to the other's emotion, but consists of feelings of sorrow or concern for another's welfare (Eisenberg and Miller, 1987). Thus, to empathize affectively means feeling the same and similar emotion someone else is feeling. It has long been shown that affective empathy can rapidly occur (Dimberg and Thunberg, 1998), even outside of our consciousness and awareness (Neumann and Strack, 2000). It is also suggested that affective empathy quickly emerges and appears stable in early development (Knafo et al., 2008; Roth-Hanania et al., 2011). A negative relationship between affective empathy and aggression is found more consistently in adolescents than in children (Lovett and Sheffield, 2007). Eisenberg and Miller (1987) found that affective empathy was positively and significantly related to measures of prosocial or altruistic behavior. Overall, behavioral findings support the idea that affective empathy is a basic and primitive beginning of empathy (Hoffman, 2001).

Affective empathy is an important factor in patient-physician communication. The affective aspect of physician empathy is defined as the physician's ability to respond to and improve his or her patients' emotional state (Kim et al., 2004). Derksen et al. (2013) found a strong correlation between physician empathy and patient satisfaction studying 964 original studies. They also found a direct positive relationship between physician

empathy and patient satisfaction. Understanding patients' emotional states and responding to them accordingly works as the basis of patient-centered care and it is also an important component of professionalism in healthcare (Mercer & Reynolds, 2002; Shapiro, 2008).

2.1.2 Cognitive Empathy

The ability to understand and explicitly reason another person's perspective, intention, and mental state is known as cognitive empathy (Eisenberg & Miller, 1987; Shantz, 1975). The development of this ability is seen as relying on both basic cognitive developmental processes (movement from cognitive egocentrism) and the acquisition of specific reasoning abilities relating to social and ethical issues (Underwood & Moore, 1982). Ford (1979) defined egocentrism as "an embeddedness in one's own point of view". Humans learn to recognize and understand others' emotional states to process emotions and behavior. Cognitive empathy is often linked with perspective-taking and theory of mind. Perspective-taking is a cognitive capacity to consider the world from other viewpoints and allows an individual to anticipate the behavior and reactions of others (Davis, 1983). Perspective takers can step outside the constraints of their own immediate, biased frames of reference (Moore, 2005). Theory of mind research investigates understanding of people as mental beings, who have beliefs, desires, emotions, hope, and intentions, and whose actions and interactions can be interpreted and explained by taking account of these mental states (Leslie, 2001). Cognitive empathy, perspective-taking, and theory of mind altogether is a complex and multifaceted socio-cognitive process that enables us to recognize and appreciate another person's point of view, whether it be the same or different from our own.

They are critical in guiding successful social interactions, effective communication, and prosocial behavior.

Patient-physician communication also has a cognitive construct of empathy. The cognitive aspect of physician empathy is defined as the physician's ability to accurately apprehend the mental state of his or her patients (the ability to take another person's point of view) and to effectively communicate this perspective back to the patients (Kim et al., 2004). Cognitive empathy may help the physicians to understand and reason with patients' thoughts, experiences, and beliefs and communicate their perspectives back to the patients in a reasonable way. It is also a critical factor for patient satisfaction and adherence (Blatt et al., 2010). Lamothe et al. (2014) found that a higher level of perspective-taking was significantly associated with a lower proportion of burnout among physicians. In other words, it is when physicians are good at adopting the point of view of their patients that reduce the effect of exposure to stress. This suggests that physicians sharing patients' emotions (affective empathy) may have difficulty maintaining a sense of ownership regarding whose emotions belong to whom. To complement the effect of affective empathy, professionals need a high level of emotional regulation skills, as is reflected by high cognitive empathy. Affective sharing without emotion regulation skills may be associated with personal distress, compassion fatigue and burnout. This indicates that physicians need to able to empathize with the patients cognitively while keeping a certain affective distance.

2.1.3 Other Aspects of Empathy

Besides affective and cognitive empathy, there are some other aspects of empathy as well. Somatic empathy is the tendency to automatically mimic sensory output such as facial expressions and movements of others (Blair, 2005; Raine & Chen, 2018). It involves having a physical reaction in response to what someone else is experiencing is another way to show empathy. There is also a behavioral aspect of empathy that has been added to the everyday practice of the healthcare domain (Batson, 2014). Altruism and the therapeutic relationship both belong to the behavioral aspect which develops empathy into practice (Jolliffe and Farrington, 2006; Lantz, 2001). Altruism is a socially directed behavior aimed at relieving difficulties, problems, and the pain associated with them (King Jr, 2011). Empathy is often linked with other affiliative motives like altruism such as cooperation, trust, and support (Devoldre et al., 2010; Eisenberg and Miller, 1987). Ringwald and Wright (2021) argued that there is a clear relationship between affiliation and empathy, but it differs across people in the context of seeking out affiliative interactions. Despite its early origins and adaptive functions, empathy is not a universal response. Cikara et al. (2011) defined the reason behind it as "intergroup empathy bias" as people often feel less empathy for strangers who belong to a different racial, political, or social group, compared to strangers who are described as belonging to the same group. Group membership may modulate empathy by enhancing in-group empathy or by reducing out-group empathy (Avenanti et al., 2010).

2.2 Measuring Empathy via a Psychometric Scale

There have been many empathy scales developed to understand the perception of empathy. Some of them are designed to examine self-reported empathy, some are more focused on rating someone else's ability to empathize and perspective-taking. The earlier empathy scales had given little consideration to the multidimensionality of the concept of empathy. Hogan (1969) constructed empathy measures including both cognitive and emotional items yet it was a combined response to both types of items into a single empathy score. Similarly, Mehrabian and Epstein (1972), developed a measure strictly of emotional empathy, it also consists of some items assessing what can only be described as cognitive responses. And all items on this measure are also summed to produce a single empathy score. Davis (1980) developed a multidimensional scale to measure different dimensions of empathy and this scale assesses four separate and relatively independent qualities of the individual: fantasy, empathetic concerns, perspective-taking, and personal distress. This scale has been adopted in many ways to understand the nature of empathy in research. For example, Long and Andrews (1990) adopted the perspective-taking subscale to assess the degree to which married couples can understand each other's viewpoints. Jolliffe and Farrington (2006) developed another empathy scale to assess affective and cognitive elements separately. They focused on having a valid measure of cognitive empathy and recognized it as essential for understanding the relationship between empathy and offending as both affective and cognitive empathy. Empathy scales have also been developed for patient-physician interactions. Jefferson Scale of Patient's Perceptions of Physician Empathy (Kane et al., 2007) measures patients' perceptions of their physician's

empathic engagement and understanding of the patient. This 5-item questionnaire does not differentiate between cognitive and affective empathy elements, it only examines the overall patient perception of physicians' empathy. Research shows that patients' perceptions of a caregiver and physician empathy are associated with a positive treatment outcome for patients (Free et al., 1985; Kurtz and Grummon, 1972). Reynolds (2000) developed a 12-item empathy scale for nurse training by collaborating with patients that identify helpful and unhelpful behaviors. This scale focuses more on the affective emotional components and less on the cognitive ones, though it does not address the multidimensionality of empathy as well.

2.3 Application of Artificial Empathy

Autonomous systems are often designed to work in a shared environment with people that require human-computer interaction (HCI). Emotion and expressive behavior can have an impact on this interaction and social robotics come into play for such behavior specially in teaching and other communicative social scenarios (Breazeal, 2002). An empathetically interacting robot is expected to increase the level of acceptance of social robots. Emotions may come through different forms of communication within social robotics: natural language processing, facial expression recognition, gesture communications, etc. (Cassell, 2000; Dario, 1996; Kawamura et al., 1996; Miwa et al., 2004; Ogata & Sugano, 2000; Rickel and Johnson, 2000). Humans are able to perceive empathy and emotions in robot speech and prefer it over the standard robotic voice (James et al., 2018). Empathic behaviors of artificial agents may range from neatly defined tasks as required such as

virtual guide, tutoring, caregiving, etc. (Graesser et al., 1999; M. Y. Lim et al., 2005; Nagai et al., 2010). These agents can detect and respond to human emotions and provide suggestions, feedbacks, and offer services according to that. There are challenges regarding finding the right balance of empathy within the agents in order to provide more empathic and effective services. In this section I am going to discuss what empathetic elements are found in existing artificial agents, specially in the field of explainable AI systems.

2.3.1 Social Robotics

Social robots are designed to interact and communicate with people in a natural, human-centric and interpersonal manner and to operate in human environments alongside people (Breazeal et al., 2016). Optimal human-robot interactions require robots to have the potential to provide effective social and task-related support, quick reactions to unexpected events, computational sophistication for meeting goals, and the ability to interact with other robots for the realization of goals of increasing difficulty (Duffy et al., 1999). They will require to connect with humans on both emotional and cognitive levels, understand human behavior and be able to empathize with humans to become a capable and competent partner. Nass and Moon (2000) stated that CASA (Computers Are Social Actors) is the concept that people mindlessly apply social rules and expectations to computers. This may extend beyond social interaction – humans are also likely to anthropomorphize social robots AI systems (Fink, 2012) and to reason about their behavior in terms of their own perspectives and human intelligence. Therefore, AI needs social understanding and communal intelligence to blend in the society (Dafoe et al., 2021). Hence, anthropomorphic design principles, spanning from the physical appearance of robots, to how they move and

behave, and how they interact with people, are often employed to facilitate interaction and acceptance. Social robots could be used in offices, pharmacies, hotels, cooking, marketing, entertainment, hobbies, recreation, personal assistant, child care, nursing care, therapy, and rehabilitation (Breazeal, 2003; Dautenhahn, 2002). The benefit that social robots provide people extends far beyond strict task-performing utility to include educational, health and therapeutic, domestic, social, and emotional goals (D. P. Miller & Nourbakhsh, 2016; Prassler et al., 2016; Van der Loos et al., 2016). Dautenhahn (2002) developed a toy robot whose purpose is to teach autistic children social behaviors. This robot, designed as a toy, is a social interface that is "interesting enough to catch and maintain" attention and "engage the child in therapeutically relevant interactions until the trial is ended". Dautenhahn's robot is designed both to take turns and to follow, and it has a behavior-based design. A number of socially interactive humanoid robots have been developed that can participate in whole body social interaction with people such as dancing (Tanaka et al., 2006), walking hand-in-hand (Lim et al., 2006), playing a musical duet (Solis et al., 2006), or transferring skills to unskilled persons (Solis et al., 2004). Breazeal and Scassellati (1999) outlined the development of a social robot, Kismet, that responds to its environment by way of infant-like prosocial responses (e.g., initiation, mutual orientation, greeting, play-dialog, and disengagement), mainly communicating its reactions through gaze and facial expressions. Kismet fits into the socially situated class of social robots because it learns from interactions with people. These social robots possess attributes of artificial empathy as they have the capability to identify human expressions, and emotions. They also attempt to communicate with and respond to human emotion and social situations like

humans by simulating model of human cognition. At present, they learn from human behavior and respond accordingly. Incorporating cognitive empathy, like perspective-taking within this system may aid the anthropomorphic design principles and make the human-robot interaction smoother.

2.3.2 Intelligent Tutoring

Most Intelligent Tutoring Systems (ITS) research emphasized that the system needed a method/model for how to interact with the learner (Clancey, 1987; Goguen et al., 1983; Weiner, 1980). Many intelligent tutoring systems focus on understanding or inferring each learner's mental model of the domain from their behavior. Intelligent tutors contain rich, dynamic models of learner's knowledge that depict the key ideas learners should understand as well as common learner conceptions and misconceptions (Woolf, 2007). Human instructors support student learning in many ways, e.g., by patiently repeating material, recognizing misunderstandings, and adapting feedback. Learning is enhanced through social interaction. Intelligent tutors also possess some of these traits, they observe student behavior and adapt teaching methods according to that. Their purpose is to provide knowledge that is used to determine the conditions for adjusting feedback. The long-term goal of the field of AI and education is to support learning for students with a range of abilities, disabilities, interests, backgrounds, and other characteristics (Shute, 2007). ITSs can conduct knowledge assessments based on what students know and can teach them after inferring what they are prepared to learn (Burton and Brown, 1979; Sleeman and Brown, 1982). To make it possible that the tutor agent makes decisions informed by the mental state of the student, the system has to construct a student model. If the tutoring systems can

do this properly, they can empathize with the learners and prepare materials based on what they know and what they can learn. This approach is one of the major elements of the empathic attitude of AI systems that have been applied to users and has been found to be effective in many cases (Beal et al., 2010; Lepper & Chabay, 1988; Woolf et al., 2010).

2.3.3 User Model

The need for a user model in the AI system has been discussed within explainable AI systems in general (Brézillon, 1994; Cawsey, 1993; Kass and Finin, 1988; Weiner, 1989). The user model ensures that the explanations generated from AI systems will suit the users or be modified to match users' mental models. This is akin to the student models of intelligent tutoring (Woolf, 2007). Some user models are also about tracking the users over time(Kelly and Belkin, 2002). This has also been discussed in the healthcare domain but from a different perspective. Darlington (2011) advocated the need for explanation in the healthcare expert system considering the user requirements of different stakeholders of the healthcare domain such as physicians, patients, administrators, and medical researchers. Personalization of explanation in AI systems has been discussed in XAI literature to draw attention to the lack of human aspects consideration in AI systems (Miller, 2019). One explanation cannot satisfy every user and therefore, there is a need to personalize these explanations. And, AI can achieve this goal by having an interactive environment where it can receive information about different aspects of its users. Google's People + AI Guidebook has described the best practices for designing human-centered AI products and

acknowledging the importance of interaction and explainability[1]. There are also other AI systems that personalize explanations in an interactive environment (Akula et al., 2019; Schneider and Handali, 2019; Sokol and Flach, 2020), but these systems did not emphasize the necessity of empathy within human-AI interaction. In an interview study with physicians, Alam (2020) found that physicians consider the empathetic aspects of communication with the patient and their families. These were not always about providing explanations or information but involved empathetic strategies to ensure their patient knew the physician listened and cared. This indicates that if AI systems may show empathy towards the user in the healthcare environment corresponding to the user's mental models, it will help improve the human-AI interaction as well.

2.3.4 Common ground: Human-AI Team

Common ground is an integral part of human-human communication, from the broadest joint activities to the smallest joint actions (Clark, 1996). The research on common ground started with the references in the conversation between experts and novices. As experts gain more expertise, their understanding of the topic becomes broader and more abstract, taking on the organization that novices cannot follow. When explaining certain concepts to novices, experts also must take on the perspectives of novices to make the most effective references Isaacs and Clark (1987) summarized the process into 3 stages: *assessing* (directly or in passing finding out the expertise level of the discourse

[1] https://pair.withgoogle.com/

partner), *supplying* (experts who are addressing novices can expand their contribution to explain the reference), and *acquiring expertise* (novices speaking to experts acquire knowledge and fill in the gaps during conversation). Throughout these communications, experts supply expertise and novices acquire it and they reach a shared understanding of the situation with the help of shared knowledge and a shared mental model. Given the widespread demand for increasing the effectiveness of team play for complex AI systems that work closely and collaboratively with people, exploring the common ground for human-AI team interaction and collaboration has also become essential (Klein et al., 2005). Common ground enables both humans and AI to comprehend each other's mental model which is important for effective coordination (Johnson et al., 2014; Klein et al., 2004). To support common ground, human-AI teams need to engage in structuring messages and signals so that one can understand the other, calibrate knowledge and assumptions, the preparation to calibrate knowledge and establish routines, use explanations and clarifications to sustain common ground, and notify each other if there is a sign of potential loss of common ground. Explanations in AI systems (XAI) can be beneficial to establishing common ground as they can provide understandability to human-AI interaction (Mueller et al., 2019).

Common ground is not a binary or constant feature—it is both continuous in its degree and constantly changing over time. Transferring some aspects of knowledge about the world may allow the agent to infer deeper concepts of expertise. If an agent is given the ability to learn models that represent the structure in ways that are like corresponding human notions, human experts and the agents may reach common ground (Hristov et al., 2018). Since it

provides recourse to bridge the gap between expert and novice humans, it may also turn out to be useful for human-AI interaction. If the XAI agents can establish and maintain common ground making users feel that it understands human perspectives, this will help improve users' perception of cognitive empathy within the agents.

So far from the literature what I observed is that the existing AI systems have very few components that could be considered empathy elements. Some of them have been described to be empathic but they are merely tailoring some of their activities and functionalities to the users. Some social robots have a few elements of affective or emotional empathy, but they are not made to express cognitive empathy to the users. AI systems would require communicating with the users in a way that users feel they are heard, and the AI systems understand their situation to some extent. Affective and cognitive empathy has the potential to complement each other in this context. Empathy plays a very important role in healthcare settings in order to ensure improved patient satisfaction, adherence to treatment recommendations, reduced distress, and enhanced patient-centered care; a decline in empathy may even threaten the quality of healthcare (Neumann et al., 2011). There has been some research on AI systems providing therapeutic empathy for mental health patients by understanding patients' thought process (Bresó et al., 2014; Martínez-Miranda et al., 2012), but that is not adequate in clinical settings for overall communication in patient-centered care.

2.4 Empathy in Patient-centered Care

Empathy creates a foundation for a successful physician-patient relationship and enhances several aspects of patient care. Empathy is often linked with compassionate care in the healthcare setting, as it is described as recognizing and understanding, emotional resonance, and empathic concern for patient's concerns, distress, pain, or suffering, coupled with their acknowledgment (Batson, 2011) – which recognizes cognitive components of empathy along with the emotional responses. In recurrent and continuous care (e.g., primary care provider), improved empathy predicts better patient comprehension, more trust in the physicians, higher satisfaction with care, improved adherence, lower anxiety, and better clinical outcomes in chronic disease management (Bauchat et al., 2016; Derksen et al., 2013; Melnick et al., 2016; Wang et al., 2018). Hojat et al. (2011) described empathy in patient care as a predominantly cognitive attribute that involves an understanding of patients' experiences, concerns, and perspectives combined with a capacity to communicate this understanding and an intention to help. It supports the impact and necessity of the cognitive component of empathy for patient care.

Communication is crucial in all steps of the healthcare process, and it is specially important for both physicians and patients during diagnosis. Though medical educators and researchers have stressed the importance of communicating with patients and their families for a long time (Frank et al., 1996; Lansky, 1998; Lipkin et al., 1995; M. A. Stewart, 1995), the term “patient-centered communication” has emerged in more recent writing from the Institute of Medicine in 2001 (Medicine, 2001) defining patient-centered communication

as "*a partnership among practitioners, patients, and their families ensures that decisions respect patients' wants, needs, and preferences, and that patients have the education and support they need to make decisions and participate in their own care, as well as participate in quality improvement efforts*". Although the definitions of patient-centered communication may vary (Epstein et al., 2005; Mead and Bower, 2000), the core concepts of patient-centered communication include "(1) eliciting and understanding patient perspectives (e.g., concerns, ideas, expectations, needs, feelings, and functioning), (2) understanding the patient within his or her unique psychosocial and cultural contexts, and (3) reaching a shared understanding of patient problems and the treatments that are concordant with patient values" (Epstein and Street, 2007). Physicians' explanations to the patients are a crucial part of the communication (Riccardi and Kurtz, 1983) and physicians who exhibit patient-centered communication behaviors gain a higher level of trust among patients (Fiscella et al., 2004).

Studies demonstrate that patient-centered communication is associated with improved healthcare outcomes, particularly in patients with chronic diseases (Naughton, 2018). Both affective and cognitive empathy have been found effective for patient-centered communication. Patients who feel understood by their physicians may be less anxious, and have greater confidence in their physician's abilities (Greenfield et al., 1985; Ong et al., 1995; Safran et al., 1998; Stewart et al., 2013). Patient experience is a measure of patient-centeredness, measuring patient satisfaction is a widely used healthcare quality metric to understand the satisfactory areas of patient experience and what could be improved based on the surveys (Browne et al., 2010; Fenton et al., 2012). Several studies show that patient

satisfaction is strongly associated with the communication behaviors that occur during the physician-patient interaction (Bertakis, 1977; Bredart et al., 2005; Buller and Buller, 1987; Korsch et al., 1968; Tallman et al., 2007; Wanzer et al., 2004). Apart from verbal communication, nonverbal communication behaviors such as eye contact, and listening attentively also play an important role in increasing patient satisfaction (Roter et al., 2006). The method to create empathy requires clinical providers to construct understandable actions, words, and behaviors (i.e., a knowledge structure). Using explanations, physicians often express empathy to the patients in order to clarify their diagnoses, treatment plans, and other actions (Alam, 2020). To develop Diagnostic AI systems informed by naturalistic human behavior, these systems also may need to follow this approach to communicate their decisions and functionalities to the patients like the physicians. To ensure patient satisfaction and trust in AI systems, these systems need to maintain common ground and use explanations for incorporating cognitive empathy during their interaction with the patients.

The review of past literature shows that there has been no clear taxonomy identified for cognitive empathy. It is important to identify the components of cognitive empathy elements specially within the context of healthcare. Also, if we aspire to incorporate cognitive empathy into diagnostic AI chatbots, we need to know what aspects of it would be beneficial to patient-AI interaction. So, I initially intended to draft a conceptual model of cognitive empathy using the literature from theoretical perspectives. I would develop it more with naturalistic and lab experiments assessing the effectiveness of the elements of cognitive empathy within the conceptual model.

2.5 Conceptual Model of Cognitive Empathy: A Theoretical Perspective

In this section, I discuss the concepts that are heavily related to cognitive empathy and how they can be organized to develop a conceptual model of cognitive empathy. These concepts fall under two broader concepts that encapsulate the notion of cognitive empathy: 1) Perspective-taking, and 2) Common Ground. These two aspects correspond roughly to the distinction between emotional empathy and sympathy—in which emotional empathy is normally used to describe a comprehension or understanding of the emotional state of another, and sympathy is used to describe a shared emotional state as I described in the section of affective empathy.

2.5.1 Perspective-taking

Perspective-taking is described as the ability to understand how a situation appears to someone else, and how to react to that situation cognitively acknowledging the other person's point of view (Johnson, 1975). As I have discussed in the earlier sections of my literature review, perspective-taking is often linked with cognitive empathy. Some researchers even see perspective-taking as the cognitive construct of empathy (Ho and Gupta, 2012; Longmire & Harrison, 2018), meaning cognitive empathy and perspective-taking are basically the same. Past literature clearly suggests that there is a perspective-taking component in cognitive empathy, and it is a cognitively demanding task but reviewing the literature I would argue that cognitive empathy is broader than perspective-taking itself. Reviewing different measures of perspective-taking, Kurdek (1978) stated

that perspective-taking is best conceived of as a multi-dimensional social cognitive skill. Perspective-taking research often overlaps with child development research so that they can learn to take the point of view of any other person (Dawson and Fernald, 1987; Flavell et al., 1981; Gzesh and Surber, 1985; Moll and Meltzoff, 2011; Mossler et al., 1976; Newcombe, 1989; Nilsen and Fecica, 2011; Salatas and Flavell, 1976). Perspective-taking skill ensures being aware of someone else's viewpoints, experience, and beliefs and acknowledging them distinctly (Gehlbach, 2004). From my interpretation, the elements of cognitive empathy that possess these attributes fall under the umbrella of perspective-taking.

2.5.2 Common Ground

The technical notion of common ground was introduced by Stalnaker (1978) based on an older family of concepts related to common knowledge, mutual belief, or actions. Clark (1996) represented common ground as a shared basis for propositions, which means if people act on the basis of their common ground, they are acting on their shared knowledge, belief, assumption, and awareness. Common ground requires being aware of someone else's viewpoints and knowledge, but it also requires sharing one's own knowledge and information they have. Common ground is also essential in developing coordination within a joint activity (Klein et al., 2005). These activities may vary, two parties may have shared goals, and they may have adversarial goals as well. In the case of having shared goals, acknowledging other persons' viewpoint is not enough, sharing the viewpoint, knowledge, and assumptions become important in such a situation. The main difference between perspective-taking and common ground is that for perspective-taking

one needs to shift their perspective and understand and acknowledge the other person's point of view, but for common ground, both parties need to develop mutual knowledge, belief, goals, choices, and assumptions as well. Common ground requires acting on the perspective-taking, which is not required in adversarial cooperation or collaboration (Bateman et al., 2005; Cleeremans, 2022; Cohen et al., 2000; Kahneman & Klein, 2009). The elements of cognitive empathy that possess such attributes, I argue that they fall under the "common ground" category of cognitive empathy.

2.5.3 Cognitive Empathetic Components

Under the two big umbrellas of perspective-taking and common ground for cognitive empathy elements, my review of the literature revealed some smaller components of elements that fit the description of either or both of these bigger categories.

2.5.3.1 Shared knowledge/Information

Effective communication requires establishing shared knowledge by externalizing the ideas and explicitly comparing the propositional expressions between two parties as knowledge residing in one party comes to be represented in another (Clark and Brennan, 1991; Krauss and Fussell, 1990). There have been many representations of shared knowledge. One of them represents the following simple and easy to understand statement (Clark & Marshall, 1981):

A and B share knowledge Proposition (*p*)

(1) A knows that *p*.

(1') B knows that *p*.

(2) A knows that B knows that *p*.

(2') B knows that A knows that *p*.

Shared knowledge could be generic (kinds of objects, states, events, and processes) or about a particular individual or particular things (particular objects, states, events, and processes). Shared knowledge could come from being situated in a common context or problem space as well (Roschelle and Teasley, 1995). From my terminology, shared knowledge could be overlapping between perspective-taking and common ground. Depending on the situation, one can only be aware of what information or knowledge another person has, they could also share with the other person what information they have. In an adversarial situation, one party may be aware of the information the other party has, but they would not want to share the information or knowledge they themselves possess. From the healthcare perspective, shared knowledge can be established within a particular problem space (e.g., diagnosis) when 1) a healthcare professional knows what the patient knows or 2) the patient knows what the healthcare professional knows.

2.5.3.2 Shared Sensemaking

Sensemaking is defined as a behavior, both internal (i.e. cognitive) and external (i.e. procedural) which allows the individual to construct and design their movement through time-space and make sense of their experiences (Dervin, 1983). Sensemaking is initiated in a crisis situation if it is realized that there is inadequacy in the current understanding of the situation (Weick, 1988b, 1995). From the decision-making perspective, it is often a retrospective analysis of events (Klein et al., 2006). Like many other communication

strategies, information seeking, and use are central to sensemaking that may lead to shared sensemaking between two or more parties. Shared or collective sensemaking in a critical situation can increase the resiliency among a group (Bartone, 2004), enabling them to integrate what is known and what is conjectured, to connect what is inferred with what is observed (Klein et al., 2007). It works as a bridge between experts and non-experts as it allows the non-experts to revise interpretations based on new information from the experts (Maitlis & Sonenshein, 2010). From the healthcare perspective, this adaptive process can help clear patients' confusion and doubts if shared sensemaking is established between patients and healthcare professionals. Based on my terminology, shared sensemaking falls under perspective-taking as it enables clinicians to be aware of patients' understanding of the current situation and revise their interpretations if needed.

2.5.3.3 Shared Decision-making

Shared decision-making is a prominent phenomenon in healthcare. It is defined as an approach where both clinicians and patients are involved with the task of making decisions and patients are empowered to consider the decision choices or options (Elwyn et al., 2010). When shared decision-making is established, patients are encouraged to consider available screening, treatment, or management options and help select the course of action that best fits based on the available evidence. Shared decision-making is a communicational concept in not only patient-clinician relationships but it is often manifested within the relationship between patients and their families as they play important role in making decision choices (Epstein & Street, 2011). Shared decision-making requires the patient, their families, and the clinicians to establish a common

ground and act (i.e. make decisions) on informed patient choices. It is connected with shared knowledge concepts as clinicians sharing the information or knowledge about the decision choices with the patients is the first step of making shared decisions.

2.5.3.4 Shared Feedback

Feedback is considered an essential component of education (Ende, 1983; Hyland, 1990; Van De Ridder et al., 2008) and client service research (Weissman, 1988; Wolverton & Gallimore, 1999). It can be either formative or summative in nature and is defined as a constructive and objective appraisal of performance given to improve skills (Bienstock et al., 2007). Feedback interventions are found to have small to medium effects on the outcomes (Kluger & DeNisi, 1996). It is a highly contextualized social process, that involves a dynamic two-way information exchange (i.e., seeking and providing feedback) between two parties (Price et al., 2011). Patient feedback is at the core of patient-centered care. Patient feedback is particularly useful in helping clinicians identify the possible failure of ongoing communication and collaborating with the client (patient) in restoring positive outcomes (Lambert & Shimokawa, 2011). A meta-analysis revealed that feedback to clinicians about patient progress shows promise for promoting improved outcomes and clinician behavior change, specially when change is needed (Sapyta et al., 2005). From the cognitive empathy perspective, clinicians should be aware of the patient feedback and ensure that it is a two-way communication (clinician seeking feedback and patient providing it). Based on my terminology, that falls under the perspective-taking category.

2.5.3.5 Shared Mental Model

Mental models are organized knowledge structures within individuals that allow them to interact with their environment (Mathieu et al., 2000). The notion of "mental model" has been used to explain high-level cognitive capacities, specially the differences in knowledge content and organization between experts and novices (Gentner and Stevens, 2014; Johnson-Laird, 1983). It is regarded as fundamental to the field of cognitive engineering, specially user models and human-AI team research that I discussed in an earlier section. Many rule-based expert systems have been developed based on the "mental model" notion (Scott et al., 1991). Mental models emerge in the interplay of perception, comprehension, and organized knowledge, and cognitive task analysis (CTA) is considered an effective way to infer the representation of mental models (Klein and Hoffman, 2008). The shared mental model theory offers an explanation of how people working in the same team can cope with difficult and changing task conditions, and how they adjust their strategies quickly and efficiently (Converse et al., 1993). The complexity and criticality of the current healthcare system require shared mental models to enhance safe and effective patient care (McComb and Simpson, 2014). The concept of cognitive empathy requires both patients and clinicians to be aware of each other's mental model when they work as a team, and they also should adapt their communication approach to align with each other's mental model to establish successful teamwork in a critical situation. So, shared mental model overlaps both the concept of perspective-taking and common ground as both awareness and aligned (i.e., similar) mental model are fundamental to such communication.

2.5.3.6 Shared Goals

"Shared goals" is regarded as a motivator that allows people to coordinate their effort and work together with a sense of shared destiny (Chow and Chan, 2008). Strongly shared goals are found to be correlated with strong cooperation and collaboration for collective benefit (Uhlaner et al., 2015). Developing a "shared intention" (Bratman, 1993) is interlinked with the concept of shared goals. When two parties have intended to do something together, a shared goal is developed implicitly. Shared goals show up early in development if the individuals could understand each other's difficulties, strengths, and perspectives through social interactions and experiences (Tomasello et al., 2005; Warneken et al., 2006). People could have joint activity pursuing their common goals (Sebanz et al., 2003), and they may have different roads to achieving that as well. But their shared intentions should remain the same. Being aware of individual goals occurs when people are in adversarial situation, but it is not adequate when they are on the same team. They would pursue shared goals in such situation (Huang et al., 2015). So, shared goals fall under both "perspective-taking" and "common ground" category as per my terminology. In healthcare settings, patients and clinicians both pursue the common goal of improved healthcare outcomes for the patient, and they interact with each other in order to achieve the shared goals.

2.5.3.7 Shared Consequences

People pursuing common goals may have shared consequences in situations when they would collectively face both the positive and negative consequences of success and failure respectively. For example, social capital is a catalyst for developing interpersonal

trust and norms of reciprocity that facilitates collective action for mutual benefit and shared consequences (Kawachi, 1999). Apart from financial institutions like social capital, shared consequences or outcomes could be applicable in workplaces as well. Shared consequences are regarded as the results of many individual performances in a workgroup and these outcomes also affect the efficiency of many individuals (Liang et al., 2015). As shared consequences refer to mutual benefits or risks for the people involved, it falls under the "common ground" category as per my terminology. This element of cognitive empathy does not apply to the healthcare setting as the patients and clinicians would never have to face the same consequences for pursuing the goal of improved health outcomes.

Figure- 1 summarizes the conceptual model of cognitive empathy I have described so far. As I have discussed above, shared sensemaking and shared feedback fall under the "perspective-taking" category. Shared decision-making and shared consequences fall under the "common ground" category. Shared mental model, shared knowledge, and shared decision-making has a lot of overlap between perspective-taking and common ground.

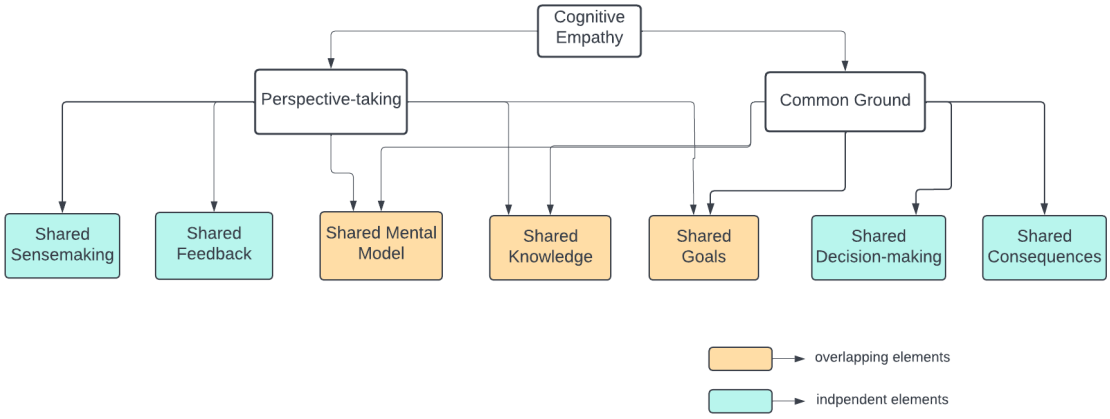

Figure 1: Conceptual model of the taxonomy of cognitive empathy

Based on the initial draft of the conceptual model for the taxonomy of cognitive empathy, my goal is to find out what elements of empathy could be beneficial in a diagnostic artificial agent. There have been some systems employed that have been successful as social robots, intelligent tutors, or user-centered models, but these merely understand the users and only tailor their activities and functionalities for the users to some extent. Adopting these systems for healthcare and incorporating them into patient-centered care requires much more than that. The healthcare domain needs one of the most effective human-AI team interactions because of its nature of service and it is not going to fly without developing a strong perspective-taking within this team interaction. For my dissertation, I assessed cognitive empathy elements within these diagnostic AI systems informed by patient-physician interaction and identify the most effective ones to establish a better perception of empathy among the patients. I also revised the initial conceptual model of the taxonomy of cognitive empathy and develop a well-grounded qualitative model of cognitive empathy using both theoretical and experimental perspectives.

In the next section, I will describe a small-scale lab study. Adopting the Other Dyadic Perspective-taking Scale (ODPT) by Long and Andrews (1990), I have developed an empathy scale to assess user perception of the dyadic perspective-taking and cognitive empathy of the AI agent. Originally, Long and Andrews adopted the Perspective-Taking (PT) subscale of the Interpersonal Reactivity Index (Davis, 1980) for the ODPT scale. I have created a pool of 10 items to assess the perspective-taking of the agent. These items were counterbalanced to overcome possible response bias with 5 requiring a positive response and 5 requiring a negative response. I will provide a more detailed description of the scale as well as the description of the psychometric assessment of the scale in the next section. I will also describe the initial study conducted using this scale applying elements of empathy in simulated scenarios. I hypothesized that these elements of empathy would improve users' perception of perspective-taking and empathic behavior in AI diagnostic or symptom assessment applications. In the following chapters, I will describe the methods and results of another lab study assessing the empathetic elements separately, one interview study with first-time mothers to extract the elements of cognitive empathy from patient-physician interaction, and another lab study assessing cognitive empathy elements based on the analysis of the interviews. Finally, I will describe the revised version of the initial conceptual model of the taxonomy of cognitive empathy and develop a well-grounded qualitative model of cognitive empathy using both theoretical and experimental perspectives and some design recommendations for diagnostic AI chatbots accommodating the concepts of the model.

3 Study 1

This section describes an initial experiment conducted to develop and validate the proposed empathy scale.

3.1 Method

3.1.1 Participants

One hundred undergraduate students at Michigan Technological University took part in the study in exchange for partial course credit. They were enrolled in the "Introductory to Psychology" course. Students in the class are typically first or second-year undergraduate students.

3.1.2 Procedure

The study was conducted online, and it took 15–20 min to complete. Participants gave their consent online before taking part in the study. I created two diagnosis scenarios in which a simulated AI-based symptom assessment application gives a list of diagnoses, rank-ordered by most likelihood. It also offers some advice on the most likely diagnosis. The participants played the role of patients in the scenarios, instructed to say they were suffering from specific symptoms. In one scenario the patient was suffering from headache and some related symptoms (Scenario 1) and in another scenario, the patient consulted the application for heartburn and related symptoms (Scenario 2). I designed the flow of the dialogue-based

questionnaire for the scenarios based on the questions asked in an actual chatbot application for symptom assessment, Ada[2].

This was a within-subject study. In the control condition, no empathetic elements were incorporated during the interaction between the simulated chatbot and the participants. In the experimental condition, in total three empathetic elements were incorporated based on the review of the literature: i) Emotional empathy ("I completely understand if you are worried", " I am sorry to hear that" kind of things), ii) Shared Knowledge (Echoing back what information is gathered from the patient about symptoms and conditions), and iii) Incorporating patient feedback (asking if they want to share anything else other than what they already shared). Thus, the experimental condition involved one aspect of emotional empathy and two aspects of cognitive empathy together but did not attempt to compare the relative benefits of these different kinds of empathy.

Participants were randomly assigned to one of two counterbalancing groups (either to control condition first or to the experimental condition first for scenario 1 or scenario 2). At the end of each scenario, participants were asked to rate the AI tool to assess how empathetic it was using the items in the AI cognitive empathy scale (AICES). AICES will assess the user's perception of the dyadic perception-taking of the symptom assessment AI agent. I created a pool of 10 items to assess the perspective-taking of the agent (see Table 1). Participants were asked to respond to each of the items according to how well the

[2] https://ada.com/

statement depicted in terms of how well the action described the AI agent's actions toward them. Responses were coded on a 5-point Likert scale ranging from *does not describe the AI very well* (1) to *does describe the AI very well* (5).

Table 1: AI Cognitive Empathy Scale (AICES)

	Does not describe AI well				Describes AI well
	1	**2**	**3**	**4**	**5**
1. The AI sometimes find it difficult to see things from my point of view					
2. The AI realizes my problem even I have difficulty describing it					
3. The AI is not good at understanding my problems					
4. The AI tries to understand me by sensing how things would look from my perspective					
5. The AI cannot anticipate what information I might need					
6. The AI tries to incorporate my perspective before making a decision					
7. The AI is not able to put itself into my shoes					
8.When the AI is sure it is right about something, it does not incorporate feedback from anything else					
9. The AI is able to accurately compare its point of view with mine					
10. The AI can predict what I would want to know in critical situation					

3.2 Results

3.2.1 Psychometric Assessment of the AI Cognitive Empathy Scale (AICES)

I conducted a psychometric assessment of the validity and reliability of AICES with the 10 items in the questionnaire. I only used the data from the control condition to examine the psychometric properties. The standardized Cronbach's alpha of the scale was 0.77. The correlation of each item with the total score (*std.r*) ranged from 0.24 to 0.72. Q8: "When the AI is sure it is right about something, it does not incorporate feedback from anything else" has a very low correlation with the total (0.24). The standardized alpha based upon the correlations (*std.alpha*) ranged from 0.73 to 0.80. The median pairwise correlation between the items is 0.3 which was moderately positively strong. The first dimension of principal component analysis (PCA) was 0.36, which means it accounted for 36% variance in the data. The loadings of individual questions on the first principal component (*PC1*) ranged from -0.72 to 0.68, where negative loadings indicated questions that were negatively framed. The overall results of the 10-item questionnaire are presented in Table 2. The psychometric assessment shows that the items are reasonably inter-correlated, but it is not very strong. That might mean that in the control condition, people's responses did not vary much across the groups.

Table 2: Psychometric properties of items for AI Cognitive Empathy Scale

Q No.	std.alpha	std.r	mean	sd	PC1
Q1	0.75	0.62	3.16	1.04	-0.59
Q2	0.75	0.62	3.27	1.12	0.61
Q3	0.73	0.72	3.46	1.08	-0.72
Q4	0.73	0.70	2.95	1.03	0.68
Q5	0.75	0.59	3.43	1.15	-0.59
Q6	0.75	0.61	2.97	1.17	0.60
Q7	0.75	0.62	2.91	1.11	-0.60
Q8	0.80	0.24	3.95	1.08	-0.08
Q9	0.75	0.58	3.00	1.06	0.53
Q10	0.77	0.43	3.44	1.06	0.34

3.2.2 Comparison of Experimental and Control Conditions

Participants perceived the AI application to be more empathetic in the experimental condition than in the control condition. There was a significant difference between the control and experimental condition (see Figure 2). I examined the rating for AICES with a repeated-measures ANOVA to investigate the main effects of the empathy condition and the scenarios. There are significant differences for the scenarios (F (1,98) = 9.00, $p < 0.05$) and there are also significantly high main effects of empathy (F (1,98) = 30.02, $p < 0.001$). So, this study provided support that cognitive empathy elements help improve users' perception of AI empathy.

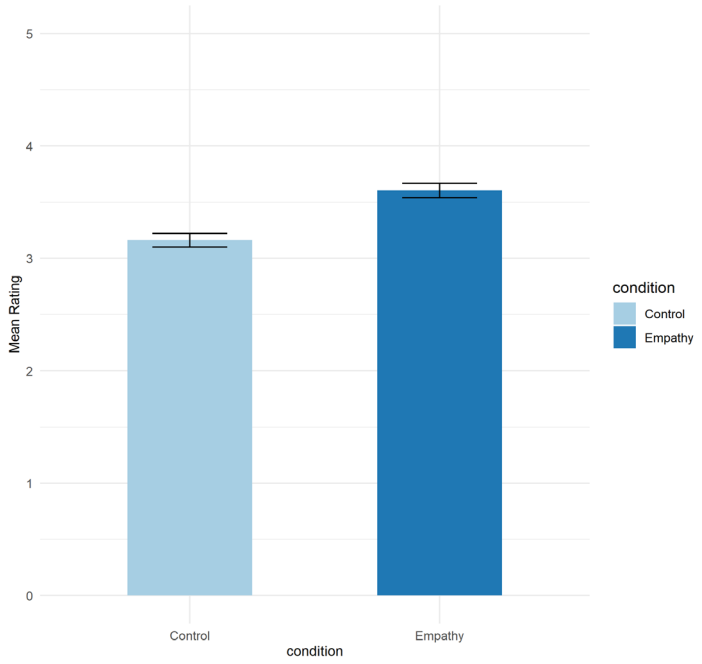

Figure 2: Mean rating in AI Cognitive Empathy Scale for control and empathy conditions

3.3 Discussion

I assessed the psychometric properties of the new AI cognitive Empathy Scale (AICES) that I developed to reflect the perceived cognitive empathy of AI health bots. It demonstrated reasonable consistency, reliability, and validity even though the items in the scale are not very strongly inter-correlated in a few cases. I also examined the effects of cognitive empathy elements during a simulated symptom assessment scenario and the study shows that these elements help improve the perception of empathy during an interaction between user and AI bots for assessing symptoms. This indicates that by incorporating cognitive empathy elements in AI chatbots, there is a possibility of improving the patient-AI communication effectively.

In the next section, I will describe a lab study on the perception of empathy involving some telehealth scenarios adopted from real-world telehealth interactions. The goal of this study is to assess the effectiveness of cognitive empathy elements distinctly and make informed suggestions for AI health chatbots with the help of the AI Cognitive Empathy Scale (AICES) and the "Explanation Satisfaction Scale" (Hoffman et al., 2018).

4 Study 2

As cognitive empathy may appear in different forms, my plan was to conduct another lab study to assess cognitive empathy elements distinctly, affective and cognitive empathy elements separately, and see which one has the maximum effect. I designed the study scenarios based on some real telehealth consultation interactions to better simulate the kinds of issues AI health bots might handle. I implemented four conditions separately in this study: Control, Affective/ Emotional Empathy, Shared Feedback, and Shared Knowledge (Common ground). I hypothesized that cognitive components of empathy (Shared Feedback and Shared Knowledge) would induce greater perceptions of empathy and satisfaction than the emotional components of empathy and no empathy (control) condition. My goals in this study were also to:

1) Further evaluate the AI Cognitive Empathy Scale (AICES).
2) Examine if there are any differences in the perception of empathy and satisfaction between AI chatbots and human physicians. I hypothesized that participants would perceive physicians as more empathetic and satisfactory even in very similar scenarios or interactions. I also hypothesize that participants will not prefer AI providing emotional empathy, but they will perceive AI as empathetic when it provides cognitive empathy or attempts to understand patient perspectives.

Results show that the participants preferred the physicians as the diagnoser more than the AI diagnoser in the same or similar scenario from both empathy and satisfaction perspectives in comparison to the control condition. Also, affective or emotional empathy

had the biggest impact and was perceived as significantly better for understanding patient perspectives, shared knowledge had a marginally significant impact, and shared feedback had no significant impact on perceived empathy.

4.1 Method

4.1.1 Participants

Ninety undergraduate students at Michigan Technological University took part in the study in exchange for partial course credit. They were enrolled in the "Introductory to Psychology" course. Students in the class are typically first or second-year undergraduate students.

4.1.2 Procedure

The study was conducted online, and it took 15–20 min to complete. Participants gave their consent online before taking part in the study. I created eight diagnosis scenarios adopted from a telehealth consultation website "icliniq"[3] where patients anonymously post some non-emergency medical issues and physicians provide medical advice. This was a within-subject study. Participants were asked to rate 8 (eight) different scenarios, in 4 scenarios they were told that the scenarios were from telehealth consultation with physician and in other 4 scenarios they were told that the scenarios were from telehealth consultations with AI chatbots. Each of the 4 scenarios for each kind of diagnoser (physician or AI bot)

[3] https://www.icliniq.com/

consisted of one of the following conditions: 1) No empathetic elements during consultation (Control), 2) Affective or Emotional Empathy, 3) Shared Knowledge (Common Ground), and 4) Shared Feedback (Perspective-taking). Figure shows example of the scenarios and how each of the empathy conditions was implemented during the simulation.

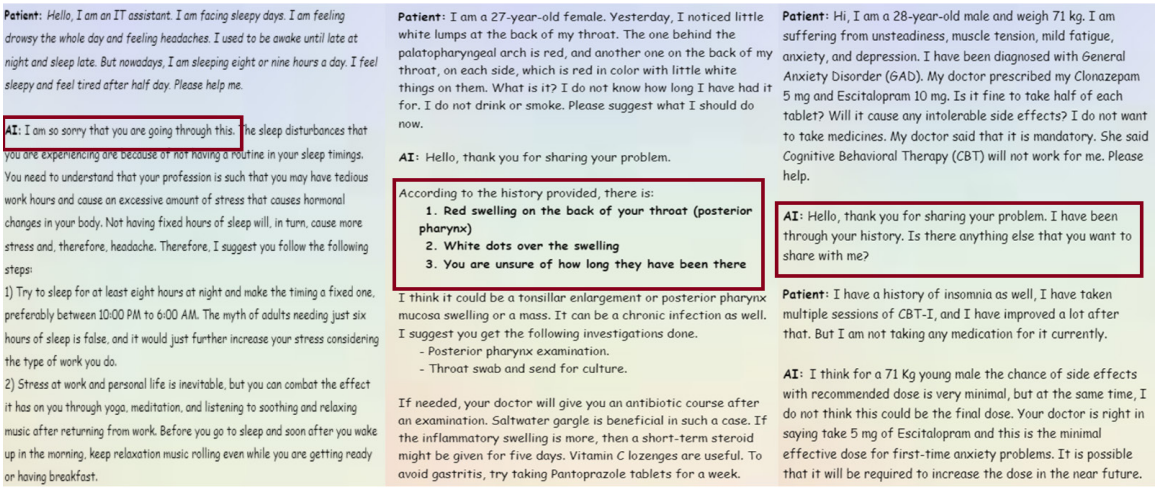

Figure 3: Example of empathy elements incorporated (a) Affective empathy (b) Shared knowledge (c) Shared feedback

Participants were randomly assigned to one of the eight counterbalancing groups and at the end of each scenario they were asked to rate the scenarios on the AI Cognitive Empathy Scale (AICES) and the "Explanation Satisfaction Scale" (Hoffman et al., 2018) to understand whether their perception of empathy and satisfaction change depending on the consultant on the other side (AI or human) and test the effects of each component of empathy separately.

4.2 Results

At first, I present the differences in the perception of empathy and satisfaction between AI chatbots and human physicians. For this, I combined all three empathy elements together to have a simplified version for this comparison and assessed the differences between control and all empathy conditions. Results show that in both control and empathy conditions, participants perceived more empathy in physicians (see Figure 4(a)) and more satisfaction for physicians as well (see Figure 4(b)).

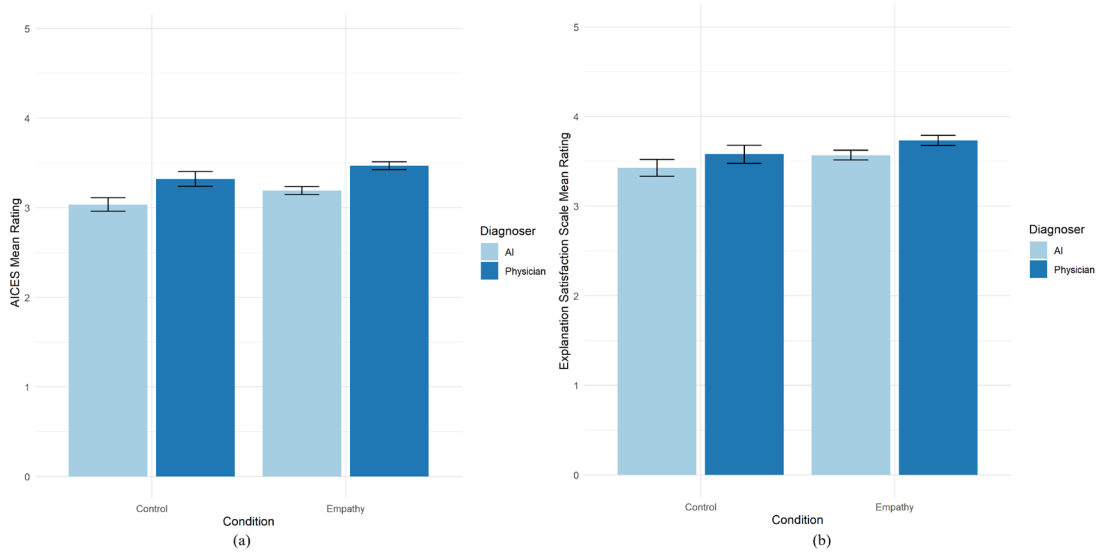

Figure 4: Differences between physician and AI as diagnoser using (a) AICES and (b) explanation satisfaction scale.

I also assessed the effectiveness of each empathy element against the control condition separately for both physician and AI as diagnoser. For all three experimental conditions,

participants rated the perceived empathy (see Figure 5) and satisfaction (see Figure 6) higher than the control condition for both physician and AI as the diagnoser.

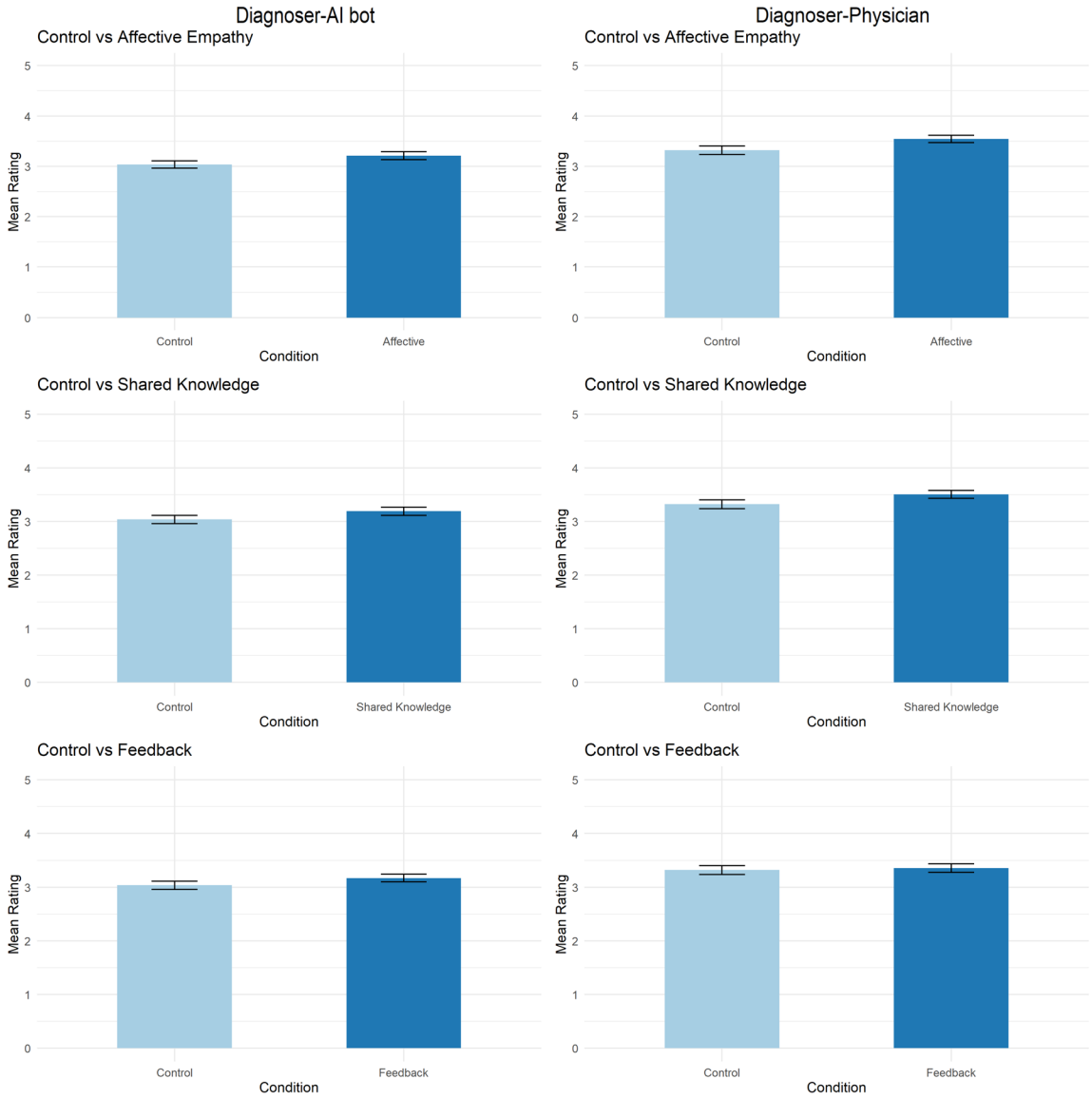

Figure 5: Perceived empathy for different empathy conditions using AI Cognitive Empathy Scale (AICES)

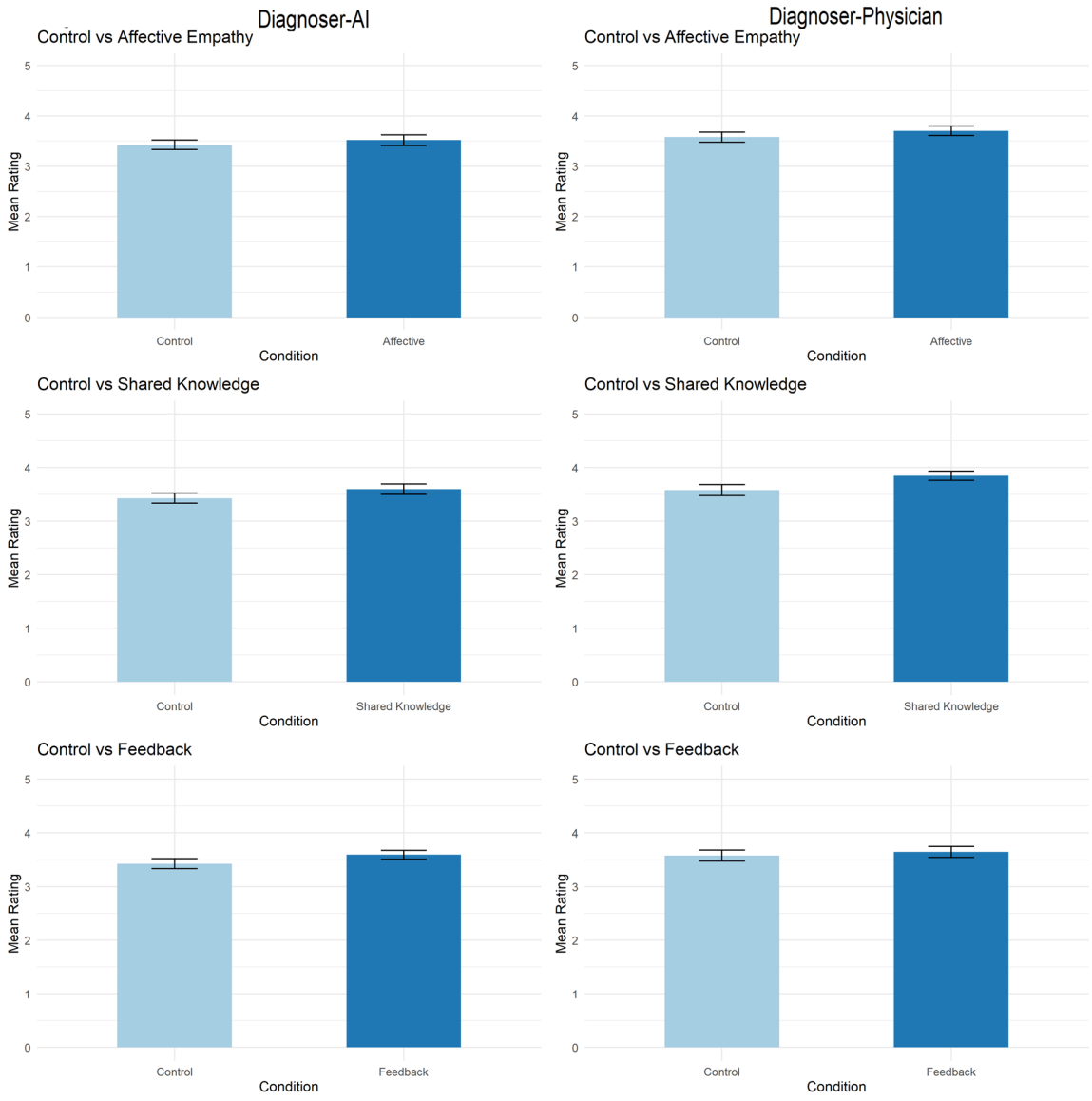

Figure 6: Perceived satisfaction for different empathy conditions using the Explanation Satisfaction Scale

I examined the rating for both AICES and explanation satisfaction scales by running a *lmer* model using the R package *lme4* (Bates et al., 2011) with a Type-II factorial ANOVA using the R package *car* (Fox et al., 2007). The results are shown in Table 3.

There were statistically significant main effects for empathy conditions (types of empathy elements), type of diagnoser (physician or AI), and the scenarios in the AICES but there was no significant condition by diagnoser interaction. In the explanation satisfaction scale, there were statistically significant main effects for the type of diagnoser (physician or AI) and the scenarios in the AICES but there was no significant main effect for conditions (types of empathy elements) and condition by diagnoser interaction.

Table 3: Results from Type-II factorial ANOVA for AICES and explanation satisfaction scale

AI Cognitive Empathy Scale				**Explanation Satisfaction Scale**			
	Chisq	DF	*p*-val		Chisq	DF	*p*-val
Empathy Condition	10.4	3	<0.05	Empathy Condition	5.84	3	0.12
Diagnoser	30.2	1	<0.05	Diagnoser	5.29	1	<0.05
Scenario	79.83	7	<0.05	Scenario	186.22	7	<0.05
Empathy Condition: Diagnoser	1.16	3	0.76	Empathy Condition: Diagnoser	1.81	3	0.61

To understand the differences between each empathy condition, I conducted Tukey post-hoc tests (see Table 4) for both AICES and explanation satisfaction scale using the R

package *emmeans* (Lenth et al., 2019). Results show that affective empathy was perceived significantly better than the control condition and shared knowledge was perceived marginally better (p=0.08) than the control condition for the AI cognitive empathy scale (AICES). For the explanation satisfaction scale, only shared knowledge was perceived marginally better (p=0.08) than the control condition. No other empathy condition was satisfactory.

Table 4: Pairwise differences between empathy conditions for AICES and explanation satisfaction scale

AI Cognitive Empathy Scale		**Explanation Satisfaction Scale**	
Control-Affective	Affective was better (p <0.5)	Control-Affective	None
Control-Shared Knowledge	Shared knowledge was marginally better (p=0.08)	Control-Shared Knowledge	Shared knowledge was marginally better (p=0.08)
Control-Feedback	None	Control-Feedback	None
Affective-Shared Knowledge	None	Affective-Shared Knowledge	None
Affective-Feedback	None	Affective-Feedback	None
Shared Knowledge-Feedback	None	Shared Knowledge-Feedback	None

4.3 Discussion

This study shows that the participants preferred the physicians as the diagnoser more than the AI diagnoser in the same or similar scenario from both empathy and satisfaction perspectives, which supports my hypothesis. Different scenarios affected the results differently, as we see from the results that the scenarios were significantly different from each other. The empathy conditions (Control, Affective/ Emotional Empathy, Shared Feedback, and Shared Knowledge) had an effect on the AI cognitive empathy scale, but it did not interact with who the diagnoser was. It means there is no support for the hypothesis that people do not prefer AI providing emotional empathy, but they perceive AI as empathetic for providing cognitive empathy or understanding patient perspectives. In comparison to the control condition, the affective or emotional empathy had the biggest impact and was perceived as significantly better for understanding patient perspectives, shared knowledge had a marginally significant impact. But patient feedback was not perceived as empathetic compared to the control condition. Participants were marginally satisfied with the shared knowledge as well, and no other empathy elements were satisfactory compared to the control condition. Overall, the results do not support the hypothesis that cognitive components of empathy (Shared Feedback and Shared Knowledge) would induce greater perceptions of empathy and satisfaction than the emotional components of empathy and no empathy (control) condition. My observation is that this might have happened as the scenarios we presented were not very powerful at eliciting any significant changes. We adopted variations of scenarios and interactions from the “icliniq” directory, so there may have been some issues with how the cases were

handled. As for the affective or emotional components of empathy, these elements might have been more salient than the other ones. Because of this, I decided to explore the cognitive empathy elements more thoroughly by understanding how cognitive empathy or patient perspectives are understood in physician-patient interaction in naturalistic environments. For this purpose, I planned to interview patients and identify recognizable communication patterns that helped establish cognitive empathy during their visits to their physicians.

4.3.1 Scenario Effect Analysis

As we have seen that there are main effects of scenarios in this experiment, I made an attempt to analyze each of the scenarios. I first rank-ordered the scenarios to organize them in terms of the overall base levels of the AICES rating using the control condition data (see Table 5). Results show that Type-2 diabetes and high cholesterol scenarios had the highest rating and sleep problems had the lowest rating though the difference is very low between them (0.18). So, even though there is a systematic difference between the scenarios, there are no substantial differences in their individual rating.

Table 5: Rank Order of the scenarios based on mean ratings using AICES

Scenario	Mean AICES rating
Type-2 Diabetes	3.07
High cholesterol	3.07
Tonsil Enlargement	3.03
COVID-19	3.00
Fibromyalgia	2.99
Inner ear disorder	2.97
High Blood Pressure	2.97
Sleep problem	2.89

I also assessed the scenarios in terms of each of the questions within AICES (see Figure 7. It shows that the scenarios do not differentiate for the positively framed questions. But for the negatively framed questions, there are some scenarios where the differences between the questions are large. For example, if we look at sleep problem and type-2 diabetes, Q3("The AI is not good at understanding the patient's problem") had a moderately low rating compared to Q8 ("When the AI is sure it is right about something, it does not incorporate feedback from anything else "). Again, for inner ear disorder, Q5 ("The AI cannot anticipate what information I might need") had a substantially low rating than Q1 ("The AI sometimes finds it difficult to see things from my point of view"). These occurrences may have driven the significant scenario effects.

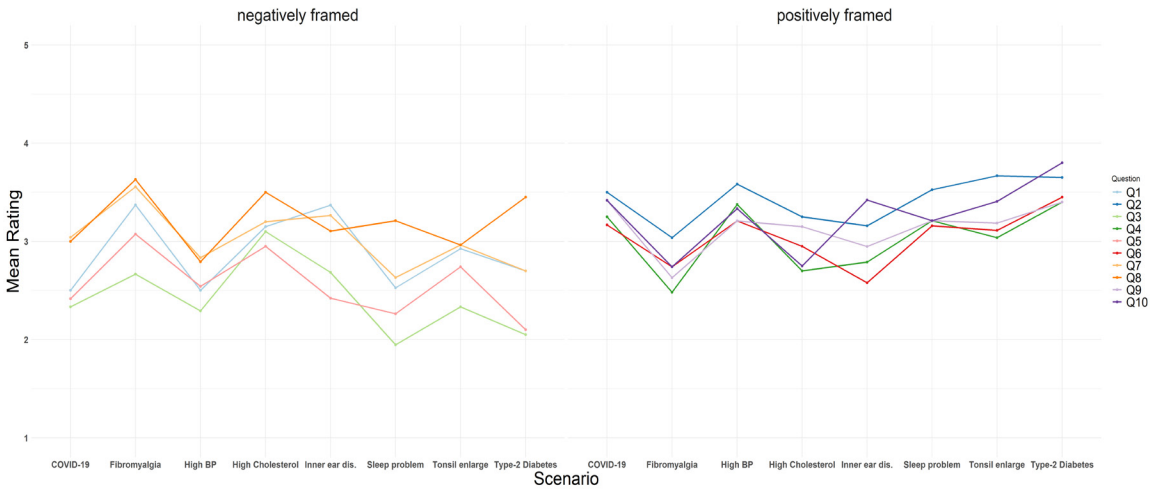

Figure 7: Scenario analysis in terms of each question in AICES

As this was a complete simulation, it is not possible to get a clear perception of the effects of cognitive empathy elements in this study. For that, we need information and evidence in a more naturalistic environment. In the next section, I will describe an interview study where I interviewed recent mothers about their interaction with the physicians during pregnancy focusing on recognizable cognitive empathy elements. The goal would be to identify recognizable communication patterns for establishing cognitive empathy during patient-physician interaction.

5 Study 3

The initial two studies of the thesis involve simulated health-care interactions with non-patients. To better ground our understanding of empathetic interactions between doctors and patients, I conducted a small interview study in which I elicited incidents and examples related to cognitive empathy during their interaction with physicians. This exploratory study was intended to understand the kinds of interactions and communications that would be considered cognitively empathetic in real patient-physician interactions. I recruited recent first-time mothers to discuss interactions with their obstetrician or midwife during the interactions prior to or following the birth event. The reason for selecting this population is:

1) To identify a group who were involved with the health care system but not because of illness, disease, or death

2) To identify incidents that had generally positive outcomes

3) Substantial informational resources exist outside of communications with a health care professional, there are many opportunities for investigating common ground, shared knowledge, and the like.

The main goals of the interview study were to:

I. Find possible communication patterns for establishing common grounds between patient-physician
II. Document example of communication for establishing common ground

III. Help develop a qualitative model for cognitive empathy in patient-doctor communication to inform healthcare AI systems

5.1 Method

5.1.1 Participants

I recruited 10 participants who are new mothers who have given birth in the last 24 months with the help of a physician or a midwife and who have had full-term pregnancy without any major complications before, during, or post-birth. Participants were recruited voluntarily through word-of-mouth and personal contacts. In order to participate in this study, participants were required to meet the following criteria:

1) Recent first-time mothers who have given birth within the last 24 months with the help of a physician or a midwife
2) Took part in at least one visit with a physician or midwife prior to the birth
3) Had full-term pregnancy without any major complications prior to, during, or post-birth
4) Did not have an unplanned C-section

Among the 10 interviewees, eight were from the US, one was from Australia, and one was from Bangladesh. Their age range was 26-37 years.

5.1.2 Interview Procedure

I implemented an incident-based interview technique (Crandall et al., 2006) to unpack the incidents where cognitive empathy was perceived by the patients during the interactions. The interviews focused on identifying incidents when some critical communications occurred between the participants and their physicians or midwives. All methods were approved by the MTU institutional review board (IRB). Participants gave oral consent before the interview and agreed to have their interview audio recorded. Interviews were conducted either via phone/internet video and lasted for 40–50 minutes. Transcriptions of the interviews were completely de-identified and complied with the HIPAA standards.

One interviewer conducted all the interviews. The participant's prior knowledge and understanding of the childbirth process were established at the beginning. This included identifying whether they were involved in a close friend or relative's recent birth; whether they were enrolled or taking childbirth education classes for their pregnancy, whether they had spent significant time reading or watching educational materials; and other related information sources. Initially, I planned to focus on critical communication specially in the earlier stage of pregnancy, but I adjusted it later as the participants reported many incidents throughout their pregnancy during the interview.

After these initial questions, interviewees were asked to identify and describe some critical communications with their physicians or midwives including when (a) the doctor/midwife did not know something the patient knew; (b) the patient did not know or understand

something the doctor/midwife was saying, or (c) the patient or doctor/midwife was working on faulty or incorrect assumptions, information, or understanding. The interviewer asked the participant to provide a timeline of the incident (i.e., the doctor-patient visit). During the timeline collection, one or two specific communication incidents were identified. Following the initial account, the interviewer prompted the participant to talk through the critical communication multiple additional times focusing on different aspects such as their prior knowledge, physician/midwife's knowledge about the situation, their miscommunication or misunderstandings, and communications that led them both to a shared understanding of the situation. The interviewer prompted the participants with some follow-up questions to identify cognitive empathy elements in the communications (see the interview guide in Appendix A). There were incidents when the critical communications led to a successful "shared understanding", but there were also cases and incidents when it did not establish a common ground or shared understanding in the end. The participants were asked what their expectations were in such situations and what they thought could be done differently to establish more empathetic communication. The objective of these interviews was to identify cognitive empathy elements from the discussed interactions between the participants and their physicians or midwives that may have or would have helped the participants perceive that the physicians or midwives understood their perspectives.

5.2 Data Analysis Approach

After carrying out the transcription of the interviews, the first step of the analysis was to isolate and extract the incidents of interactions from the transcripts and unitize them. Participants' prior knowledge about pregnancy and birthing process, their overall opinion about their physician or midwives, and any supplementary information were excluded. Some of the incidents of interactions were broader, so we broke them into multiple sub-units. Considering the sub-units as independent ones, in total 66 interactions were obtained from the transcripts. Two researchers discussed the incidents from the transcripts between themselves and reached an agreement to create six themes of cognitive empathetic interactions for coding the interactions from the interviews. These themes were created based on the literature on cognitive empathy, perspective-taking approaches, and the observations from the transcripts about the patterns of interactions and participants' expectations from their physicians and midwives during their interactions. The themes include:

1) Shared Information/Knowledge
2) Shared Sensemaking
3) Shared Decision-making
4) Communication about the Outcomes
5) Shared Goals
6) Tailored to Circumstances

The researchers also developed brief descriptions of each of the themes so that it may help the coders to understand them clearly while coding the interactions.

5.2.1 Coding Approach

Two independent coders coded each interaction unit from three of the interview transcripts into one or multiple of the six themes generated. I measured the inter-rater reliability using weighted *Cohen's kappa* from the R package "psych" (Revelle and Revelle, 2015). As the coders coded a few interactions into more than one theme, we followed the permissive coding approach and considered that the coders were in agreement if one of the themes they chose matched with the other coder. Overall, they achieved inter-rater reliability of $k = 0.76$. Given the high agreement, a single coder coded the rest of the interviews. As the coders identified the interactions and coded them into the themes, they also identified a sub-pattern where some of the interactions were found as negative experiences or interactions at times when patients and their physicians or midwives could not reach a shared understanding.

5.3 Qualitative Analysis Results

As I discussed above, the interactions discussed in the interview data were organized into six themes: 1) Shared Information/Knowledge, 2) Shared Sensemaking, 3) Shared Decision-making, 4) Communication about the Outcomes, 5) Shared Goals, and 6) Tailoring to Circumstances. 19 of the interactions were encoded as Shared Information/Knowledge, 18 as Shared Sensemaking, 9 as Shared Decision-making, 8 as Communication about the Outcomes, 9 as Shared Goals, and 12 as Tailoring to

Circumstances. All the coded interactions along with the successful and failure aspects are mapped in Appendix B. I will describe all of these themes in this section with their brief description and some of the corresponding quotes from the interviews. I will also discuss the positive and negative sub-patterns that emerged from each of the themes.

5.3.1 Shared Information/Knowledge

This is the kind of interaction where the doctor/midwife made sure the patients knew what they (doctor/midwife) knew, and they (patients) clearly understood that. Shared information or knowledge was the most common cognitive empathetic interaction across all our interviews. Participants reported about critical points of events where the physicians or midwives would answer their questions in detail, discuss what the birthing process may look like, provide resources, and explain the complications and different possibilities to make sure their patients had all the information they needed, and they understood the particular situation accurately.

"20 weeks of pregnancy, in the ultrasound they saw the baby was on very large side, 99th percentile. That resulted in conversations that she (the mother) was not thinking she would have. She was not prepared to know about what to do with a large baby. The doctor was coming to her with a bunch of information in regard to like things that she should be thinking about. She had a bunch of ultrasounds back-to-back as the baby was not showing face. The doctor then informed her about the baby being very large or measuring very large in regard to leg length and arm length and they would keep monitoring it with more frequent ultrasounds but it was going to be something they would

need to talk about as they get closer to the end, like if she would need to get like a C section, or about inducing. They would also need to do an ultrasound at 36 weeks."

"The doctor explained how women conceive, how close the sac comes, how the baby comes to the womb. She drew a picture in her notebook to make her understand how the sac looks like. She said there was still a chance that she could still conceive a baby, the baby might come in the sac later, it happens to many women. She explained the ultrasound report in detail and drew the picture along with that to make things clear for the mother. She explained her that her sac is in round shape, if the sac was in twisted shape, then it could be a bad symptom, it could be a miscarriage. She explained what the positive things in her case are and what could go wrong. This doctor was very straightforward and informed her about every single step in that scenario."

Participants also reported about few incidents when the doctor or the midwife was unable to establish a shared-information environment and fulfil the to-be mother's expectations.

"She (the mother) would like if the doctor would understand the reason why she wanted to run. She thinks fitness throughout any stage of life is important, being pregnant she's still herself. In her first pregnancy, "I am pregnant" and that's all she was. She would like if the doctor was more open to educate herself more on the fitness issue, learn about fit pregnancy and exercises that are safe and providing those resources instead of shaming the patient for trying to stay healthy. She asked if she could run 4 miles. The doctor asked if she sweated then she couldn't run and that's it. The doctor did not try to understand why she wanted to carry out an exercise routine throughout the pregnancy,

and why it is important to her. It did not seem like the doctor cared about that. Acting a little caring and personable would help."

5.3.2 Shared Sensemaking

As the participants were first-time mothers, there were times when they were confused about some of the aspects of their pregnancy. Some symptoms or incidents they were worried about were actually common in pregnancy, and some things they thought normal were actually worrisome in some situations. In this case, participants reported that the doctor/midwife helped in reframing their mental model, this aspect of their interaction aligns with the concept of shared sensemaking (Bartone, 2004; Weber and Glynn, 2006; Weick et al., 1999) in critical situations.

"She had some pain in her pelvic area in her third trimester. She shared that with her midwife. She told her it was quite normal at her stage of pregnancy. The midwife did not ignore or brushed off her concerns. She explained it to her why the pain was occurring and why it is quite normal. The midwife explained that her body was preparing itself for giving birth."

"The primary midwife was able to kind of help calm her fears and assured her that women gain weight at different bell curves of their pregnancy. She assured her (the mother) that the way that she had gained weight, she was still very much on the healthy spectrum and well within the expected amount of weight gain. Being reminded that every woman is different and what she was experiencing is healthy and normal; just been reassured about that was all she really needed."

Participants also reported about interactions where they felt their concerns were not being addressed properly by the doctor or the midwife. As they were first-time pregnant, there were concerns about lifestyle, exercise routine, fitness, and things important to the mothers but from their perspectives, some of these concerns were not heard by the physicians or the midwives.

"She (the mother) was sharing her concerns (about exercise routine) over multiple visits, but it wasn't a high priority, because it wasn't anything serious in their mind. But it was for her, which is partly why she left the OB. She felt like her concerns weren't being addressed. If they tried get to know patient better, have a better relationship so that way you can feel like you trust your physician, and they know about you and they don't dismiss your concerns, because even though it might not seem like a big deal to them, only because a lot of women deal with it. But it could be a big deal to the patient (her)."

5.3.3 Shared Decision-making

Participants reported that they felt the physician or midwives were understanding their perspectives when they laid out different options for the participants to choose from. They explained that their patients could decide to choose freely from the options considering their preferences and comfort levels. This aspect of their interaction can be considered a shared decision-making approach, and it is a vital component of informed patient choice and patient-centered care (Elwyn et al., 2010; O'Connor et al., 2007). Our interviews show that they also feel empowered and consider it as the doctor or midwife understanding their perspectives.

"The midwife mentioned if she (the mother) wanted to let things go, then they would want her to set up additional appointments, a non-stress test, an additional ultrasound. She gave her the options and then she also laid out the risks because as she got further past her due date, the risk to the baby did go up slightly. The midwife was comfortable with her decision as long as she had set up the additional appointments every other day. She was not telling the mother what option to choose rather she was giving her all the information, laying out the risks and benefits and then letting her choose herself. That helped her also to agree to the midwife's request for additional appointments."

"She (the mother) was kind of on the fence about hiring a doula because she wasn't willing to pay the extra money and have that. They (midwife and mother) talked through different options and she wasn't sure if the midwife would be open to having a doula at her birth, because she was uncertain if the midwife would see it as like someone trying to step into her territory. But when they talked about this, the midwife was really open to it, she encouraged her and said "doulas are worth their weight in gold". So the fact that she was really open to having like another support person at the birth, for her, felt really good that she didn't roll her eyes or say like "I don't think you need that or you know anything like that.""

But there were also a few incidents when the participants felt that patient autonomy and their preferences were not being considered by the physician or the midwife. These are the times when they failed to reach a shared understanding.

"She had a lot of pain while running, she asked the physician about it, they just asked to stop running. She did not like the answer. She told them it was part of her lifestyle and really like to be active and so she'd really appreciate, if they had any you know just kind of tips, or if she should go see a physical therapist or any kind of recommendations. She insisted that this is really important to her, but it just kind didn't seem like it was important to them to help, that was rough. They just said, like a lot of women experience pelvic pain. When they're pregnant and it's pretty common and it will just go away at birth. She thought what would have helped is if they maybe would have given her options of things that she might be able to do to help or recommend because she ended up going to the athletic training clinic in her university."

5.3.4 Communication about the Outcomes

Part of shared decision-making also involves communicating the outcome of each choice the doctor and the patient make together. We consider it as a different theme emerging from the interviews as it not only includes the decision options but also lays out the likely benefits and risks of each option. Participants reported incidents when the doctor/midwife explained the consequences of decisions/tests/birth plans, discussed the pros and cons, and communicated that they were suggesting those considering what would be best for the patient. They provided guidance on how to weigh up the consequences of different options, patients considered it as facilitating their engagement in the interactions, doctor/midwife understanding where they (patients) stand, and explaining they had their patients' best interest in their mind.

"The doctor explained what might happen to her (the mother), and one of the things that she brought up is if the baby was as large as they were thinking, there was going to be a solid chance that she would have some major tearing. And the doctor was talking about her recovery, that she was going to recover quicker if she got a C section than if she was to tear as much as they thought she might. It was better for her to be a better mom. She would be able to take care of all the things that she needed. The doctor walked her through why she was doing what she thought was best for her. Walking her through the actual thought process and explaining why she wanted to do what she did helped out a lot in regard to making her feel like the was on her side."

"The baby's heartbeat was a bit unstable, then the midwife sent her to the hospital to do some additional monitoring. Everything ended up totally fine. After having that interaction, she felt that the midwife had her best interest at heart and she wanted to make sure the baby was healthy. When she saw something that was even just a little concerning, she wanted the mother to go check it out. She felt safe in her hands from that incident."

5.3.5 Shared Goals

This aspect of the interaction involves the doctor/midwife and the patient sharing a common understanding of approaches to achieve their desired outcomes, specially ensuring the mother and the baby's health (Inkpen, 1996). Participants reported incidents when the doctor/midwife validated their concerns/symptoms/problems and

communicated compassionately that they will work together to address their (patient) concerns and issues.

"She (the mother) was very sick in her first trimester, throwing up all day. She knew she could medication for that. She had tried all the usual things, home remedies but nothing was working. She felt she needed medication to control it otherwise it was starting to get in the way of her job. She was worried that she would have to prove to the midwives she was seeing at the moment that she was really sick. She started keeping track of how many times she threw up every day, and how many times she had been very sick. She was doing that because she thought they were not going to prescribe her medication very easily. So she went into her first appointment with that midwife, she mentioned she had been very sick and she had tried every home remedy. The midwife listened to her problem and immediately started discussing different prescriptions. It gave the mother a sense of relief that she did not have to pull out her little calendar to prove her sickness. The midwife was willing to help her anyways and it gave her comfort."

"When she (the mother) was gaining weight, the midwife knew that she was still active every day, either doing strength or doing yoga. So she would check in and make sure that she was still being active. The midwife knew that having a healthy lifestyle was a priority for her and so she checked in to see if there was anything that she could help with as far as like providing information for a better diet and whatnot. She didn't need extra information from that, but the midwife made herself available to provide material or help, however, she needed to if she needed to."

5.3.6 Tailoring to Circumstances

This theme emerged from the perspectives shared by the participants in the interviews, though it is a bit unconventional considering the cognitive empathy, shared understanding, and perspective-taking literature. Participants discussed that in many points of their interactions with their physicians or midwives, the communication was empathetic and that held common ground between them and the physicians/midwives as doctor/midwife could understand the patients, their personalities, and their unique situations and they provided information/explanation/communication accordingly.

"In times of crisis, she (mother) is very logic driven. So the doctor didn't involve emotion at all. She laid out the facts. She explained that she's gone to school for this and her co-worker/friend didn't even though she had the best interest for her in heart. The conversation came down talking about the risk factors with vaginal birth vs C-section. The doctor walked through her thought process and mentioned this was why she needed to start considering whether or not to do a C section."

"They shared their concerns with her, explained what the complications could be. They offered her to see a dietitian, also suggested what she herself could do from her end to keep it under control without doing any harm to the baby. She talked to the dietitian, made some adjustments in her lifestyle to keep it under control. The midwife wasn't rude about it at all, she didn't shame her for this. She said, "yeah I get it, you are pregnant and there's lockdown going on, you cannot go out very frequently. That's all good but try

to do these things." They were always open to help her try alternatives for losing weight without doing any harm to the mother's or the baby's health."

Some critical communications also came up in the interviews as the physician/midwife failed to see the patient's unique circumstances which led to misunderstanding.

"The midwife said, "Oh you're gaining way too much weight, you need to slow down, you need to change your diet." Meanwhile the mother feels she was incredibly healthy and active person and felt that was pretty inappropriate for her (midwife) to say so."

5.4 Discussion

Many components of the conceptual model of cognitive empathy developed based on the literature review (see Figure 1) have come up in this interview study. Also, apart from what is considered cognitive empathy in literature, analyzing this interview study we came across some more aspects of cognitive empathy that patients perceive as important for their interaction with the physicians. Even though these elements may not traditionally be considered as part of cognitive empathy, interviewees described these as important for communications when they thought the physicians or the midwives were trying to see things from their (interviewees) perspectives and a shared understanding was established during their interactions. For example, shared decision-making has been an important aspect of cognitive empathy within healthcare settings, but there is more to it that qualifies as a separate element of cognitive empathy. Communicating about each of the outcomes after laying out the decision options or choices has appeared to be almost equally important as shared decision-making considering the prevalence of it across the

interviews (Shared decision-making 9 times and communicating about outcomes 8 times). Based on the themes that emerged from this study, I have revised the conceptual model of cognitive empathy (See Figure- 8) to include the newly discovered elements in it. I have also added some examples of incidents with the corresponding elements in the model. Though some of the incidents (baby size concerns, birth plan, exercise routine, etc.) are common across the interviews, I did not add them in the examples for every kind of interaction that occurred.

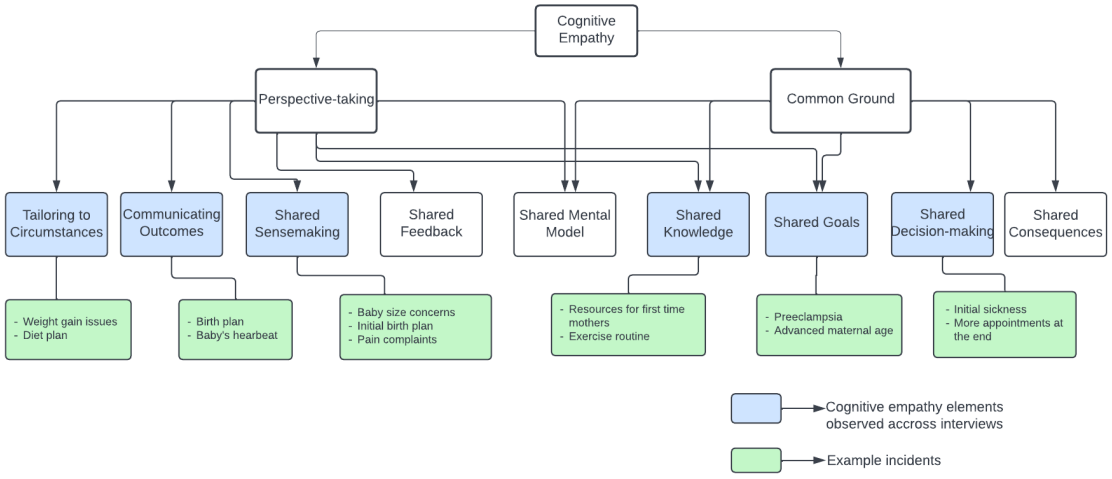

Figure 8: Revised conceptual model of cognitive empathy based on the interview study

Two additional elements are included in the framework: 1) Communicating the outcomes and 2) Tailoring to Circumstances. Both elements go under the "Perspective-taking" category in the framework as they involve being aware of the other party's viewpoints and actions, and not sharing the same plan, choices, or information. Some of the elements that we observed from the theoretical perspectives such as shared mental model, shared consequences, and shared feedback were not detected in the interview study. Partly because

some of these elements are part of inter-group empathy or team empathy (shared mental model, shared consequences). They only apply when two parties are working from the same side of the partnership (in some cases financial partnership for shared consequences) or they may have similar kinds of expertise (for example, both are healthcare professionals). There are also some differences as we are only discussing human-human interaction for critical communications. We have observed in the interviews that a lot of back-and-forth conversations had happened between the physician/midwife and the patient accounting for feedback from the patients during these interactions.

In the next section, I will discuss another follow-up lab study based on the previous lab studies but also informed by the naturalistic examination of human-physician interactions from this interview study. Figure- 8 represents the taxonomy of cognitive empathy and its independent and overlapped elements, but not all of these elements can be incorporated into patient-AI communication. Considering the prevalence of the elements across the interviews and what we can incorporate in a lab study for patient-AI interaction scenarios, we added two more cognitive empathy conditions to our previous study. The goal of this study was to test the cognitive empathy elements in light of the data from the interviews and further examine and replicate findings in Study 2.

6 Study 4

Study 1 and 2 were designed to evaluate the empathy scale and test whether different kinds of interactions were capable of producing measurable differences in perceived empathy. However, they were not informed by the naturalistic examination of human-physician interactions. Thus, I planned to run another follow-up lab study after conducting the interview study based on the interview data. Based on the prevalence of alternate communication strategies from the interviews that help establish cognitive empathy and that can be incorporated into human-AI communication, I added two more cognitive empathy conditions in addition to what cognitive empathy conditions I tested in Study 2. As I observed in Study 2 that participants liked affective or emotional components of empathy in the scenarios even if they were not realistic and the pattern was similar across all the scenarios, I decided to solely focus on cognitive empathy components in this final study. Also, I did not include the patient-doctor and patient-AI interaction in this study as we already know from Study 2 that people prefer physicians as diagnoser no matter what the scenarios are or how they are handled.

For this study, I also adopted the scenarios based on real telehealth consultation interactions from "incline". I tested four cognitive empathy conditions independently in this study: Shared Decision-making, Shared Sensemaking, Shared Knowledge, and Shared Feedback.

Results show that shared decision-making and shared knowledge were significantly better than the paired control scenarios for perceived empathy but shared feedback and shared sensemaking did not have any significant effect. For satisfaction measures, there was no

significant improvement for any of the cognitive empathy elements compared to the paired control scenarios.

6.1 Method

6.1.1 Participants

One hundred and thirty undergraduate students at Michigan Technological University took part in the study in exchange for partial course credit. They were enrolled in the "Introductory to Psychology" course. Students in the class are typically first or second-year undergraduate students.

6.1.2 Procedure

The study was conducted online, and it took 15–20 min to complete. Participants gave their consent online before taking part in the study. As we have observed in Study 2 that there were significant effects of the scenarios and how they were handled, I came up with paired scenarios for this study to make the experimental design more sensitive. There were 4 pairs of scenarios adopted from "incline". Each pair had similar, not the same symptoms but had a different diagnosis. One scenario in each pair was in the control condition where no cognitive empathy element was provided, the other scenario contained one cognitive empathy element among 1) Shared Decision-making, 2) Shared Sensemaking, 3) Shared Knowledge, and 4) Shared Feedback. This was a within-subject study. Each pair of scenarios was counterbalanced across the participants, but the scenarios were not counterbalanced across the pairs. Participants were told each scenario was an interaction

between a telehealth chatbot and a patient and they were asked to rate the scenarios at the end of each scenario on the AI Cognitive Empathy Scale (AICES) and the "Explanation Satisfaction Scale" to understand whether their perception of empathy and satisfaction change depending on the components of cognitive empathy. The goal was to explore which cognitive empathy elements have the maximum effect compared to the control conditions. Figure 9 shows the example of how shared sensemaking and shared decision-making aspects were incorporated in the experiment.

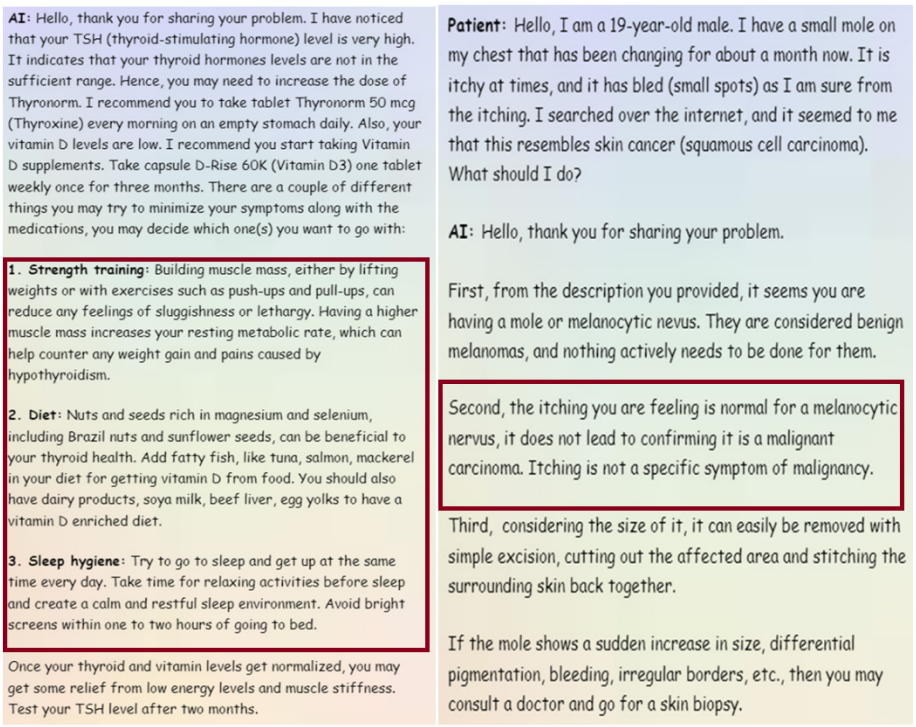

Figure 9: Example of cognitive empathy elements incorporated (a) Shared decision-making (b) Shared sensemaking

6.2 Results

I split the results for each empathy condition by scenario to see if there was still an effect of scenarios even though they were paired scenarios. Results show that participants perceived more empathy in all empathy conditions compared to the control conditions in all scenarios except one scenario in shared decision-making (see Figure 10). But for the satisfaction scale, participants' perceived satisfaction was similar across empathy and control conditions (see Figure 11). In some cases, satisfaction in control conditions surpassed the cognitive empathy conditions (i.e., shared feedback condition).

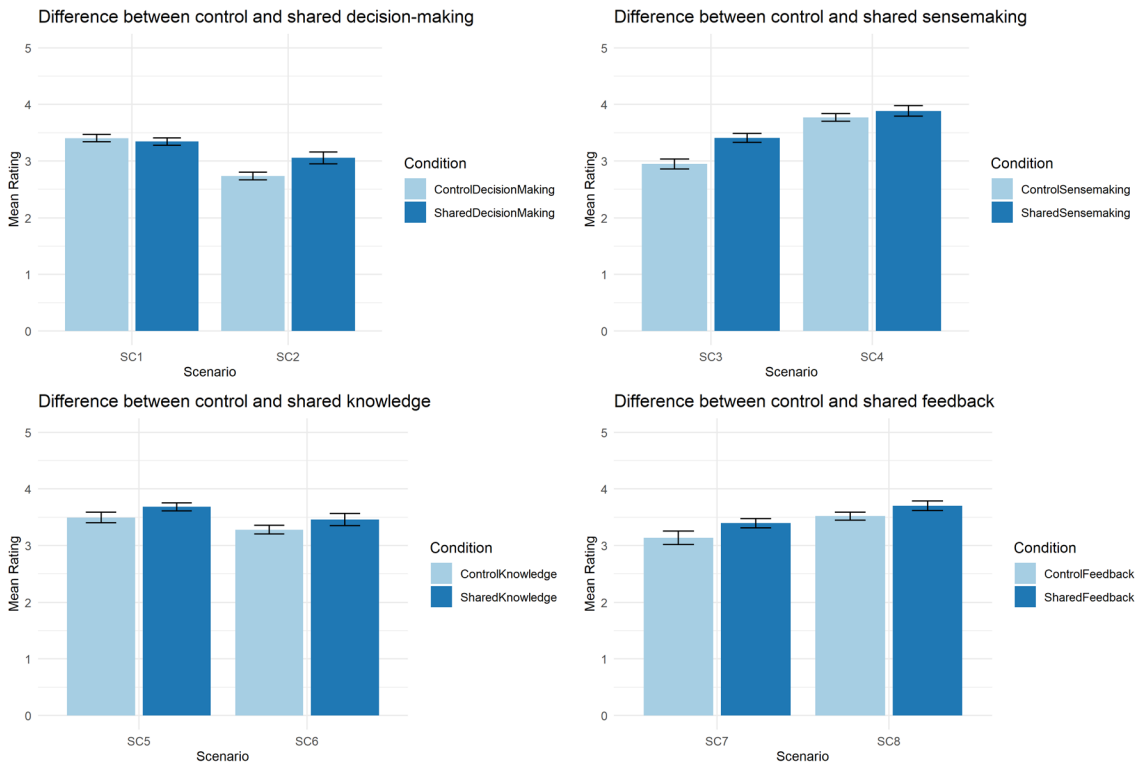

Figure 10: Perceived empathy across different empathy conditions compared to paired control condition using AI Cognitive Empathy Scale (AICES)

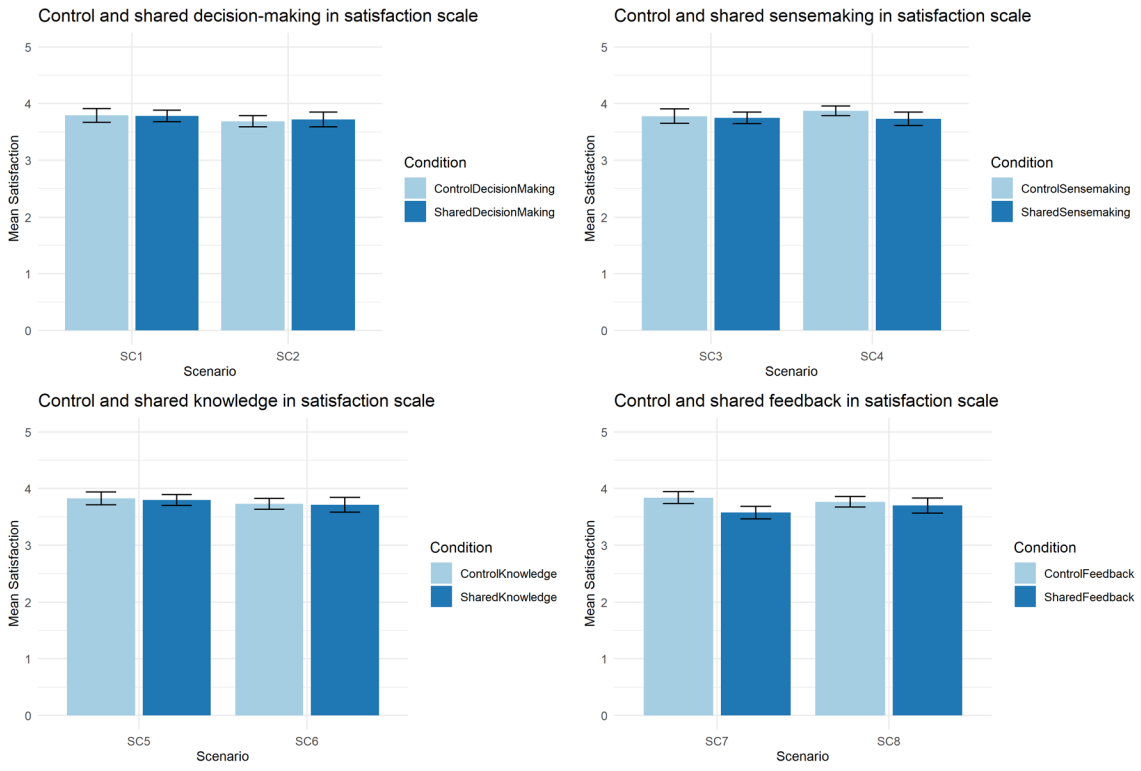

Figure 11: Perceived satisfaction across different empathy conditions compared to paired control conditions using Explanation Satisfaction Scale

I examined the rating for AICES with a repeated-measures ANOVA to investigate the main effects of cognitive empathy conditions and the scenarios. The results are shown in Table 6. Shared decision-making and shared knowledge significantly improved perceived empathy among the participants, but the effects of shared sensemaking and shared feedback were not statistically significant. There were statistically significant main effects for scenarios across all empathy conditions. That shows that even if we made some changes to make the design more sensitive, there were still some effects on what the cases looked like in the scenarios and how they were handled through telehealth consultation.

Table 6: Repeated measures ANOVA results for perceived empathy across different empathy conditions compared to the paired control conditions.

	Empathy Conditions	**Scenario**
Control vs. Shared Decision-making	F (1,129) = 17.17 $p < 0.05$	F (1,129) = 43.55 $p < 0.05$
Control vs. Shared Sensemaking	F (1,129) = 1.50 $p = 0.22$	F (1,129) = 89.92 $p < 0.05$
Control vs. Shared Knowledge	F (1,129) = 10.86 $p < 0.05$	F (1,129) = 7.36 $p < 0.05$
Control vs. Shared Feedback	F (1,129) = 2.41 $p = 0.12$	F (1,129) = 21.30 $p < 0.05$

I also examined the rating for attributes of satisfaction with a repeated-measures ANOVA to investigate the main effects of cognitive empathy conditions and the scenarios. There were no statistically significant main effects for empathy conditions and the scenarios for attributes of satisfaction.

As we did not counterbalance the scenarios between empathy conditions, we also asked the participants in which cases they thought the AI chatbot tried to understand the

patient's perspective in the telehealth consultation. It was a between-subject question as we only provided the four case options to choose from. One group only could choose from the cases which had the cognitive empathy elements, the other group could only choose from the control condition cases. For both control and empathy conditions, participants chose the sensemaking case scenarios as the most likable and the decision-making scenarios as the least likable (see Table 7). I also conducted a Chi-squared test on this data and found that the participants' preferences about the scenarios were statistically significant ($X^2(3) = 7.6$, $p = 0.05$).

Table 7: Proportion of preferences about the case scenarios

Scenario type / Condition	Decision-making	Sensemaking	Knowledge	Feedback
Control	8.14%	58.14%	15.12%	18.6%
Cognitive Empathy	4.55%	43.18%	11.36%	40.91%

6.3 Discussion

In Study 2, we observed that participants gave higher ratings to the consultation when they were told the diagnoser was a physician, not an AI chatbot. So, it was established that even for the same scenarios or similar ways of handling telehealth consultation, people like it more when a physician is involved than an AI chatbot tool. Also, people

perceive emotional empathy as beneficial even though it has no real effects during consultation. Again, different case scenarios and how they are handled had effects on the perceived empathy and satisfaction. Considering all these aspects, I did not include the different diagnoser (physician and AI) and affective empathy elements in this final lab study. I also made some changes in the design to make it more sensitive and came up with paired scenarios in this study. In the paired scenarios, the cases discussed were similar but they had different diagnoses. Overall, shared decision-making and shared knowledge conditions were significantly better than their respective paired control condition whereas shared sensemaking and shared feedback could not make much difference. Even if I designed paired scenarios, they can never be the same as there were different diagnoses involved, and how the cases and the diagnoses were described also varied to some extent across the scenarios as they were all adopted from real telehealth consultation. So, there were still some impacts of scenarios.

6.3.1 Scenario Effect Analysis

As we have seen that there are main effects of scenarios in this experiment even though I revised the experiment design to make it more sensitive after I did study 2 and before I started conducting study 4. Even with the paired scenarios, there were large effects of scenarios in this experiment. So, I again rank-ordered the scenarios like study 2 to organize them in terms of the overall base levels of the AICES rating using the control condition data (see Table 8). Results show that Cyst scenario (Sensemaking control) had the highest rating and hypothyroidism (decision-making control) had the lowest rating though the difference is very low between them (0.23). I have colored the paired

scenarios in the same color so that it is easier to compare them. The top 4 scenarios are from 4 unpaired control conditions, which explains the scenario differences.

Table 8: Rank Order of the scenarios based on mean ratings using AICES

Scenario	Mean AICES rating
Cyst	3.07
Work stress	3.05
High BP	3.00
Fibromyalgia	2.99
Anxiety disorder	2.98
Mole	2.97
Tonsil enlargement	2.92
Hypothyroidism	2.84

I also assessed the scenarios in terms of each of the questions within AICES (see Figure 12). It shows that there are some scenarios that do not differentiate between questions much, specially for the positively framed questions. But for the negatively framed questions, there are some scenarios where the differences between the questions are large. For Fibromyalgia, High blood pressure, and Hypothyroidism, Q3("The AI is not good at understanding the patient's problem") and Q5 ("The AI cannot anticipate what information the patient needs") had substantially low ratings than the other three negatively framed questions. This may have driven the significant scenario effects, as the other five scenarios do not show a similar pattern. Also, for hypothyroidism, Q4 ("The AI

tries to understand me by sensing how things would look from my perspective") received a moderately low rating than the other positively framed questions. Both the fibromyalgia and hypothyroidism scenarios were providing Shared Decision-making elements in the experimental condition, the lower ratings in the control condition seem to be driving the significant improvement due to the use of Shared Decision-making components. There is also a pattern within the rating of the questions for a particular scenario, for example, in the Cyst scenarios, all the positive questions have higher ratings, and all negative scenarios have lower ratings than most other scenarios. Sensemaking elements were incorporated in the experimental condition for this scenario, but it is evident that people already liked the scenario in the control condition, without any cognitive empathy elements.

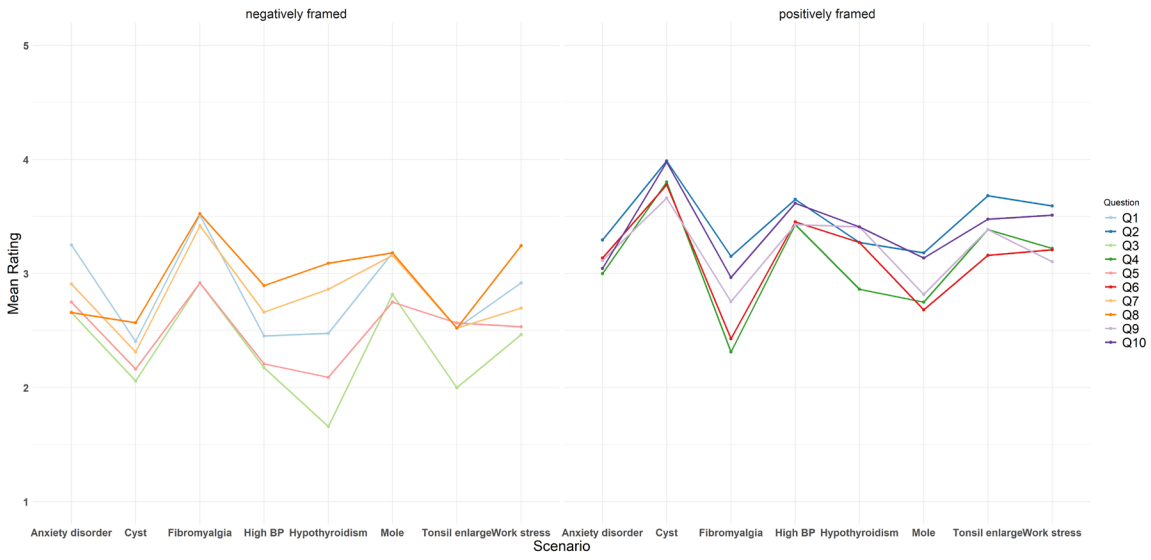

Figure 12: Scenario analysis for each question in AICES

For some scenarios, the differences between the control and cognitive empathy conditions were reasonably high and in other cases, there were not large differences. It is clear from the experiments that no matter what kind of cognitive empathy components are incorporated in patient-AI interactions, there would be some effects on what the symptoms are, how they are described, and how the AI chatbot comes to a decision and gives a diagnosis. But for satisfaction attributes, there were not any significant differences between control and cognitive empathy conditions across the scenarios.

At the end of this study, participants were asked in which cases they thought the AI chatbot tried to understand the patient's perspective in the telehealth consultation. For both control and cognitive empathy conditions, participants liked the sensemaking condition the most and the decision-making condition the least. That is the opposite of what we observed within the context of perceived empathy. It probably means that adding cognitive empathy elements to the sensemaking scenarios did not improve perceived empathy much because participants already like the scenarios. The second most likable one is the shared feedback scenarios. The preference for sensemaking cases went down a bit (from 58.14% to 43.18%) when shared sensemaking elements were incorporated, but that was mostly because it was drawn towards the shared feedback scenarios (from 18.6% to 40.91%). The proportion of people who preferred the shared feedback condition doubled from the control condition. It seems the shared feedback scenarios provided a very salient boost. Even though sensemaking and feedback elements did not show significant impacts through perceived empathy and satisfaction ratings, the proportion of people liking or preferring these cases or conditions increased massively

when asked. Overall, all the cognitive empathy elements made some impact over the control conditions through different dimensions of evidence, whether it is perceived empathy or preferences.

7 General Discussion

After completing the final lab study, I decided to take a final look at the conceptual model of cognitive empathy, this time specially within the context of patient-AI interaction. My objective was to frame it according to the results from the studies I conducted for my dissertation and develop an understanding of the taxonomy of cognitive empathy elements for effective patient-AI interaction. Then, I will provide some design recommendations for diagnostic AI chatbots incorporating cognitive empathy elements based on the conceptual model.

7.1 Conceptual Model of Cognitive Empathy for Patient-AI Interaction

Across all the lab studies I conducted, I have tested four of the cognitive empathy elements that were observed in the literature: shared knowledge, shared sensemaking, shared decision-making, and shared feedback. From the interview study, I also identified two new elements (that were not observed in the literature) of cognitive empathy within patient-physician interaction: tailoring to circumstances and communicating the outcomes (see Figure 8). There are also two other elements from past research that I have not tested in my scenarios due to some limitations in simulated scenarios. These are shared mental models and shared goals. Based on all the observations I made through past research and my own studies, I have developed an understanding of the taxonomy of cognitive empathy elements within the context of effective patient-AI interaction.

7.1.1 Shared Knowledge

Shared knowledge is considered an important element of establishing common ground (Clark and Brennan, 1991; Krauss and Fussell, 1990). In my lab experiments, I tested the shared knowledge aspects in scenarios where AI ensures it knows the patient's condition and symptoms and communicates that the patient knows what the AI knows. It was found to be marginally effective compared to the control condition in the lab study discussed in chapter 4. But there was a significant effect on the scenarios. So, if shared knowledge is incorporated by AI systems in relevant cases or situations, there are possibilities that shared knowledge or information would establish cognitive empathetic communication between patients and AI systems. The final study discussed in chapter 6 shows that shared knowledge was effective compared to the control scenarios for perceived empathy. In the interview study, we also observed shared knowledge being a major component of communications as it helped the patients perceive that the physicians or the midwives were understanding their situation and viewpoints.

7.1.2 Shared Decision-making

Shared decision-making plays an important role in ensuring patient-centered care (Elwyn et al., 2010). Besides increasing patient engagement, it helps establish effective communication in healthcare settings. I tested this element of cognitive empathy in only one of my lab experiments (chapter 6). Shared decision-making was found to be effective compared to the control scenarios for perceived empathy. In the interview study, it was

observed that shared decision-making aided in establishing a shared understanding between patients and the physicians or the midwives.

7.1.3 Shared Sensemaking

In critical situations, shared sensemaking helps to resolve the inadequacy in the current understanding of the situation (Klein et al., 2007; Weick, 1988a). Like shared decision-making, I tested this element of cognitive empathy in only one of my lab experiments (chapter 6). Though it did not show improvement compared to control conditions, it was thought to be handled better by the AI system in the scenarios. Participants thought the AI chatbot handled those situations better even though perceived empathy in those scenarios was not very high compared to the control scenarios. There are potentially some saliency boosts in the sensemaking scenarios presented in the experiment. As there were significant effects of the scenarios, it is possible that sensemaking components may be effective for critical assessments or rare diagnoses (as they represent critical situations). In other cases, it may not be very effective. In the interview study, we also observed that sensemaking played an important part in communicating the critical and common symptoms to the patients.

7.1.4 Shared Feedback

I tested feedback components in the studies discussed in chapter 4 and 6. Though it did not show improvement compared to control conditions in either of the studies when asked participants perceived the cases to be handled better by the AI system in the feedback-seeking scenarios. It seems there are also some saliency boosts in the feedback

scenarios like sensemaking components. We have observed that scenarios make a big difference in perceived empathy and patient satisfaction, so the cases, symptoms, and the types of diagnosis or the situation may also be a catalyst for how seeking feedback is perceived by the patients when they interact with the AI chatbots.

7.1.5 Tailoring to Circumstances

Different cases may demand different components of cognitive empathy- what works for a routine assessment may not work for a continuous consultation for chronic or serious illness, and what works for unusual circumstances may not work for a straightforward diagnosis. We have observed in the interviews that it makes a big difference to the patients if the physicians consider their unique circumstances and provide explanations understanding their personalities. Based on an interview study with physicians, Alam and Mueller (2022) reported that physicians also tailor their explanations in critical situations based on patients and their families' circumstances, intellectual levels, and cultural and emotional states. Based on the pieces of evidence, tailoring to the circumstances could also be an important cognitive element within patient-AI interaction. Different situations may demand different cognitive elements, so tailoring the cognitive empathy elements to the patient's circumstances should also be taken into account. In the first study, we observed that all empathy elements together were significantly better than the control, but when implemented separately in other studies, patient feedback did not show any significant effects. So, it is also possible that some situations may require multiple forms of cognitive empathy, and in other cases, one element of cognitive empathy may be sufficient.

7.1.6 Communicating about Outcomes

The interview study shows that besides making patients aware of the decision choices, communicating the outcomes of each of the decision choices is equally important to the patients. This could also be incorporated into the AI chatbots as an extension of shared decision-making to lay out the risks, benefits, advantages, and disadvantages that follow the options. Treatment options may often offer multiple paths and the portrayal of the outcomes could make a real difference. In the next section, I will provide some recommendations about how this can be incorporated into real AI chatbots.

7.1.7 Shared Mental Models

Due to some limitations in the simulated scenarios, I did not test the components of shared mental models in the lab experiments. But the concept of shared mental model and shared knowledge often gets fuzzy around the edge as mental models are organized knowledge structures and shared mental models allow individuals to understand the organization of each other's knowledge content (Johnson-Laird, 1983; Mathieu et al., 2000). We have observed across the lab experiments and the interviews that shared knowledge has significantly improved the perception of empathy, so even if the components of mental models were not tested specifically, there was evidence that understanding each other's knowledge content can be useful in patient-AI interaction. . If the AI chatbot can understand the patient's mental model and communicate their (chatbot) mental model to the patient through effective explanation strategies (Hoffman

et al., 2018; Klein and Hoffman, 2008; Mueller et al., 2019), that will help the AI chatbots to be able to tailor the cognitive empathy.

7.1.8 Shared Goals

We observed from the interview studies that shared goal is an important element to develop a shared understanding between patients and physicians or midwives. If the clinician knows about patients' intentions and plans and the patients know the clinicians', then they can work toward a shared goal. It is regarded as a motivator that allows two parties to coordinate their effort and work together (Chow and Chan, 2008). Though I have not tested it in the lab experiments, there are possibilities to incorporate this into AI chatbots for diagnosis purposes.

Overall, all these cognitive elements I tested show promise to improve the perceived empathy of patients, and incorporating these elements into real diagnostic AI chatbots have the potential to establish a stronger patient-AI communication for diagnosis purposes. As discussed in the initial conceptual model, shared consequences are not applicable for patient-physician or patient-AI interaction. So, I eliminate it from the final conceptual model as it is solely intended for patient-AI interaction. Table 9 summarizes the effectiveness of different cognitive empathy elements across the four studies I conducted, including the lab experiments and the interview study (For reference, Study 1, 2, and 4 are lab experiments and Study 3 is the interview study). Finally, Figure 13 shows the revised conceptual model for cognitive empathy specifically within the context of patient-AI interaction.

Table 9: Evidence of effectiveness of different cognitive empathy elements across the studies

Type of Element	Evidence
Shared Knowledge/Mental Model	Study 1, Study 2, Study 3, Study 4
Shared Decision-making	Study 3, Study 4
Shared Sensemaking	Study 3, Study 4
Shared Feedback	Study 1, Study 4
Tailoring to Circumstances	Study 3
Communicating about outcomes	Study 3
Shared Goals	Study 3

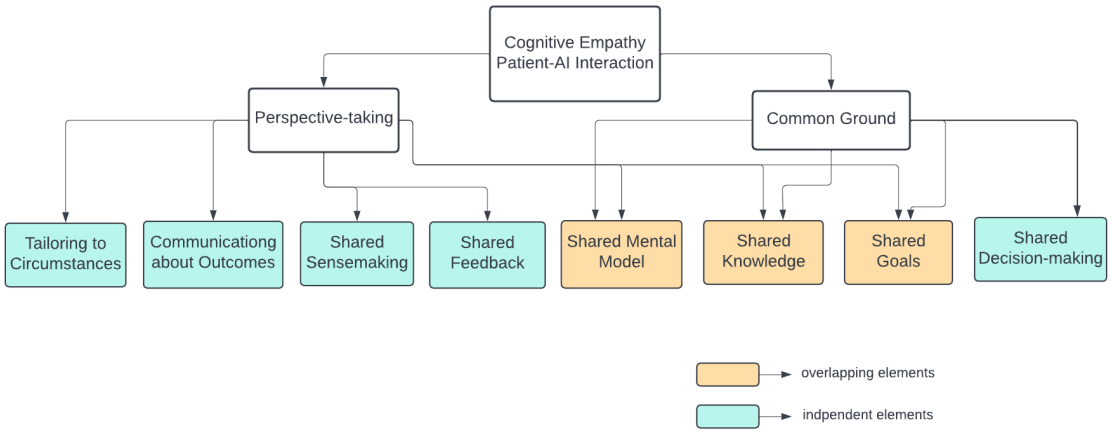

Figure 13: Conceptual model of cognitive empathy within the context of patient-AI interaction

7.2 Design Recommendations for Diagnostic AI Chatbots

In this section, I am providing some design recommendations based on the conceptual model of cognitive empathy and the occurrences we observed across the interviews. AI systems that are designed for medical diagnosis purposes may build more effective communication with patients if they incorporate these into their system.

7.2.1 Shared Goals

AI systems should provide more transparency about high-risk and high consequence decision-making tasks such as medical diagnosis (Hepenstal et al., 2019). One way to do this is to communicate its goals clearly by using appropriate explanations about the decision-making process. It should communicate how it can optimize its goals based on cost, accuracy, and safety while validating patient concerns properly (Eiband et al., 2018; Lepri et al., 2018). Figure 14 shows one example of how an AI system can communicate its goal to its patient about confirming celiac disease diagnosis, how it can optimize the diagnosis based on either cost or certainty concerns, and how the patient and AI could reach a shared understanding about it. Depending on the circumstances, an AI system should also explain how it does the diagnoses. For example- a lot of symptom assessment tools suggest the most likely thing based on available data, so they may misdiagnose some rare conditions and they should state that clearly while they provide an assessment. In my interview study, participants also reported that the physicians and the midwives

shared their goals clearly when they intended to establish a common understanding of approaches to achieve their goals, specially ensuring the mother and the baby's health.

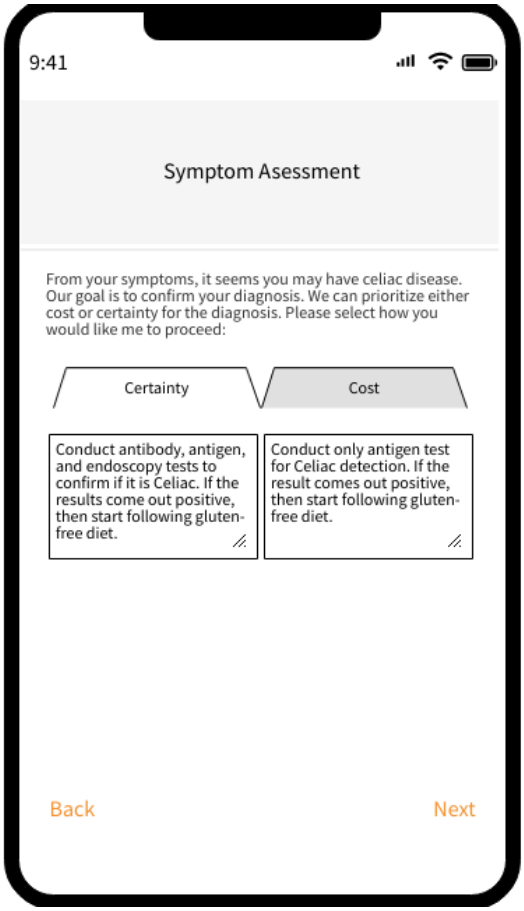

Figure 14: Design recommendation for AI communicating shared goals

7.2.2 Shared Decision-making

Shared decision-making has been an integral part of establishing shared understanding in healthcare settings. Making patients a part of the decision-making and sharing the decision choices is an efficient method for improved patient care (Elwyn et al., 2010; Frosch & Kaplan, 1999). In my interview study, participants also reported that they felt

that physicians or the midwives were understanding their perspectives when they clearly stated all the options they could choose from. AI systems should also incorporate such features. Figure 15 shows an example of how an AI system can lay out all the decision

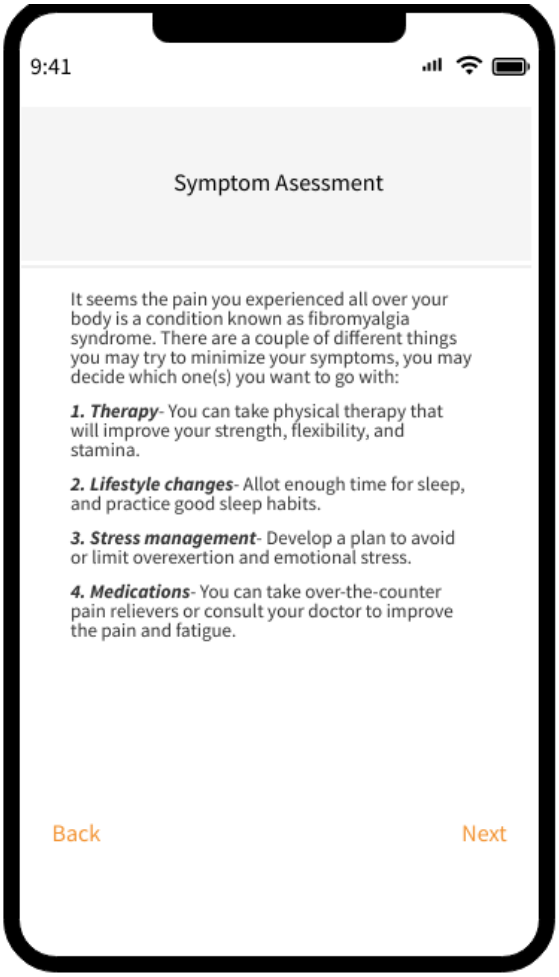

Figure 15: Design recommendation for AI establishing shared decision-making

options for a patient suffering from fibromyalgia syndrome as there are multiple ways (therapy, lifestyle change, stress management, or medications) to minimize their symptoms and improve their overall health.

7.2.3 Communicating about Outcomes

Along with stating the decision choices clearly, AI systems should also be prepared to communicate the risks, benefits, advantages, or disadvantages of each of the options so that patients know and can think clearly about how to choose from the options. The results from the interview study show that this is also very important to the patients, specially when they do know have a lot of knowledge about the situation. Shared decision-making and communicating the outcomes come hand in hand with establishing common ground with patients, but it may not be applicable for all situations as sometimes there is only one treatment option available for a diagnosis. Figure 16 shows an example of how an AI system can communicate the outcomes for three alternate treatment options (medication, radiotherapy, surgery) for a patient suffering from hyperthyroidism such as their risks and benefits and if they provide a gradual or immediate cure.

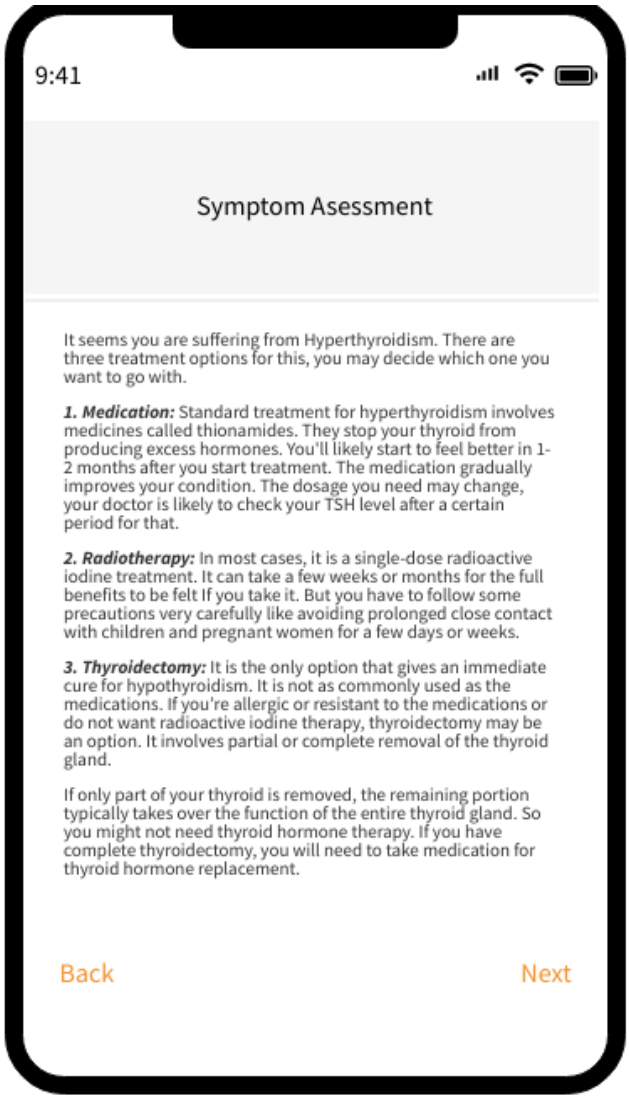

Figure 16: Design recommendation for AI communicating outcomes for decision choices

7.2.4 Shared Knowledge and Feedback

AI systems should make sure that the patients know what they know, and they know what the patients know. It is one of the core elements of cognitive empathy (Clark & Marshall, 1981; Krauss & Fussell, 1990) and also is an important element of patient-centered care (Hsu et al., 2004; Strøm and Fagermoen, 2014) as it creates a bridge between expert

physicians and patients who have very small knowledge (novice) about their conditions. Asking for feedback from patients can also help establish an empathetic relationship as we have observed within the interactions described across the interviews. Feedback can solidify the shared knowledge aspects of the communication in case there is a gap in knowledge structure between the patient and the AI system. In the lab study discussed in Chapter 6, we also observed that even though perceived empathy was not improved in the case of sharing feedback, participants thought the AI systems tried to understand patient perspectives in those scenarios. Figure 17 provides an example of how AI systems can make sure that they established shared knowledge with patients by echoing back the symptoms the patients shared with them and how they can ask for feedback in case a patient did not share something or forgot to share something at the beginning.

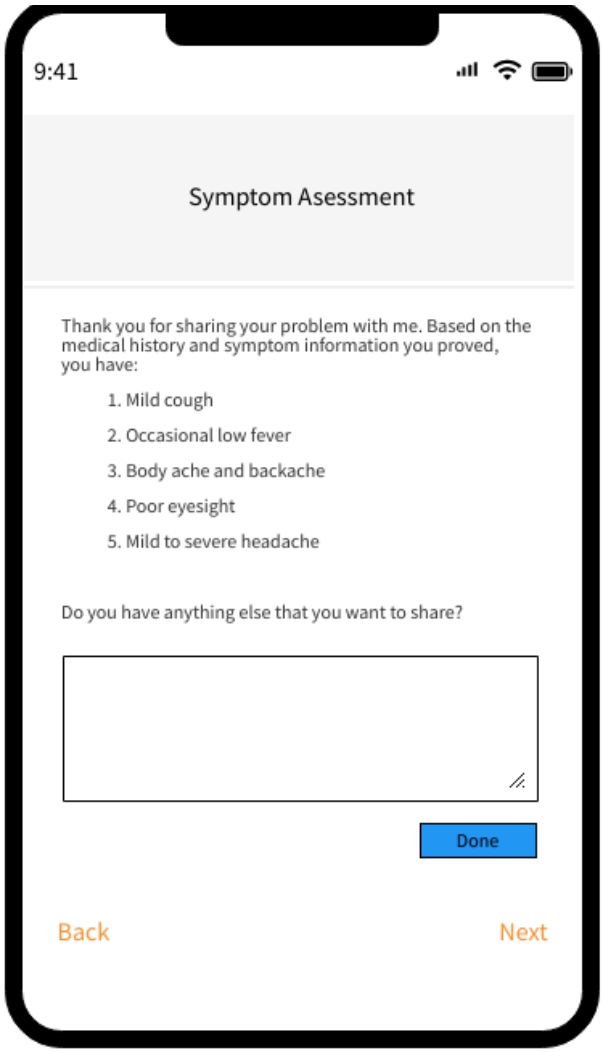

Figure 17: Design recommendation for AI system establishing shared knowledge and seeking feedback

7.2.5 Shared Sensemaking

Sensemaking has been considered an important aspect of human-AI teaming (Klein et al., 2006; Klien et al., 2004). AI systems can help patients update their knowledge structure by explaining what the evidence says and what is mere speculation. In critical situations, AI systems can also help patients understand what they think normal is actually

something worrisome. Physicians often implement this to communicate that they understand patients' perspectives, we have seen examples of it in the interview study too. Figure 18 shows an example of how an AI system can clear a patient's concerns about a suspicious lump and when they ask if it is a sarcoma (malignant) or not. AI clears their confusion by explaining that the pain is a symptom of a regular cyst, it does not provide any evidence that it is malignant since it has been unchanged for a few years.

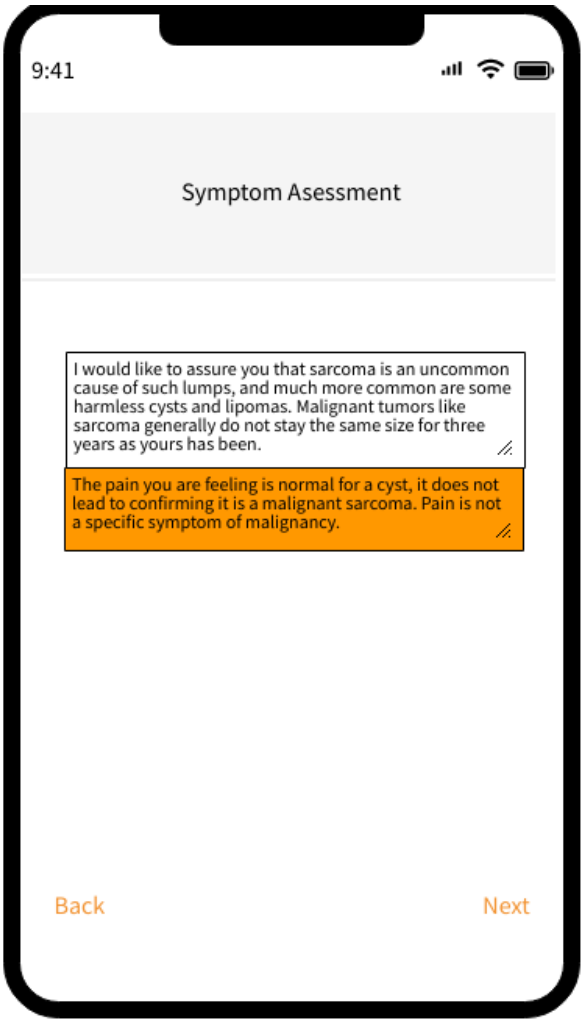

Figure 18: Design recommendation for AI systems implementing sensemaking theory

7.2.6 Tailoring to Circumstances

All the design recommendations I provided above depend on one common piece of advice, tailoring the cognitive empathy element on the basis of patient circumstances. We have seen across the lab studies that the scenarios have a significant impact on perceived empathy, though I was not specifically expecting such a result. Also, patients' mental models may vary, not all patients will equally understand or be willing to accept the explanations AI systems provide to establish cognitive empathy. The interviews revealed that participants preferred when the clinicians tailored their communications to their unique circumstances. It helps to build the rapport they wished for and helped them realize that the clinicians were willing to understand their point of view. AI systems should be prepared to address such issues too even though it may be difficult in many cases. Some cognitive empathy components may be successful in one situation, in other situations they may not work. Or it could happen vice versa. Some elements may be perceived as helpful to some patients, others probably would consider them meaningless too. Some situations may require multiple forms of cognitive empathy elements, in other situations, one particular element may be the most effective. It may also depend on the complexity of the patient's condition. Alam and Mueller (2021) argued that it is a crisis situation when explanations are heavily needed in healthcare, otherwise, people may just leave the AI chatbots and see another clinician. If a crisis arises, AI chatbots should be prepared to provide cognitive empathy tailored to the crisis. It may also differ for routine health checkups and complex illness consultations. Future research should address how the cognitive empathy elements should be tailored to these different circumstances.

7.3 Limitations

There are some limitations in this research that involves the study population, cognitive empathy conditions, and the AICES and explanation satisfaction scale.

7.3.1 Study Population

In all three lab experiments, participants were undergraduate students who took part in the study in exchange for partial credits. Though they were not asked about their direct experience with clinicians, it is possible that many of the participants from this population were not familiar with the cognitive empathetic behavior in clinical settings because of a lack of experience in direct interaction with clinicians. It is a possible cause of not seeing significant effects for some of the cognitive empathetic manipulations. If we had an adult population in the lab experiments, we may have observed larger effects in the manipulation of the cognitive empathy conditions as they may have more experience in interacting with clinicians directly. We may also have observed a change in perceived satisfaction that is missing from the lab experiments I conducted. But there is also another side to having a college student population as participants, as they are more likely to use AI-based technology for healthcare if the AI contains an adequate level of information (Jeffrey, 2020) and they are more potential users of AI as the first point of contact for diagnosis purposes.

7.3.2 Application of Cognitive Empathy Elements

There are some limitations regarding the implementation of cognitive empathy conditions in the lab experiments. As these were simulation-based scenarios only, some of the elements from the conceptual models were not tested in the lab experiments. For example, testing shared goals and tailoring to circumstances would take more in-depth and real-time multiple conversations with AI chatbots. This was not viable to do with single case-based scenarios. Some elements like shared mental models and communication about outcomes were blended into other elements like shared knowledge and shared decision-making as these were all simulations, not real-time patient-AI interaction. There are possible ways of incorporating the elements for real diagnostic AI chatbots and I provided some design recommendations for them in the previous section. If the design recommendations are applied in real patient-AI interaction, there will be opportunities for testing many of the different cognitive empathetic elements and observing their effectiveness in a more naturalistic environment.

7.3.3 Limitation of AICES

The AI Cognitive Empathy Scale (AICES) is reasonably strongly coherent as a single measure but cognitive empathy is not a single-dimensional construct based on the taxonomy I developed. It addresses the components of perspective-taking mostly (might be slight overlaps with common ground), but it was never linked back to the specific elements of cognitive empathy. A couple of different processes including the final conceptual model were developed after developing AICES, though AICES actually

guided the progress of these processes by aiding to measure different empathy conditions. I have linked the elements from the conceptual model to the questions in AICES (see Table 10), most of the questions align with shared knowledge elements with perspective-taking component.

Table 10: Linking cognitive empathy elements to questions within AICES

Questions	**Cognitive Empathy Elements**
1. The AI sometimes finds it difficult to see things from my point of view	Shared Knowledge (PT)
2. The AI realizes my problem even though I have difficulty describing it	Shared Knowledge (PT)
3. The AI is not good at understanding my problems	Shared Knowledge (PT)
4. The AI tries to understand me by sensing how things would look from my perspective	Shared Mental Model (CG)
5. The AI cannot anticipate what information I might need	Shared Knowledge (PT)
6. The AI tries to incorporate my perspective before making a decision	Shared Mental Model (PT)
7. The AI is not able to put itself into my shoes	Shared Mental Model (PT)
8. When the AI is sure it is right about something, it does not incorporate feedback from anything else	Shared Feedback (PT)
9. The AI is able to accurately compare its point of view with mine	Shared Mental Model (PT)
10. The AI can predict what I would want to know in a critical situation	Tailoring to circumstances (PT)

There are opportunities to augment the scale with new questions too, specially considering the results from my experiments and interviews. So, I am proposing a new scale (see Table 11) that incorporates the changes in AICES, addresses both perspective-taking and common ground aspects of cognitive empathy, and eliminates the bad questions (low correlation and sensitivity- Question 8 and 10) from AICES. Some

questions are rephrased from the previous version in order to accurately capture the notion of cognitive empathy elements, others are completely newly generated to link with cognitive empathy elements in the conceptual model. I have also discussed what can be considered perspective-taking (PT) and what could be common ground (CG) within the questions. I came up with 22 questions in total, 11 items require positive responses and 11 require negative responses. The revised questionnaire on a 1-7 Likert scale may help to capture the effects of different cognitive empathy elements more clearly in the future.

Table 11: Proposed Revised AI Cognitive Empathy Scale (AICES)

Questions	**Cognitive Empathy Elements**
1. The AI finds it difficult to see things from my point of view	Shared Knowledge (PT)
2. The AI realizes my problem even though I have difficulty describing it	Shared Knowledge (PT)
3. The AI is not good at understanding my problems	Shared Knowledge (PT)
4. The AI understands my situation the same way I do	Shared Mental Model (CG)
5. The AI cannot anticipate what information I might need	Shared Knowledge (PT)
6. The AI tries to incorporate my perspective before making a decision	Shared Mental Model (PT)
7. The AI is not able to put itself into my shoes	Shared Mental Model (PT)
8. The AI is able to accurately compare its point of view with mine	Shared Mental Model (PT)
9. The AI and I have the same decision choices for treatment purposes	Shared Decision-making (CG)
10. The AI incorporates my feedback about the diagnosis and treatment	Shared Feedback (PT)
11. The AI and I have the same goals to address my condition	Shared Goals (CG)
12. The AI is able to fill up the inadequacy in my knowledge about my condition	Shared Sensemaking (PT)

13. The AI does not understand my goals for my treatment	Shared Goals (PT)
14. The AI explains the pros and cons of all the treatment options	Communicating about Outcomes (PT)
15. The AI is able to address my concern in a critical situation	Tailoring to circumstances (PT)
16. The AI is not willing to incorporate my feedback	Shared Feedback (PT)
17. The AI does not discuss the risks and benefits of each treatment option	Communicating about Outcomes (PT)
18. The AI does not understand my unique circumstances	Tailoring to circumstances (PT)
19. The AI and I possess the same information about my condition	Shared Knowledge (CG)
20. The AI does not allow me as a part of the decision-making	Shared Decision-making (CG)
21. The AI cannot interpret my knowledge gaps about my situation	Shared Sensemaking (PT)
22. The AI does not know all the information about my symptoms as I know	Shared Knowledge (CG)

Table 12 shows the mapping of the proposed AI Cognitive Empathy Scale (AICES) onto the taxonomy of cognitive empathy. Among the 22 questions, 16 questions link back to perspective-taking components, the rest with the common ground components. The psychometric properties of the proposed scale could be assessed in the future within new experiments related to cognitive empathy, maybe addressing some other limitations of this dissertation (different study population).

Table 12: Mapping of Proposed AICES onto the taxonomy of cognitive empathy

	Perspective-taking	**Common Ground**
Shared Knowledge	Q1, Q2, Q3, Q5	Q19, Q22
Shared Mental Model	Q6, Q7, Q8	Q4
Shared Goals	Q13	Q11
Shared Decision-making		Q9, Q20
Shared Sensemaking	Q12, Q21	
Shared Feedback	Q10, Q16	
Communicating about Outcomes	Q14, Q17	
Tailoring to Circumstances	Q15, 18	

7.3.4 Explanation Satisfaction Scale

I have used the explanation satisfaction scale (Hoffman et al., 2018) to measure the satisfaction of using AI chatbots containing cognitive empathy elements, but it was not sensitive to the manipulation of cognitive empathy elements at all. There could be some ceiling effects, as we have seen that participants were generally positive about the diagnoses in the scenarios. It does not provide any evidence that people were not satisfied with the cognitive empathetic elements, because most of the time they gave moderately high satisfaction ratings. The only issue was that the manipulation of empathy conditions did not change their satisfaction significantly. If I used any general patient satisfaction scale or common user satisfaction scale, we might have seen a change in the results, even probably significant effects for different cognitive empathy conditions. Future research may use such a scale to assess if there is any change in satisfaction with different cognitive empathy conditions.

For many complex diagnosis scenarios, satisfaction is a reasonable measure to understand the initial assessment, but it is not going to be sufficient for critical situations in patient-centered care. There is a need for more consistent measures related to safety, comfort, and trust to ensure patient satisfaction in those situations, it may also end up going beyond satisfaction.

8 Conclusion

For my dissertation, I have developed a conceptual model of cognitive empathy based on theoretical and experimental perspectives. I developed a scale for measuring AI systems' cognitive empathy called AICES and did a detailed psychometric assessment of it. I conducted three lab studies using that scale and found that cognitive empathy elements show promises to be incorporated in diagnostic AI chatbots. I did an exploratory interview study with first-time mothers to reflect on the naturalistic perspectives of cognitive empathy in healthcare settings and found two new elements of cognitive empathy by analyzing the results of that study. Finally, I revised the conceptual model specifically within the context of patient-AI interactions based on all the studies I conducted and provided some design recommendations for AI chatbots that provide an assessment of symptoms to the users. My studies show that cognitive empathy has the potential to improve patient-AI communication and develop a shared understanding between them that will eventually help improve patients' willingness to use these systems and ensure proper utilization of these systems.

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A Interview Guide: Study 3

These are typical questions used and provide an example of the types of questions.

We are interested in assessing communication pattern for cognitive empathetic interactions and common grounds between patient and physicians. Not all questions are always asked- questions depend on the answers participants provide, so we may not ask all the questions, but that is typically the goal.

A.1 Prior information

First, we will establish the patient's prior knowledge and understanding of the childbirth process. This will include identifying whether they were involved in a close friend or relative's recent birth; whether they were enrolled or taking childbirth education classes, whether they had spent significant time reading or watching educational materials; and other related information sources.

A.2 Timeline

In this stage, the interviewer works with the participant to collect a timeline of the incident (i.e., the doctor-patient visit). The focus of this is on identifying critical communications in which (a) the doctor did not know something the patient knew; (b) the patient did not know or understand something the doctor was saying, or (c) the patient or doctor were working on faulty or incorrect assumptions, information, or understanding. During the timeline collection, one or two specific communication incidents will be identified.

A.3 Probes

Next, the critical communication event will be talked through 2-3 additional times, each time focusing on a different kind of information. This includes:

1. Prior knowledge
2. Knowledge of the physician/midwife
3. Misunderstandings
4. Communications that led to shared understanding.

A.4 Follow-up questions:

Following the incident, when appropriate, we will focus the interview with these questions to help identify cognitive empathy and misunderstanding.

1) Did the doctor understand how the problems you were going through would look from your perspectives?
2) What did she/he do to make you feel that way?
3) Was there something you knew about your condition, that you thought it mattered but the doctor didn't ask about/ give importance?
4) Was there a time when the doctor would know your problem even if you could not explain the symptoms well? Would you please discuss the incident clearly?

5) Was there some time when the doctor guessed your symptoms correctly even you did not tell them?
6) Did the doctor explain everything you wanted to know? Do you think she/he explained it well?
7) Did the doctor clear up your confusion whenever you were confused?
8) Did the doctor put an effort to incorporate your thoughts before making any decisions about your treatment or medicines?
9) Do you think the doctor could put himself/herself into your shoes and provide good examples to ease your stress?
10) Did it seem like the doctor was thinking from your perspective rather than theirs?

Note: Follow up questions based on participants' answers may emerge to clarify answers.

B Interview data- Interaction Statements

Category	Statement	
Shared Goals	Successful	She read online that sometimes doctors make it sound bad that you're older and you're having your first baby, you shouldn't have kids. Her doctor eased her worry about that. She shared her concern about being an older mom in her second appointment. He talked about her blood works and assured her that the numbers are in a good range for being pregnant. They were trying for baby for some time, they had issues, so she was worried about her pregnancy. The doctor was very positive about her pregnancy, her age. He said everything was going to be fine, he would be there to monitor her if she had any issues. He said they would work out on the game plan together and figure out what to do if there is any issue.
		The mother wasn't expecting this phone call and the fact that the midwife took the time out of her busy day to call her and leave a message and say "Hey I'm going to leave soon, but here's my cell phone number. If you have questions. Let me know when you can talk about this. I'm sure, everything is fine, but just to rule anything out, I want to make sure you get this done ASAP." That kind of put her on edge a little bit, she was a little bit more concerned. At that point, like "Oh, she wouldn't go out of her way to call me and insist on this, if you weren't actually concerned"
		She had preeclampsia, so the doctor wanted her to deliver at 36 weeks but she wanted to try to get to 38 weeks. They had a disagreement about that. But in the end, her blood pressure went out and she had to be delivered early. She believes it is the practice and it is their goal to have a healthy mom and a healthy baby. In this case her goal was to have a healthy baby avoiding early delivery. So she was coming to terms with the early delivery with what she knew about the practice versus what was actually happening to her body.

		Her daughter was measuring small in the end, the midwife became fairly concerned, especially because of her advanced maternal age. They were worried that the baby wasn't growing properly, so she had to have extra growth ultrasounds done throughout her third trimester to make sure that the baby was still growing. And that was just as a precaution, to make sure the placenta was still doing its job and the fluid levels are still looking healthy. The mother did not want to do it. Then her midwife called unexpectedly saying, “Look, I just want you to have this one extra test done because, just to be extra sure.”
		She was very sick in her first trimester, throwing up all day. She knew she could medication for that. She had tried all the usual things, home remedies but nothing was working. She felt she needed medication to control it otherwise it was starting to get in the way of her job. She was worried that she would have to prove to the midwives she was seeing at the moment that she was really sick. She started keeping track of how many times she threw up every day, and how many times she had been very sick. She was doing that because she thought they were not going to prescribe her medication very easily. So she went into her first appointment with that midwife, she mentioned she had been very sick and she had tried every home remedy. The midwife listened to her problem and immediately started discussing different prescriptions. It gave the mother a sense of relief that she did not have to pull out her little calendar to prove her sickness. The midwife was willing to help her anyways and it gave her comfort.
		When she was gaining weight, the midwife knew that she was still active every day, either doing strength or doing yoga. So she would check in and make sure that she was still being active. The midwife knew that having a healthy lifestyle was a priority for her and so she checked in to see if there was anything that she could help with as far as like providing information for a better diet and whatnot. She didn't need extra information from that but the midwife made herself available to provide material or help, however, she needed to if she needed to.

	Failure	They asked a number of times to take STD tests, but she declined since she has been with only one partner and neither of them suspected any STIs. They were push quite a bit but every time she pushed back and denied to do those tests. In her words, she is usually a pretty big advocate for herself, so she was not afraid to push back and stand up for herself and not have unnecessary testing done.
		She was sharing her concerns over multiple visits, but it wasn't a high priority, because it wasn't anything serious in their mind. But it was for her, which is partly why she left the OB. She felt like her concerns weren't being addressed. If they tried get to know patient better, have a better relationship so that way you can feel like you trust your physician, and they know about you and they don't dismiss your concerns, because even though it might not seem like a big deal to them, only because a lot of women deal with it. But it could be a big deal to the patient (her).
		The other two midwife she saw before were only suggesting home remedies to her, and she was fine with it then as she wasn't very sick in her earlier appointments. But they never mentioned it could get worse, or what she should do if it continued to get worse. Her mom mentioned to her that she could get a prescription for this. She felt she really needed that, but the other two midwives never even mentioned that the prescriptions could be an option. So she thought it had to be really severe for them to take it very seriously.
Communication about the outcomes	Successful	The doctors were very good about explaining why she didn't or why maybe she would want to get certain tests like what were the risks and benefits and based on like her health and family. They were very good at explaining like why really didn't need these tests, but here is what if she wanted them, this is what they would tell her. They were clear on everything that was going to happen with tests and what she would need and what she wouldn't need it.

		The doctor explained what might happen to her, and one of the things that she brought up is if the baby was as large as they were thinking, there was going to be a solid chance that she would have some major tearing. And the doctor was talking about her recovery, that she was going to recover quicker if she got a C section than if she was to tear as much as they thought she might. It was better for her to be a better mom. She would be able to take care of all the things that she needed. The doctor walked her through why she was doing what she thought was best for her. Walking her through the actual thought process and explaining why she wanted to do what she did helped out a lot in regard to making her feel like the was on her side.
		The midwife mentioned if she wanted to let things go, then they would want her to set up additional appointments, a non-stress test, an additional ultrasound. She gave her the options and then she also laid out the risks because as she got further past her due date, the risk to the baby did go up slightly. The midwife was comfortable with her decision as long as she had set up the additional appointments every other day. She was not telling the mother what option to choose rather she was giving her all the information, laying out the risks and benefits and then letting her choose herself. That helped her also to agree to the midwife's request for additional appointments.
		She had trust that they have her best interest at heart, also her son's best interest. But the issue was she knew too much about the process as a nurse. So she realized she had to step aside and stop being the nurse. She had to realize that she was a patient at that moment. Once she got on that page, they both were on the same page of what to do.
		The midwife wanted to get labor moving and the mother wanted to wait and let it happen on its own. So they ended up agreeing that the midwife would let her continue waiting for the baby to come as long as she started coming in for appointments more frequently. They set up appointments almost every other day. The practice is to induce if the mother gets to 41 weeks. But she

		did not want to be induced. So they started having more frequent appointments and she had the baby two days later.
		The baby's heartbeat was a bit unstable, then the midwife sent her to the hospital to do some additional monitoring. Everything ended up totally fine. After having that interaction, she felt that the midwife had her best interest at heart and she wanted to make sure the baby was healthy. When she saw something that was even just a little concerning, she wanted the mother to go check it out. She felt safe in her hands from that incidents.
		The doctor asked to do the down's test right away, at the beginning of her pregnancy because of her age. She was 34 when she got pregnant, she was 35 when she had the baby. The doctor explained that the test could show if the baby possibly had down syndrome because she was an older mom. But the couple said they were not going to do the test because no matter the baby had it or not, they would still keep the baby. They expressed that they were not worried about it at all and the doctor was fine about it.
	Failure	They asked a number of times to take STD tests, but she declined since she has been with only one partner and neither of them suspected any STIs. They were push quite a bit but every time she pushed back and denied to do those tests. In her words, she is usually a pretty big advocate for herself, so she was not afraid to push back and stand up for herself and not have unnecessary testing done.
Shared Decision-making	Successful	She had bad back pain during pregnancy, the doctor was very good at suggesting different options for that. He suggested exercise at home, or she should try physical therapy, she also could go to massage or chiropractic. They talked though all the options to try to help with the back pain.
		When they were doing back to back ultrasounds as they could not see the baby's face, it was becoming very expensive. The doctor understood it. She walked her through her thought process in regard to why she was doing what she was doing. She also said they may not do it if she (patient) does not

		want to, as they would do ultrasounds later as well. She offered her opinion and asked if she agreed with it. They talked about risk analysis, plan A (see the face in next ultrasound) and plan B (go to a specialty place for special ultrasound-very expensive). The doctor never made decision on her behalf, she explained why she was offering the path forward. Also with alternative paths in case the first one did not work.
		They listened to her and understood she was not happy, but explained their reasoning behind it. She understood where they were coming from, and she on the other hand, was just trying to do everything and use her own knowledge to get her son to closer to term. The doctor did help her giving suggestions to do things holistically (changing diet, drinking more water, resting, relaxing) and at the end it all worked out. She could get to 37 weeks. At that time, she felt that they are on the same page, they were actually listening to her, they never set up a day for inducing until her last appointment.
		The midwife mentioned if she wanted to let things go, then they would want her to set up additional appointments, a non-stress test, an additional ultrasound. She gave her the options and then she also laid out the risks because as she got further past her due date, the risk to the baby did go up slightly. The midwife was comfortable with her decision as long as she had set up the additional appointments every other day. She was not telling the mother what option to choose rather she was giving her all the information, laying out the risks and benefits and then letting her choose herself. That helped her also to agree to the midwife's request for additional appointments.
		The midwife laid out different options for her as they were kind of negotiating. Going in, the mother knew that the midwife was going to offer different options like that because she had mentioned in a previous appointment that if they get to 41 weeks, they would want to induce and get going. So the mother had some time to prepare some questions to ask and she knew this kind of interaction was coming. So she asked what if they don't do it, what are the available options to let things progress as

		they naturally do. The midwife answered those things clearly.
		Her midwife understood where she was coming from and helped her improve her situation. She said there are couple different options, so if the mother didn't get relief from one, she could try something else. The midwife set an additional appointment for her. She wasn't supposed to have another appointment for 4 weeks. The midwife said they could have a follow-up appointment the next week to see if she got some relief from the prescription. When they met the next week, the prescription was not helping. So the midwife switched it to a different one and she finally got relief from the second medication. Offering that next appointment, like the follow up, saying "I hear you this sounds really awful let's try this option and then let's have a specific time to follow up" felt really good to her.
		She was kind of on the fence about hiring a doula because she wasn't willing to pay the extra money and have that. They talked through different options and she wasn't sure if the midwife would be open to having a doula at her birth, because she was uncertain if the midwife would see it as like someone trying to step into her territory. But when they talked about this, the midwife was really open to it, she encouraged her and said "doulas are worth their weight in gold". So the fact that she was really open to having like another support person at the birth, for her, felt really good that she didn't roll her eyes or say like "I don't think you need that or you know anything like that."
		She had a good rapport with her midwife. She was not forced to do anything during her pregnancy. Before making any decisions, she would discuss it with the mother in details. She was upfront about if the mother had any question, she should call her without hesitation, or keep a note of the questions, so that they could discuss those during her appointments.

	Failure	She had a lot of pain while running, she asked the physician about it, they just asked to stop running. She did not like the answer. She told them it was part of her lifestyle and really like to be active and so she'd really appreciate, if they had any you know just kind of tips, or if she should go see a physical therapist or any kind of recommendations. She insisted that this is really important to her, but it just kind didn't seem like it was important to them to help, that was rough. They just said, like a lot of women experience pelvic pain. When they're pregnant and it's pretty common and it will just go away at birth. She thought what would have helped is if they maybe would have given her options of things that she might be able to do to help or recommend because she ended up going to the athletic training clinic in her university.
Shared information	Successful	The doctor said he already had an idea in his head about what they would do if anything went wrong when she goes into labor and delivery. But everything was fine at that point (10/12 weeks). She was asking questions about the delivery very early in her pregnancy because she thought it would ease her mind to know things ahead of time. The doctor's positivity was very reassuring for her, and she trusted him because of his experience. She thinks his experience had made him more caring and understanding.
		She always had a list of questions, the doctor would take the time, listen, explain, and make sure she understood his answer. He was never in a rush to leave. He made her feel that her appointment time was only about her. It made her feel that they were on the same page.
		She asked a lot of questions about epidurals and other options for pain management, or not doing anything at all for the pain, do it naturally. He answered all her questions, he said pick what she wanted to do, don't fixate on it as everything may

		change in the moment. They decided to try no drugs, if they needed to then they would end up using it.
		Midwife gave her a lot of resources that she didn't get from the OB. She recommended books, she recommended websites. Her husband came to all her visits and midwife would always ask him if he had any questions. The doctors really focused on the mother. So, it was really nice for her husband to kind of get to participate. And she would give him some like information or like ideas of how he could help like during the birth or during different things too, so it was like it felt like a more whole experience.
		They made the birth plan in the third trimester. Each time they kind of checked in with her a little bit about what she knew about being induced. They would let her know that because of her advanced maternal age she was eligible to be induced any time after 39 weeks. So, they would prompt her with questions or ask if she had been reading or researching or thinking about what kind of drugs she'd like if she wanted to use any or if she wanted to be totally natural. Towards the end she had a better idea and she had consumed more information. They wrote it with a lot of fluidity.
		20 weeks of pregnancy, in the ultrasound they saw the baby was on very large side, 99th percentile. That resulted in conversations that she was not thinking she would have. She was not prepared to know about what to do with a large baby. The doctor was coming to her with a bunch of information in regards to like things that she should be thinking about. She had a bunch of ultrasounds back to back as the baby was not showing face. The doctor then informed her about the baby being very large or measuring very large in regards to leg length and arm length and they would keep monitoring it with more frequent ultrasounds but it was going to be something they would need to talk about as they get closer to the end, like if she would need to get like a C section, or about inducing. They would also need to do an ultrasound at 36 weeks.

		Her ribs was hurting, she mentioned it during ultrasound. The doctor said it was because the baby was right up against her ribs. The doctor validated what she was feeling or her discomforts so that was very helpful as she was a first time mom.
		Her midwife is very supportive of her working out. She just asked to watch out her heart rate, breathing while working out. If she doesn't get oxygen the baby doesn't get oxygen. So she stops working out when she gets winded and let her breath catch up.
		She asked for a blood pressure medicine, but the doctor did not prescribe it. They told her day 1 that they won't give her blood pressure medicine, so even if she asked to get one later to keep the baby and grow inside to get to 38 weeks, they did not agree to it. The reasoning behind it was pretty clear from the doctor's end. The medicine masks the symptoms of high blood pressure. The doctor would rather know what the symptoms were rather than having all the symptoms and not know about them at all.
		The other doctor's approach was very different from the first doctor. She explained every single step of the problem. She explained how baby comes into the sac, what are the stages, how it all happens. That way the mother got a lot of information about the whole situation and could make a sense of the process. This doctor was very descriptive, she gave every single detail of the issue, she even drew pictures to help the mother understand what was going on. She thinks it was very helpful as she also got to know about even a few other things when the doctor was explaining the problem to her.
		She explained how women conceive, how close the sac comes, how the baby comes to the womb. She drew a picture in her notebook to make her understand how the sac looks like. She said there was still a chance that she could still conceive a baby, the baby might come in the sac later, it happens to many women. She explained the ultrasound report in detail and drew the picture along with that to make things clear for the

		mother. She explained her that her sac is in round shape, if the sac was in twisted shape, then it could be a bad symptom, it could be a miscarriage. She explained what the positive things in her case are and what could go wrong. This doctor was very straightforward and informed her about every single steps in that scenario. Seeing this doctor, she did not find the hope she was looking for, but she got to know about the situation more clearly.
		The midwife explained what a normal heartbeat would look like for the baby: “It'd be high for a little bit, and then it would be low for a little bit and then high for a little bit then low for a little bit. And she explained that's normal for a baby's heart rate to go up and down, if the baby kicks a bunch it's going to go up and then it falls asleep it's going to go down. Even though there's ups and downs you still expect there to kind of be like a standard resting heart rate. And the baby's heart rate was never like settling into that it was up, it was done, it was up, it was down it wasn't it wasn't never settling into a constant number.” The midwife saw the panic in the mother’s eye as she was sending to hospital. She said, “I want you to go to the hospital right away because I am concerned about this, but your baby's kicking, everything's good. We just want to you hooked up to the monitors, so they can monitor you for like a good hour to as opposed to like the 10 minute monitor you get in an appointment.” The midwife was able to put her at ease at that moment saying this is concerning that's why we're sending you to the hospital to have this checked out, but she was not going in an ambulance by any means.
		Throughout their time together in her pregnancy, the midwife got to know her more and more, and then by the time came, time to have her to be induced and have the baby, she knew exactly what she was dealing with by the time they got to that point, and she knew how to approach the birth together so.
		The midwife explained everything really well about all the different potential things that can happen. She thinks the midwife did a good job explaining that nothing in childbirth is black and white, “Your water might break your water might not break your

		it's like there's no guarantees. This is common, but this is also common and kind of like some sense of what could potentially happen, even though there's like 1000 different things that could happen when you give birth."
		She talked to the midwife about COVID-19 vaccine, she said it was okay to get the shots, they have done all the research and it has been cleared for pregnant women from the government. The midwife also mentioned that till then they did not find any cases where there was side effects from the vaccine within pregnant women. They can't guarantee that there won't be any side effects, but the way she portrayed the scenario had positivity in it. Then she felt confident to get the vaccine as her midwife was also okay with that.
	Failure	She had concerns about running, so during her appointment she asked about it. The doctor said if she's sweating then she should not do it. So she stopped working out. It was lazy pregnancy. But it took a mental toll on her gaining around 90 pounds. It was hard trying to bounce back and be a mom. She didn't like their answers on that matter. She's again pregnant now, she is working out, doing CrossFit. She asked about how much weight she should gain each week and sticking to it. She feels much better about herself and her fitness now. She has a gym coach who's helping her this time, she is not seeing a doctor, but a midwife for the second pregnancy. She's supportive of her working out. She feels she is able to force the dialogue now more than the last pregnancy.
		At the very early stage of her pregnancy (3/4th week of pregnancy), she was having some complications. There was the sack in her womb, but there was no sign of the baby. As it was her first pregnancy, she became very confused and worried. She had no knowledge of what was happening. She became afraid as well. She asked her physician about what the consequences were. The doctor seemed a bit rude in response to her concerns, she felt the doctor was not very welcoming of her questions. She was expecting to receive detailed responses and at least a little positive vibe from her, but that was missing. She was expecting the doctor could explain things well,

		say what are the chances, this could go either good or bad direction. The doctor was trying to give her comfort, but was not responsive towards her concerns or confusions.
		After giving birth to the child, she came to know that she was GBS positive, but they did not test her for this during her pregnancy. She also came to know that the hospital she went to, they do not do this test but this was a very common test. She thought it would have been good if they asked her to get this test done. She was upset about it, she let a hospital staff know about it. But she is not sure if they took a note about it. They just informed her that they do not do that test in their hospital. But they did not share this information with her when she was pregnant. She had no idea about GBS or someone might have it.
		She would like if the doctor would understand the reason why she wanted to run. She thinks fitness throughout any stage of life is important, being pregnant she's still herself. In her first pregnancy, "I am pregnant" and that's all she was. She would like if the doctor was more open to educate herself more on the fitness issue, learn about fit pregnancy and exercises that are safe and providing those resources instead of shaming the patient for trying to stay healthy. She asked if she could run 4 miles. The doctor asked if she sweated then she couldn't run and that's it. The doctor did not try to understand why she wanted to carry out an exercise routine throughout the pregnancy, and why it is important to her. It did not seem like the doctor cared about that. Acting a little caring and personable would help.
Shared sensemaking	Successful	Every time she pushed back before and the midwife was kind of just were like "okay yeah, you trust your own gut that's fine for now." But when they got pretty resistant to that, she agreed to do the test. At that time, the midwife was very concerned about her size, she really wanted to make sure she wasn't getting the cord wrapped around her neck and having her nutrients cut off or the placenta was somehow detaching. She may

		have explained those a little bit within that phone call. And that was enough for her to say she would do whatever the midwife asked to do at this point.
		After a particularly long run, one weekend she had spotting. And that's what freaked her out. This was a Saturday, she had to wait until Monday and she had to wait on hold forever to get ahold of a the nurse hotline at the provider's office. And then play some ping pong telephone game to ultimately be told this is nothing to worry about and by then the spotting had subsided. She would have liked if there was an easy instance reassurance that would have done a lot. They said as long as it's very, very minimal spotting and it's ever decreasing she shouldn't have anything to worry about. If it does flare up and become more than spotting then call them right away or go to the ER.
		At that time, she was talking with a coworker who had a baby previously and was also pregnant. She was very much trying to voice her opinions and did not like the idea of C-section. The mother also voiced her concerns to the doctor. She asked how she would know if the doctor is doing what's best for her. Then she had a very frank conversation with the doctor about the fact that even though her co-worker might have her best interest out there for her, she (co-worker) was not a medical professional. Her doctor asked to have trust in her, and made jokes like "if you don't trust me to have your best interest in heart, we need to find you another doctor". But she trusted the doctor anyways. She thinks it's just hard when there's so many places to get pieces of information to know what's actually true and what isn't. Her doctor had very well bedside manners. She approached it very factually and she didn't discredit the co-worker/friend at all. She was like "I know your friend thinks they're doing what's best for you, but I'm your number one you know champion right now. My job is to make sure that you have the best pregnancy, you can have. And that you are happy and healthy after the baby is here."

		The doctor understood and talked about how difficult it was to navigate through like all the various pieces of information right because you get information off social media, you get information off your friends, your family, you get it from everywhere. She said that it's both of their job to have these types of conversations, to make sure that they come to the same conclusion or agree on what they want to do. The doctor heard her concerns and understood where she was coming from and didn't make her feel bad about anything but made her feel understood, which was part of the reason why she trusted her enough to continue their partnership.
		Each time she had any problem, the doctor would encourage her to have an ultrasound. She did not like the idea as she felt like it might affect her baby. So she asked the doctor if it was going to harm the baby in some way, the doctor cleared it up that there was no negative effect on the baby. The doctor said that ultrasounds are actually good as it is very helpful to understand the condition of the baby. That convinced her to go for frequent ultrasounds. She felt that the doctor was not putting any pressure on her, she was only encouraging her to do that for the baby's sake.
		The doctor said as it was her first pregnancy, she might not be able to understand the baby's movement quickly, it will take some time for her to understand the movement of the baby. She assured her there was nothing to be worried about, she will be able to feel the baby's movement in few weeks. The doctor explained that it was pretty early to feel the baby's movement, she thinks it connected pretty well with her thoughts and concerns. She listened to her, answered all her questions even if she had repeat questions. She was not irritated at all. She briefed her about the baby's growth, how much they grow every month, she made her understand that how the baby acts in a certain week or trimester. She did not use medical jargons, rather she explained it in a simpler way the mother could understand.

		The doctor told her that this is a sign that her belly was very tight and the baby's position was not convenient for vaginal delivery. The doctor understood she was a bit frustrated, so she assured her it was a quite normal situation, it happens to a lot of people. She asked her to relax, she said they would still try to have vaginal delivery if it's possible. It helped her to prepare herself mentally and physically for the C-section.
		She noticed that some movement cause a sharp pain sometimes. It was not that severe to go to the doctor. She knew that from reading all the books. So, she messaged the doctor and told her everything that was going on. The doctor was quick and prompt with her responses and told her that it was a normal thing. The response was to the point.
		She knew the risks of miscarriage were higher earlier on in pregnancy. She shared her concerns about the risks being higher. The doctor would tell her that she was healthy, she was not in the high-risk group for miscarriage. There are factors that make people higher risk. Risk is a possibility but from everything they had measured, the baby was healthy and she was healthy and her pregnancy was an uncomplicated one. She thinks it was the best reassurance her doctor could offer in her pregnancy, and that was very helpful.
		She had some pain in her pelvic area in her third trimester. She shared that with her midwife. She told her it was quite normal at her stage of pregnancy. The midwife did not ignore or brushed off her concerns. She explained it to her why the pain was occurring and why it is quite normal. The midwife explained that her body was preparing itself for giving birth.
		She kind of gave them a rundown of exactly what would happen when the mother would get to the hospital – "you know once they called at the hospital knew we were coming, you're going to go into a triage room, they're going to hook you up to the same machine that you're on right now just be at the hospital, it's going to be pretty boring you're just going to be sitting there for like over an hour. She explained the hospital was going to do the same thing they were doing here at the

		appointments and that was helpful too. The midwife also said, “Once they get the results and they'll tell you what the results are and tell you how everything's going. They're also going to send me the results, so I’ll be able to look at them.” That was helpful too because in medical situations like this, it seems like the doctors don’t talk to each other. It felt good to know they were all going to be on the same page, the midwife will review every information she received from the hospital.
		She was confused if it is safe to have intercourse during pregnancy. They showed her figures that how it happens, and it will not make any harm to the baby.
		She herself was also worried about her weight and the complications. She started thinking what would have happened if she should not lose all the weight before the delivery. She was stressed how much it was going to affect the birth of her baby. The midwife eased her stress telling that it had nothing to do with the delivery, the weight was bad for her own health and the baby’s health. She reassured her showing the data of her vitals that it was not going to have an impact on the delivery, there were still chances to have vaginal delivery. But she ended up having a C-section at the end.
		Her primary midwife was able to kind of help calm her fears and assured her that women gain weight at different bell curves of their pregnancy. She assured her that the way that she had gained weight, she was still very much on the healthy spectrum and well within the expected amount of weight gain. Being reminded that every woman is different and what she was experiencing is healthy and normal; just been reassured about that was all she really needed.
		In her third trimester (around 30th week), she was confused and worried about the baby’s movement. She felt like the baby was not moving that much, the way he used to do. It was the day before her appointment. Seeing her worried, the midwife checked the baby’s position, she told her it might hurt while she was checking, she would stop when she would want her to stop examining the baby’s position. She also managed to arrange an

		assessment slot for her in the assessment center so that they can thoroughly assess and check the baby's heartbeat. She sent her to the assessment center, so that she was happy with the baby's movement, they did not discharger her from the center until she was satisfied that everything was good. That gave her the confidence that if she felt that something wasn't right, the midwife would be there for her to check things put until she's satisfied.
	Failure	She had a lot of pain while running, she asked the physician about it, they just asked to stop running. She did not like the answer. She told them it was part of her lifestyle and really like to be active and so she'd really appreciate, if they had any you know just kind of tips, or if she should go see a physical therapist or any kind of recommendations. She insisted that this is really important to her, but it just kind didn't seem like it was important to them to help, that was rough. They just said, like a lot of women experience pelvic pain. When they're pregnant and it's pretty common and it will just go away at birth. She thought what would have helped is if they maybe would have given her options of things that she might be able to do to help or recommend because she ended up going to the athletic training clinic in her university.
		The midwife said, "Oh you're gaining way too much weight, you need to slow down, you need to change your diet." Meanwhile the mother feels she was incredibly healthy and active person and felt that was pretty inappropriate for the other midwife to say so.
		She was sharing her concerns over multiple visits, but it wasn't a high priority, because it wasn't anything serious in their mind. But it was for her, which is partly why she left the OB. She felt like her concerns weren't being addressed. If they tried get to know patient better, have a better relationship so that way you can feel like you trust your physician, and they know about you and they don't dismiss your concerns, because even though it might not seem like a big deal to them, only because a lot of women deal with it. But it could be a big deal to the patient (her).

Tailored circumstances	Successful	Throughout their time together in her pregnancy, the midwife got to know her more and more, and then by the time came, time to have her to be induced and have the baby, she knew exactly what she was dealing with by the time they got to that point, and she knew how to approach the birth together so.
		The midwife really helped by just listening and hearing her concern and then being empathetic to that. She knew how to respond. She knew what kind of comment won't sit well with her patient because she had already taken the time to get to know her. The mother didn't feel dismissed, the midwife took the time to hear what she had to say and didn't brush things under the rug and ignore it.
		When she was gaining weight, the midwife knew that she was still active every day, either doing strength or doing yoga. So she would check in and make sure that she was still being active. The midwife knew that having a healthy lifestyle was a priority for her and so she checked in to see if there was anything that she could help with as far as like providing information for a better diet and whatnot. She didn't need extra information from that but the midwife made herself available to provide material or help, however, she needed to if she needed to.
		In times of crisis, she is very logic-driven. So the doctor didn't involve emotion at all. She laid out the facts. She explained that she's gone to school for this and her co-worker/friend didn't even though she had the best interest for her in heart. The conversation came down talking about the risk factors with vaginal birth vs C-section. The doctor walked through her thought process and mentioned this was why she needed to start considering whether or not to do a C section.
		She thinks she is fairly intelligent and she usually does not like when doctors treat her dumb. So when she is in a vulnerable situation of not knowing something or coming with questions, this doctor never treated her like that , never tried to dumb down the conversation. They established such relationship very early, from her first visit. The doctor understood her personality. When she was

		becoming vulnerable about the baby's size, the doctor understood it, and treated her with respect, the respect she though she deserved. That was very helpful at the moment of insecurity. The doctor validated her feelings and concerns at that time. She also reassured her with many "I" statements like "I feel that I know what's best for you, that's my background, my experience." Kind of things. She never said "you should not have done this", it was very therapeutic.
		They shared their concerns with her, explained what the complications could be. They offered her to see a dietitian, also suggested what she herself could do from her end to keep it under control without doing any harm to the baby. She talked to the dietitian, made some adjustments in her lifestyle to keep it under control. The midwife wasn't rude about it at all, she didn't shame her for this. She said, "yeah I get it, you are pregnant and there's lockdown going on, you cannot go out very frequently. That's all good but try to do these things." They were always open to help her try alternatives for losing weight without doing any harm to the mother's or the baby's health.
		Pregnancy is an intimate experience, the whole pregnancy, so she feels if the doctor seemed more invested even if they are not, that would help. The comfort level is much different than the midwife even though they are in the same office. Just asking other questions, not only straight up textbook questions, making personal conversation would help.
		Her daughter was measuring small in the end, the midwife became fairly concerned, especially because of her advanced maternal age. They were worried that the baby wasn't growing properly, so she had to have extra growth ultrasounds done throughout her third trimester to make sure that the baby was still growing. And that was just as a precaution, to make sure the placenta was still doing its job and the fluid levels are still looking healthy. The mother did not want to do it. Then her midwife called unexpectedly saying, "Look, I just want you to have this one extra test done because, just to be extra sure."

		The doctor got used to her personality after a few appointments. She read a lot and she had a lot of information, she was very analytical about the pregnancy at that point. She would always come to the appointments with lot of questions, so after a couple of appointments the doctor started anticipating that she would have questions.
		Her primary midwife was able to kind of help calm her fears and assured her that women gain weight at different bell curves of their pregnancy. She assured her that the way that she had gained weight, she was still very much on the healthy spectrum and well within the expected amount of weight gain. Being reminded that every woman is different and what she was experiencing is healthy and normal; just been reassured about that was all she really needed.
		Throughout her pregnancy, she'd speak up for herself and asked the questions she had, and the doctor always respected that. So she thinks they had an equal partnership in her pregnancy and the doctor got used to her temperament.
	Failure	The midwife said, "Oh you're gaining way too much weight, you need to slow down, you need to change your diet." Meanwhile the mother feels she was incredibly healthy and active person and felt that was pretty inappropriate for the other midwife to say so.