Analysis of Doctor-Patient Consultations and Implications for Design of Human-Agent Relational Dialogue

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Abstract

Embodied Conversational Agents (ECAs) are virtual agents that exhibit humanlike verbal and non-verbal behaviours. When it comes to digital health, ECAs can provide vital support to patients by being more reachable. In order to make ECAs more effective, humanlike empathy expressed during conversation through relational cues is essential. Empathy revolves around a wide range of verbal and non-verbal behaviours that include, for example, the choice of words in social dialogues.

Owing to the COVID-19 situation, there was an opportunity to record online consultations in the Incontinence Clinic and Sleep Clinic at the Children's Hospital at Westmead in Sydney, Australia. The present study analysed these human dialogues using qualitative research methods to understand the role of empathic dialogue used by the medical team. The qualitative analysis of the live calls used psychology-based relational cues derived from conversational characteristics of humans to build a coding framework around the most relevant themes. Statistical analysis was used to compare relational cue usage between healthcare roles. Finally, using the framework dialogues of the medical team and two ECAs known as Dr Evie (eVirtual Agent for Incontinence and Enuresis) and SAM (Sleep Adherence Mentor) were compared to provide recommendations for health practitioners and future ECA dialogue development.

Contents

Declaration of Originality

I hereby confirm that all material contained in this project are my original authorship and ideas, except where the work of others has been acknowledged or referenced. I also confirm that the work has not been submitted for a higher degree to any other university or institution. The research project was approved by the Sydney Children's Hospital Network HREC/18/SCHN/360 on 6 April 2020.

Signed:

List of Tables

List of Figures

Abbreviations

CHW   Children's Hospital at Westmead

CUI   conversational unit interfaces

Dr Evie   eVirtual agent for Incontinence and Enuresis

ECA   embodied conversational agent

eADVICE   electronic Advice and Diagnosis Via the Internet following Computerised Evaluation

ICCS   International Children Continence Society

SAM   Sleep Adherence Monitor

Word List

A

avatar-based health intervention

B

bottom-up approach

breastfeeding

C

client-centred therapy

colour

computer-aided conversational agents

D

daytime

decision-making

E

empathic (not empathetic)

everyday conversational dialogues

F

first-time patients

follow-up patients

H

health-related consultations

high-quality sound recordings

humanlike

L

life-threatening

live-call transcripts

long-term relationships

N

non-task-based dialogues

non-task-oriented dialogues

O

occurrence

P

phenomenon (singular), phenomena (plural)

R

real-life environment

real-time collection

recognise

relationship-building dialogues

rule-based dialogue

T

task-based dialogues

task-oriented empathy

trustworthy

U

unconditional

V

visualise, visualisation, visualising

W

well-being

Chapter 1: Introduction

Embodied Conversational Agents (ECAs) are virtual agents that exhibit humanlike verbal and non-verbal behaviours. They are increasingly being applied in contexts where the main mode of interaction is a dialogue between two or more humans (Bickmore, Gruber, & Picard, 2005). In eHealth, ECAs can provide vital support to patients by being more reachable and available in their time of need (Richards & Caldwell, 2017). The agents can not only act as a source of information on health issues (Lisetti et al., 2012) and their prevention or cure (Yin, Ring, & Bickmore, 2012), but also motivate the patients to adhere to treatments (Bickmore, Puskar, Schlenk, Pfeifer, & Sereika, 2010; Richards & Caldwell, 2017). For teenagers and children, a virtual agent can act as an educator, buddy and motivator (Looije, Neerincx, & Lange, 2008), such as those designed for childhood obesity intervention (Kowatsch et al., 2017) or for promoting well-being and positive thoughts in young people undergoing cancer treatment (Greer et al., 2019).

In order to make ECAs more effective, humanlike empathy expressed during conversation is a vital component (Bickmore et al., 2005). Empathy is an essential part of building rapport and creating a bond, or a working alliance, between the patient and therapist to improve patient adherence and satisfaction (Bennett, Fuertes, Keitel, & Phillips, 2011). Empathy has been defined as 'an observer reacting emotionally because he perceives that another is experiencing or about to experience an emotion' (Paiva et al., 2005, p.4), or 'the process whereby one person feels her/himself into the consciousness of another person' (Wispé, 1987).

Empathy is expressed through a wide range of non-verbal behaviours, such as mirroring head nods, and verbal behaviours, such as the choice of words in social dialogues, the use of greetings and farewell rituals and the art of bringing continuity in the conversation (Laver, 1975). In this thesis, I focus on empathy expressed through verbal dialogue. There has been more than a decade of research on the importance of empathy in human dialogues, which has led to interest in how ECAs can express empathy to bring about behaviour change (McRorie, Sneddon, de Sevin, Bevacqua, & Pelachaud, 2009; Ochs, Pelachaud, & McKeown, 2017; Ravichander & Black, 2018).

ECAs typically have a particular purpose referred to as task-oriented empathy (Bickmore, Caruso, & Clough-Gorr, 2005; Bickmore et al., 2010), which is more easily detectable in focused dialogues. However, social empathy, which is not task based, is also important, as it offers comfort and encourages long-term relationships (Bickmore, 2004). According to Halpern (2007), task-oriented empathy comes

more naturally in doctor-patient dialogues while a doctor gathers the patient's background information or recommends a certain treatment. Non-task-based, or social, empathy is more generic to the conversational themes in daily life. In designing ECAs, the component of social empathy is more complex and has been less commonly analysed (Halpern, 2007).

Expressing empathy is a skill that often takes many years to develop (Jeffrey & Downie, 2016). It is more than sympathy or feeling sorry for someone, as it requires understanding of the situational perspective and expression of emotions to which responses are uttered through relational cues (Eisenberg & Strayer, 1990). If it is difficult for humans to acquire this skill, it will be even more difficult for ECAs to get it right. This thesis is concerned with designing ECA dialogues that help to build a relationship with the human user. Thus, it focuses on relational cues that encompass empathic cues, which can include expressing understanding, mirroring and self-disclosure, but also other dialogue-based cues such as continuity behaviours. This thesis seeks to contribute to the understanding of the usage of relational cues in human patient-therapist conversations to inform the design of conversations for ECAs in similar roles. To achieve this, it analyses dialogues from multiple health professionals from a paediatric incontinence clinic and paediatric sleep clinic as they interact with patients and their families.

1.1 Domain Background

According to the International Children Continence Society (ICCS),[1] the medical condition of incontinence refers to intermittent or continuous bed wetting during the day or night or both (Maternik, Krzeminska, & Zurowska, 2015). Paediatric incontinence is a common condition affecting up to 20% of school-aged children (Malhotra et al., 2020) in many of their social activities like sports and sleepovers, which often leads to avoidance of social interactions. The children feel embarrassed and anxious, which leads to abnormal behavioural patterns of prolonged expression of frustration and low self-esteem (Theunis, Van Hoecke, Paesbrugge, Hoebeke, & Walle, 2002). Incontinence for children is basically the failure to control their bodies and hence is a direct cause of other psychological disorders such as depression, eating disorders and identity problems. Children report a negative self-image owing to the physical and psychological impact of having incontinence, which is often unrecognised and seen as just another milestone in their growth (Butler, 1998; Harter, 1982).

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[1] http://www.i-c-s.org/

Despite the fact that incontinence impacts the patient's quality of life and is a cause of stress for them and their families (Malhotra et al., 2020; Thibodeau, Metcalfe, Koop, & Moore, 2013) long waiting times to receive treatment are common, up to two years. This is because of a shortage of specialists, as incontinence is categorised as non-life threatening. Hence, ECAs could provide more timely support(Richards & Caldwell, 2017);(Laranjo et al., 2018).

To address the problem of long public hospital waitlists, an incontinence specialist for children aged 3-18 at the Children's Hospital at Westmead (CHW) in Sydney, Australia, created an interactive eHealth program known as eADVICE (electronic Advice and Diagnosis Via the Internet following Computerised Evaluation). eADVICE enables young patients accompanied by their parents to get consultation regarding incontinence treatment factoring in the patient's medical history and encoded algorithmic response scenarios that capture the domain knowledge of the health experts. Developed in 2016, the website was evaluated in several pilots that found adherence to the six possible recommended treatments was around 50%. To allow patients and families to 'discuss' their treatments, eADVICE was enhanced through the addition of an ECA known as Dr Evie (eVirtual agent for Incontinence and Enuresis), which gave a human embodiment to the online consultation experience. Possessing the actual voice of the incontinence specialist, this ECA significantly improved the adherence and health outcomes of patients on the hospital waiting list (Richards & Caldwell, 2017). The success of Dr Evie can be attributed to its availability and its empathic and empowering dialogue (Bickmore, 2004).

Owing to its success for incontinence patients, the eADVICE approach – involving a website to provide tailored recommended treatments and an ECA to discuss the treatments – has been deployed for sleep disorders (eADVICE-sleep), another condition that is not life–threatening but significantly reduces quality of life (Roth, 2007). Roth (2007) associated sleep disorders with "the presence of long sleep latency, frequent nocturnal awakenings or prolonged periods of wakefulness during sleep periods". This condition is considered chronic if the sleep environment is comfortable enough and the daytime routine is full of distress, light headedness and anxiety due to lack of sleep (Kredlow, Capozzoli, Hearon, Calkins, & Otto, 2015).

As sleep disorder patients also suffer from long waiting periods to access specialists and poor adherence, they can potentially benefit from an ECA (Horsch, Brinkman, Eijk, & Neerincx, 2012; Yin et al., 2012). Known as SAM (Sleep Adherence Mentor), the ECA in eADVICE-sleep acts as a virtual sleep coach. SAM has eight dialogue sets to cover the range of treatments and to ensure the dialogues are appropriate for the child's age.

1.2 Research Aims and Questions

The dialogues for Dr Evie and SAM were written in 2016 and 2019–2020, respectively, by the medical and technical teams at CHW based on their experience. Due to COVID-19, ethics approval was requested and obtained to record online consultations in the Incontinence Clinic and Sleep Clinic at CHW. It was not possible to create the dialogues based on actual patient-therapist sessions because the medical and technical team did not have the opportunity to record actual sessions prior to these clinics going online in 2020.

This project aims to understand the role of empathic dialogue and use of relational cues by the medical team, compare the human and ECAs dialogues, and identify design features for further ECA dialogue development and improvement.

The following research questions will be explored in this thesis:

1. What is the role of relational cues in patient-therapist conversations?

2. Do different individuals or roles (e.g. nurse, physiotherapist, paediatrician and psychologist) in the medical team use relational cues differently?

3. How do the medical team's conversations compare with the ECAs' (i.e. Dr Evie and SAM) dialogues?

4. What improvements can be made to the dialogues of Dr Evie and SAM based on actual human conversations?

5. What recommendations can be made concerning the design of future ECA relational dialogue and/or the training of health professionals in patient-therapist communication?

1.3 Thesis Approach

This thesis will use qualitative methods to answer the above research questions because the available data consists of textual dialogues in the form of recorded conversations between the medical team, patient and/or their family, as well as the dialogues created for Dr Evie and SAM.

As a starting point for analysis of the dialogues, I draw on the literature to define the relationship-building cues in human dialogue. These cues include 10 themes drawn from Bickmore's (2005) work, starting

with empathy as an independent category, followed by themes such as continuity, social dialogues, reciprocal self-disclosure, greetings and farewells. Due to the relevance of (Richards & Caldwell, 2017) work in the domain and the Dr Evie dialogues, I added further dialogue features to form a total of 16 relational cues to explore in the recorded conversations. I then coded the data according to these 16 cues as themes using NVIVO. Analysis of the coded results was first undertaken with NVIVO. Discursis was used to identify the sequence of dialogues in terms of different health specialists and utterance structures. Different health professionals, roles, new and follow-up patients, and human versus ECA dialogues were compared, leading to the thesis conclusions and recommendations for the design of ECA empathic dialogue for building therapeutic relationships.

1.4 Research Contributions and Scope

Bardovi-Harlig (2010) defines pragmatics as 'the study of language from the point of view of users, especially of the choices they make, the constraints they encounter in using language in social interaction and the effects their use of language has on other participants in the act of communication' (p. 221). Research on social cognition through pragmatics (Bosco et al.) has resulted in empathic pragmatic models (Zhanghong & Qian, 2018) that refer to empathy in the context of verbal utterances that help build strong relationships. This thesis focuses on identifying a set of verbal relational cues that have been reported in the literature, particularly in psychology, to build a working alliance or strong rapport between the patient and the health specialist.

The main contribution of the thesis is the development of a relational cue coding framework from coding of the cues in the transcripts of live clinical calls recorded during COVID-19 by CHW in Sydney, Australia, to establish the usage of relational cues in real-life scenarios where there are no experimental setups. Dialogues are further contextualised according to the consultation type and patient demographics. The scope not only covers the live calls but also analysis of relational cues in two ECAs (Dr Evie and SAM). Insights on the semantics and pragmatics of the ECAs and live calls are used to inform recommendations for building future ECAs.

1.5 Thesis Structure

This chapter has presented the research background and motivations, as well as the domain knowledge used to clarify the research questions. It also briefly discussed the research contributions and scope of the thesis. The thesis structure is outlined in this section.

Chapter 2 consists of a literature review that describes empathy and gives examples of relational cues and their meanings. It also reviews the use of relational cues in conversational agents to highlight the research challenges.

Chapter 3 covers the methodology, starting with the coding process and tool-assisted analysis approach. It also establishes an analysis process that starts with independent coding agreement scores and builds on further qualitative analytical methods.

Chapter 4 presents the analytical results based on statistical methods and their interpretations. It compares other ECAs' relational dialogue usage, and it interprets the dialogue structure and utterance sequence. Analysis was conducted from the perspectives of the medical team's roles and demographics.

Finally, Chapter 5 addresses the research questions, considers the research limitations and offers suggestions for future research.

Chapter 2: Literature Review

This chapter first defines empathy, its role in human relationships and past ECA work involving empathy and human-ECA relationship building. Section 2.1 establishes that the use of expressions of empathy in ECAs is especially vital for building therapist-patient relationships in eHealth applications. Section 2.2 draws on the field of psychology to identify and define verbal relational cues and types of dialogue expressions that have been found to assist relationship building. This provides the basis of coding themes used in the methodology (Chapter 3). The details of each cue and expression include examples from each theme and snippets of dialogues found in the dataset. This helps to ground the coding framework in the literature and to ensure consistent and reliable coding.

2.1 Empathy and Human-ECA Relationship Building

2.1.1 Defining Empathy

Empathy is a complex human behavioural phenomenon defined by Hoffman (2001) as 'the cognitive awareness of another person's internal states that is, his thoughts, feelings, perceptions and intentions' (p.29). Hoffman refers to empathy as any emotional reaction compatible with (but not necessarily similar to) the other's situation. Carl Rogers' (1959) theory of positive psychology and his client-centred framework emphasise that 'for a person to 'grow', they need an environment that provides them with genuineness (openness and self-disclosure), acceptance (being seen with unconditional positive regard) and empathy (being listened to and understood)'(Mamarimbing, 2021),(p.8).

In a survey of computational empathy Paiva et al. (2005) refer to three types of empathy that are also mentioned in (Omdahl, 2014). The first two types bring into comparison the affective and cognitive elements of empathy while the third one is the conversations reflecting both. In conversations where dialogues are used to understand other person's emotions is categorized as cognitive whereas affective empathy caters to the fact that the listener makes an effort to also verbally express their empathy.

As a specific theme in this thesis, empathy is discussed further with examples in Section 2.2.1.

2.1.2 Empathy and Relationship Building with ECAs

Owing to the importance of empathy in human relationships, many researchers have created and evaluated empathic ECAs such as GRETA (Hartmann, Mancini, & Pelachaud, 2005) and REA, the Real

Estate Agent (Cassell et al., 1999). Subsequently, many others have worked on improving the verbal and non-verbal empathic incidents that seem incongruent to actual user response (Rossini, 2011). Building and maintaining human-ECA relationships, however, is broader than congruent expression of empathy and includes other behaviours.

Understanding and connectivity in conversations can be expressed through non-verbal and verbal behaviours (Hartmann et al., 2005). Nonverbal behaviours that are used for relationship building include instant gestures like nodding and expressions that have an indirect meaning of exhibiting comfort and trust like smiling (Ochs et al., 2017). They also include 'close conversational distance, direct body and facial orientation, increased and direct gaze, pleasant facial expressions and facial animation in general and frequent gesturing' (Kuppevelt, Dybkjær, & Bernsen, 2005) – these project liking for the other and engagement in the interaction, and are correlated with increased solidarity (Cassell, Vilhjálmsson, & Bickmore, 2004);(Chi, Costa, Zhao, & Badler, 2000);(Coker & Burgoon, 1987).

According to research, non-verbal expression has more impact than verbal expression during a conversation, and many indices of mutual understanding and empathy have been developed that give higher weighting to non-verbal empathic behaviours (Vogel, Meyer, & Harendza, 2018). For this reason, many ECA researchers have focused on non-verbal expressions during dialogue building, which exhibits humanlike responses for building strong relations. Examples of such ECAs include listening agents (Bevacqua, Mancini, & Pelachaud, 2008; Maatman, Gratch, & Marsella, 2005), laughing agents (Ochs, 2017) and agents developed by SimSensei in (DeVault et al., 2014).

This thesis focuses on human-ECA relationship building through the verbal expression of empathy and use of relational cues that draw on the psychological aspects of delivering a dialogue (Laver, 1975). For a human to build a strong and trustworthy relationship with virtual characters, the responses during the conversation need to emulate the expected social interaction in a conversation between two humans (Havens, 1988). Long-term relationships are highly influenced by the use of the right relationship-building dialogues (Stafford & Canary, 1991). According to the psychology or medical literature, a working alliance is important for successful therapy (Halpern, 2007). Many scales have been developed that emphasise the use of empathic and social dialogues during health-related consultations (Kraus, 2015; Looije et al., 2008; Yin et al., 2012).

Verbal behaviours used for relationship building include empathic dialogues used in non-task-oriented phases of the conversation (Alam, Danieli, & Riccardi, 2018). While these verbal behaviours are mainly

used in the opening and closing phases of a conversation, their presence in the middle phase is also important, as this is where the participants are exchanging more information, developing trust, and gaining comfort and a greater sense of ease in the relationship. In eHealth, verbal dialogue is mandatory. Since patients meet health professionals because they are facing a problem, the more the doctor talks with empathy, the more productive the sessions become (Vogel et al., 2018). A balance between task- and non-task-oriented dialogues is also important, since the exchange is a professional discussion and too much focus on using empathic expressions is not healthy for either participant (Abramovitch & Schwartz, 1996).

2.1.3 Empathic ECAs and Health

ECAs with empathic dialogues have been studied across a diverse range of health programs such as relational agents for anti-psychotic medication adherence (Bickmore et al., 2010), avatar-based health intervention to modify unhealthy lifestyles (Lisetti et al., 2012), exercise advisors that interact with older adults (Bickmore et al., 2005) and ECAs that can help cancer patients to adopt a positive lifestyle after chemotherapy (Greer et al., 2019). Research has suggested frameworks that determine the useful verbal and non-verbal behaviours for virtual agents, such as 10 cues including empathy, social dialogues and continuity (Bickmore et al., 2005), the Big Five model of personality traits (Neff, Wang, Abbott, & Walker, 2010) or five dialogue characteristics that exhibit relationship building (Richards & Caldwell, 2017). Krämer, Lucas, Schmitt, and Gratch (2018) analysed the psychological aspect of interaction with virtual agents and found that humans exhibit the same emotional state whether they are interacting with virtual agents or humans. Gratch and Marsella (2004) have built domain independent frameworks based on appraisal and coping mechanisms that can be implemented for all types of ECAs. Revolving around emotions such as joy and anger expressed through non-verbal behaviours, these frameworks help in analysing the social intelligence of conversations.

Bickmore, Schulman, and Sidner (2011) dialogue cues are a baseline for designing structured dialogues in many recent ECAs. (Rojas-Barahona et al., 2018) introduced avatars helping patients with mental disorders who learned through deep learning, citing Bickmore's framework as the foundational rule-based dialogue system for the machine learning that generated a more sophisticated dialogue corpus. Another ECA was proposed by (Almohanna, Win, & Meedya, 2020), who aimed to provide post-delivery support for women in breastfeeding newborns, mentioning Bickmore's (2005) framework of dialogue cues as a comprehensive solution for building computer-aided conversational agents. Cancer patients have been a focus of (Chatzimina, Koumakis, Marias, & Tsiknakis, 2019), who proposed a virtual mentor

for treatment adherence of cancer patients especially after chemotherapy, and (Al Owayyed, 2020), who aimed to use a virtual coach to help students going through mental stress. Both works used Bickmore's empathic and relational cues, as they help to orient avatars with the humanlike comforting response, making his work a sound and workable framework for dialogues.

This thesis utilises Bickmore's 10 relational cues, along with additional cues from the literature in the following section. They lay the foundation of the coding framework in Chapter 3.

2.2 Relational Cues in Verbal Behaviours

In their leading research on this topic, Bickmore et al. (2005) have identified the following relational cues:

1. Empathy for the user

2. Social dialogue

3. Reciprocal self-disclosure

4. Humour

5. Meta-relational communication

6. Expressing happiness to see the user

7. Talking about the past and future together

8. Continuity behaviours

9. Reference to mutual knowledge

10. Specific language constructs, such as inclusive pronouns, politeness strategies, and greeting and farewell rituals

Commonly known as the '10 unspoken rules of spoken interactions' (Timothy W Bickmore, 2004), these will be used as themes in the coding and presented in the following methodology chapter.

In addition to the description of each of these 10 cues (and where cues have been combined), I also draw on (Richards & Caldwell, 2017) findings on the Dr Evie dialogues to validate the present study's findings on Dr Evie and SAM (see Table 1).

Table 1: Dr Evie's Dialogue Characteristics (Richards & Caldwell, 2017)

Dialogue Characteristic	Example Dialogue Snippets
empathy for the user	"I understand. It is annoying to have to do something you don't like."
providing education through explanations and asking questions	"Do you know why you have been asked to drink more?" "You might be surprised to know that drinking will actually make you dryer. When you drink more, you stretch your bladder which will be able to hold more". "The good news is you can still eat white chocolate as it contains very little caffeine".
Motivational	"good on you", "That's the right attitude. Just give it a go." "Excellent, with a positive attitude like that I am sure you will try hard."
Confirming language	"That's excellent. Do your best and see how you go". "Ok good. Do your best to keep away from these drinks".
Encouraging adherence and the benefits	"Great! Sticking to the amount on your treatment plan will really help"
empowerment approaches that include choices	"Do you think you could do this?" "Do you know which drinks are bad for you?" "Do you like drinking water?"
Letting the user drive their information needs	"Ok then, is there anything else I should know?" "How can I know how much I am drinking each day?", "maybe, but do you have anything else I could try?
Everyday conversational language	"No thanks, I'm okay", "Well, if you don't need to know anymore information, all the best and see how you go."
Forgiving/accepting/non-judgemental language and options	"ECA: Okay, so if you don't like water, you could try these other fluids to make it easier to drink while you are at school"; "User: No I won't be able to remember to go"
Clarifying Consequences.	"What if I don't ..?" ".. but medication might make it easier to get dry"
Confirming responsibility and decision-making:	"The decision to take medication or not will be up to you", Yes, I think this would help me, so I will give that a try.", "Yes I will try.

The characteristics (see Chapter 3) in Table 1 can be covered under the following themes:

- Empathy

- Motivation/Encouraging adherence/Confirming language/Affirming language

- Decision-making/Empowerment/Clarifying consequences/Giving options

- Everyday conversational dialogues

- Informational dialogues/Educational/Explanation

- Tasks (Previous treatments/Current health status/Medical history/Treatment adherence/Recommendations [Future Treatments]/Family history)

Review of the literature on these cues helps in building the coding framework for the dialogue to support and structure the thematic analysis. The following sub-sections contain definitions and examples from

the literature to bridge the gap between the philosophy and abstract concept of the theme and its application to the categorisation of actual dialogue.

2.2.1 Empathy As a Verbal Cue

Halpern (2007) defines empathy as 'engaged curiosity about another's particular emotional perspective' (p.1). There are multiple ways in which health specialists can exhibit empathy, especially in extreme situations where the patient is either in a conflict mode or highly apprehensive about the physician's treatment methodology. This includes first understanding their own emotions and then managing the patient's negative emotions with the passage of time, listening and moulding their dialogues to the patient's verbal and nonverbal emotional messages and openly welcoming negative feedback to let the patient be more comfortable. It is emphasised in research that health specialists make a greater therapeutic impact if they use empathic cues with their patients by reducing the level of frustration and anxiety in patients.

For example, Coulehan et al. (2001) compared the empathic versus non-empathic dialogues between doctor and patient:

> Patient: You know, when you discover that you have cancer, you kind of feel—well, kind of—(the patient becomes emotional and starts crying).

The rest of the dialogue may occur as follows:

> Without Empathy

> Dr. A: When did you actually discover that you had cancer? Patient: (absently) I don't know. It's been a while.

> With Empathy

> Dr. B: That sounds frightening. Patient: Well, yeah, sort of. Dr. B: Sort of frightening? Patient: Yeah . . . and I guess I'm feeling like my life is over. Dr. B: I see. Worried and sad too.

Coulehan et al. (2001) divided empathic phrases into three categories – Queries, Clarifications and Responses – which will be the foundation of empathic cue detection in the dialogue set:

1. Queries

'Would you (or could you) tell me a little more about that?'

'What has this been like for you?'

'Is there anything else?'

'Are you OK with that?'

2. Clarifications

'Let me see if I have this right.'

'I want to make sure I really understand what you're telling me. I am hearing that . . .'

'I don't want us to go further until I'm sure I've gotten it right.'

'When I'm done, if I've gone astray, I'd appreciate it if you would correct me. OK?'

3. Responses

'That sounds very difficult.'

'Sounds like . . .'

'That's great! I bet you're feeling pretty good about that.'

'I can imagine that this might feel . . .'

'Anyone in your situation would feel that way . . .'

'I can see that you are . . .'

Empathy can be simple or complex. Simple responses include using empathic phrases directly and openly, such as 'How awful' or 'It must be tragic for you'. Sometimes word choice prevents patients from shutting themselves down; for example, instead of 'you are terrified', 'I would have been as terrified as you are'.

Empathy can become complex when it is goal driven and keeps pushing the patient gently towards opening up and revealing their true selves. For example, if the patient says. 'No one understands', then the response needs to be really carefully crafted. If the patient is religious, sometimes mentioning a higher

authority that knows everything is very important to build blind faith in the patient is a way of expressing empathy, such as 'God knows you are troubled' (Havens, 1988).

2.2.2 Social Dialogue

This section is based on the work of (Laver, 1975), who defines social dialogues as language constructs that are mostly uttered during greetings and farewells. They build continuity in the conversation and contribute to ice-breaking during the conversation. They are specifically non-task oriented and bring in the structure in the conversation with which humans psychologically become ready to open up and talk.

In eHealth, dialogues that are about a patient's current health status or previous medical history are called task-oriented. According to Laver (1975), task-oriented dialogues and utterances can be divided into three basic phases of conversation: the opening, middle and closing phases. The purpose of opening phase is to ease the transition from non-task oriented communication to task oriented, and to increase the level of comfort during the conversation. . This helps 'break the ice' before the task oriented middle phase begins, hence the objective is to work around the reason for which the discussion is happening. In eHealth, it is to classify the level of the health issue and recommendation of the treatment. The closing phase again helps in transitioning from task oriented communication to a comfortable finish. (Laver, 1975).

Social dialogues play their role in the opening and ending phases. Some examples are (Cruz, 2014),(p.9):

1. Past reference: 'Terrible night last night', 'Nasty smog yesterday'

2. Present reference: 'Nice day', 'Beautiful morning'

3. Future reference: 'Going to clear up', 'Snow's coming', 'Frost tonight'

Social dialogues that are empathic yet inquisitive are not self-oriented, in which the speaker talks about themselves. Inquisitive social dialogues are often in question form, as in: 'How's life (business/things/the family/the wife/etc.)?'; 'How do you like the sunshine, then?' or 'Do you come here often?' Occasionally, there are other forms of comment, such as 'That looks like hard work.' ((Laver, 1975).

Other examples would be: 'I'm sorry, I have to go, I'm about to give a lecture'; 'I'm afraid I must be off, I've a million things to do'; 'I wish I could stay longer, but I have to get back to relieve the babysitter'. A particularly interesting subcategory of social dialogues is where esteem is expressed for the listener's

needs, as the compelling external power. Examples are: 'Mustn't keep you'; 'I guess you have to get on, I'll be going' (Laver, 1975).

Dialogues that include a factor of respect for the other person – such as 'It was nice seeing you'; I do enjoy our little chats'; and 'Talking with you always cheers me up' – are regarded as social dialogues. Other examples show care for the other participant, such as comments on their future well-being ('Hope your cold gets better soon'), benevolent warnings ('Take care, now' or 'Watch how you go') and occasionally blessings ('God bless'). The closing phase can have social dialogues such as 'Say hello to Jeanie for me', or 'Tell Jeanie I was asking after her'. Some dialogues can have a future commitment and be coded under continuity, with a tint of social dialogue, such as 'See you next week' (Laver, 1975).

2.2.3 Reciprocal Self-disclosure

Ravichander and Black (2018) define self-disclosure as a key social strategy used in conversations to build relations and increase conversational depth and as a process of disclosing details about yourself to the listener. In a doctor-patient conversation, it is for the purpose of showing to the patient that the health specialist understands what the patient is going through (McDaniel et al., 2007).

Self-disclosure is analysed in psychology, especially in the verbal behavioural literature, for its ability to induce self-disclosure from the recipient, a phenomenon known as reciprocity (Ravichander & Black, 2018), whereby self-disclosure by one participant in a two-way social dialogue results in self-disclosure from the other participant in response. For example, in a doctor-patient conversation, if the doctor says 'I understand how restricted you feel in your daily chores because of your broken arm and I know it's frustrating because I broke my arm once', the patient may also reciprocate with self-disclosure such as 'Yes, I cannot even lift a glass of water and it tires me'.

2.2.4 Meta-relational Communication

Meta-relational communication is a conversation that is carried out to maintain a balance in the relationship. It can be a routine dialogue that has a higher strategic goal of maintaining positivity in a relationship or gauging the sentiments between the participants, or it can be occasional such as during a therapist session. The meta-relational communication is oriented towards building a feeling of mutuality, commitment, liking and togetherness (Dainton & Stafford, 2016; Stafford & Canary, 1991).

According to Stafford and Canary (1991), meta-relational talk is specific talk that results in enjoyable relationships, cooperation, building up self-esteem, giving compliments, being courteous and polite,

mitigating criticism, making the participants patient and forgiving, encouraging openness and talking about the relationship quality and needs, and helping to acknowledge the relationship.

Planalp and Benson (1992) provide the following examples of meta-relational communication:

- 'We make a good team'

- 'How are you finding our sessions together?'

- 'How can we stay in touch more when you are away?'

- 'Let's talk about where we stand'.

2.2.5 Continuity Behaviours

Continuity is about referring to past, present and/or future contexts in a conversation. A dialogue that includes a commitment for the future and is mainly task-oriented basically shows responsibility and commitment on the part of the speaker.

Gilbertson, Dindia, and Allen (1998) divide continuity into three types of behavioural units: prospective, introspective and retrospective. For a doctor-patient interaction, prospective and retrospective are covered under verbal interaction, but introspective is more about showing a symbol or making a gesture in the absence of each other, such as wearing a wedding band as an indication of introspective continuity. Following the time and volume chart or doing alarm training are examples of non-verbal continuity by the patient.

Prospective continuity defines the 'meaning and duration of the impending separation and the likely return' (p.4). Dialogues that can be categorized as prospective continuity include greetings and farewell relational cues that also set the agenda for future interactions such as 'I'll see you at the office tomorrow morning' (p.4). Retrospective continuity occurs 'after the period of relational non-co-presence has ended' (p.4). The relational cues during the opening phase of conversation in which a 'catch up' is done on events after the last meet up can be considered as examples of retrospective units. Some examples include (Planalp & Benson, 1992):

- 'Last time we talked about….'

- 'We usually talk about….'

- 'It will be next month before you see me again....'

- 'See you next week'.

2.2.6 Reference to Mutual Knowledge

According to (Planalp & Benson, 1992), examples of mutual knowledge include knowledge of a partner's biography, present life or habits, and recent or future events. Some relatable dialogues are:

- 'How is Brenda doing?'

- 'Are you all ready for your trip next month?'

2.2.7 Inclusive Pronouns

Inclusive pronouns are first-person plural language constructs including 'we', 'us' and 'ours', and not 'they', 'you' or 'me'. The pronouns evoke a sense of commonality and togetherness between the person leading the dialogue and the audience, such as:

- 'We are all in this together'

- 'They will invite us to the birthday party'.

2.2.8 Affirmation

Cameron, Mazer, DeLuca, Mohile, and Epstein (2015) recognises affirmation as 'something complex or otherwise emotionally challenging for the patient' (p.7). The complexity can be due to multiple reasons ranging from whether or not take up a medicine or follow a recommended treatment that is not fully understood or experienced. The main purpose of affirmation is to enable to patient to express their frustration openly. Letting the patient voice out their concerns and responding in understandable utterances is the essence of affirmation.

An example from the literature (Cameron et al., 2015) takes a scenario when a patient has to go through chemotherapy and is feeling anxious:

> P: I was worried on the way here thinking I don't think I can take this chemo today because I don't think I would be able to survive it. I think I'll end up getting sick. I'll end up, you know, 140 pounds before you know it and losing strength. So, if we can get to the bottom of what's the

root of this thing and then maybe we suspend the chemo until such time as we feel comfortable then I can start to get back into the normal rhythm in life.

D: Yeah, I think clearly… yeah, I think you're absolutely right, today – treatment today is the wrong, wrong…

P: Okay, all right.

Other examples of affirming responses from Madson, Loignon, and Lane (2009) include:

- 'I appreciate that you are willing to meet with me today.

- 'You are clearly a very resourceful person'

- 'You handled yourself really well in that situation'

- 'That's a good suggestion'

- 'If I were in your shoes, I don't know if I could have managed nearly so well'

- 'I've enjoyed talking with you today'.

2.2.9 Confirmation

Abramovitch and Schwartz (1996) define confirmation as a means to reiterate the facts or validating the correctness of something previously believed or suspected to be the case. Some dialogue examples from the literature[2] include:

- 'This means you are doing the time volume chart for the last one month, is that right?'

- 'Do you understand what I have just explained?'

In eHealth, through confirmation, the doctor understands the issues explained by the patient and in return receives confirmation from the patient, who trusts them to be 'an individual specialised in the alleviation of suffering, and who will act in the patient's interest, preserve confidentiality and honour reasonable requests' (p.5). The confirmation dialogues enable the patient to voice their concerns

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[2] https://www.thoughtco.com/confirming-information-1212052

18

repetitively and also helps build more trust in the doctor as it shows the level of engagement of the health specialist. It builds a long term relationship and is vital for building an empathic relationship.

2.3 Summary

This literature review established the components of relationship building via verbal and non-verbal behaviours as well as the importance of empathy in dialogues. The relational cues extracted from the literature act as a foundation for the coding framework that will be built in this thesis. These cues begin with empathy, followed by further relational cues such as continuity, social dialogues, reciprocal self-disclosure, confirmation, affirmation, meta-relational communication and reference to mutual knowledge. The coding framework is highly dependent on the examples for each cue taken from psychology and other ECAs' dialogue structures. This chapter only includes a subset of the examples that were used to provide guidance and direction. A detailed study of utterances has been carried out that uses the definitions and examples as a baseline for the methodology and implementation presented in Chapters 3 and 4, respectively.

Chapter 3: Methodology

This chapter clarifies the methodology used in this thesis. The thesis primarily uses a qualitative approach involving a process of data collection and analysis that is iterative and evolves based on the insights gained from prior iterations to answer the research questions. This process is summarised in Figure 1 and described in detail below.
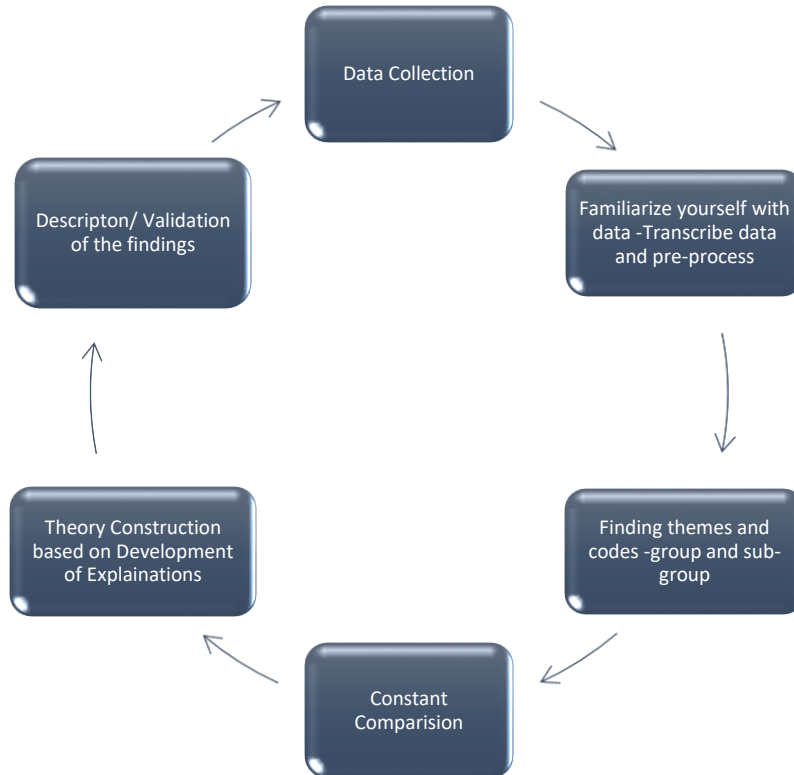
Figure 1: Data collection and analysis process.

3.1 Data Collection

CHW recorded its live clinical calls for research purposes during the COVID-19 period from June to November 2020. In these calls, the patients are children aged 3–18 and they have specific issues such as incontinence of urine. The objective of this study is to analyse these actual human dialogues using qualitative research methods and draw findings focused on the element of empathy in doctor-patient conversations. This live-call dataset provides a unique view of how actual dialogues, recorded in a real-life environment, can suggest changes to the existing ECA dialogues and help to validate the existing component of empathy in these ECAs.

The health specialist demographics are listed below.

- Senior Paediatrician/Doctor: Australian female, the most senior doctor with 40+ years of experience

- Nurse: Australian female, with about 30 years' nursing experience

- Physio B: Australian male doctor (registrar), with about 5 years' experience as a physiotherapist but minimal experience in this clinic

- Physio C: Australian female, with about 30 years' experience

- Paediatrician: female, of Indian descent, but trained in Australia, with 10 years' experience

- Registrar: female doctor (registrar) of Indian background with an Indian accent, with about 8 years' training.

The data is composed of 23 consultation sessions, with a total of 50,000 utterances, collected over six months from the incontinence clinic only. Ethics approval had also been obtained for data collection in the sleep clinic that allows us to work on anonymized patient's dialogues, however insufficient recordings (only 6 recordings 15-25 minutes in duration) were captured to provide adequate data for analysis and thus only live call data from the sleep clinic was analysed, but ECAs Dr Evie and SAM were included in the ECA dialogue analyses and comparisons. The patients' consent was confirmed in the beginning and data has been anonymised to remove their original name and other personal details such as emails or phone numbers. Figure 2 shows the dialogue count in each consultation session.
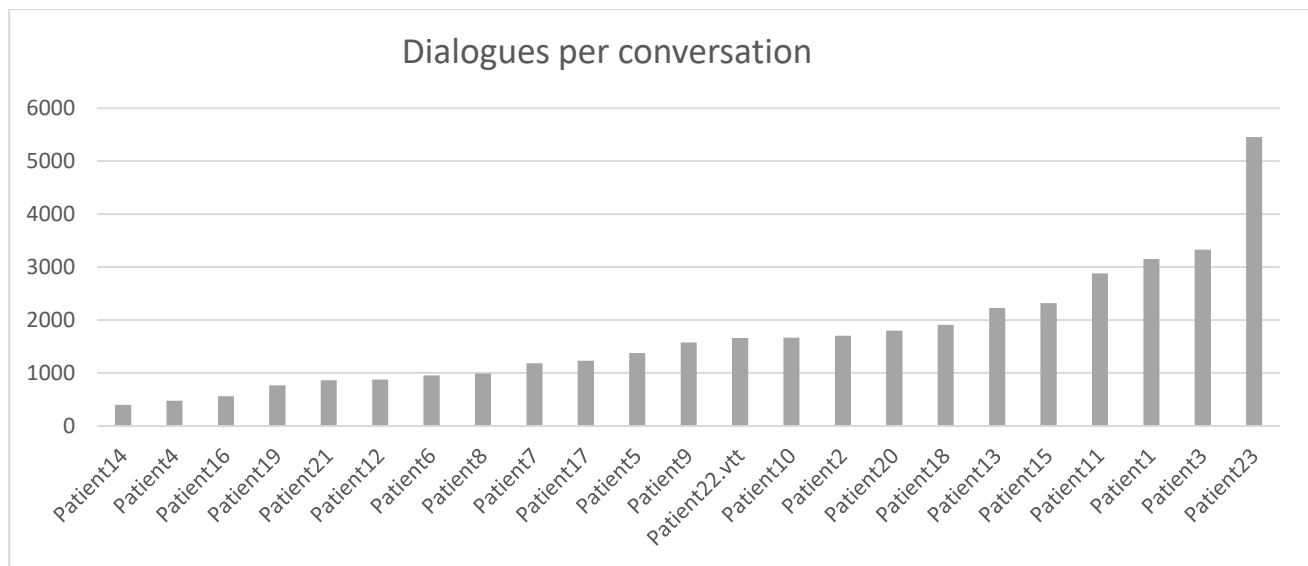
Figure 2: Dialogue count in consultation sessions encompassing overall data of 23 patients.

3.2 Data Pre-processing

The process of analysing live calls begins with transcribing the recorded calls. Transcription involves generating text files from the audio recordings followed by character identification (e.g. physio, nurse, paediatrician, patient or relative of patient) and validating the dialogue assignment to the respective character. To ensure privacy, elimination of the patient's personal information (e.g. name, contact number and email) is the next step. The tools used for transcribing the data include Temi[3] and Transcribe Wreally.[4]

3.3 Qualitative Analysis Overview

Qualitative data analysis is an approach to finding patterns in conversations and interviews. The data itself can be unstructured, which means there are no predefined questions or predefined answers to choose from. The qualitative analysis method chosen depends upon not only the level of structure in the data but also how acquainted a researcher is with the subject being analysed. Figuring out the context of the data in the form of variables is known as coding.

The description follows Bengtsson (2016), who used content analysis in the domain of nursing, which is close to the domain of interest. Coding has two main approaches, deductive and inductive. In the

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[3] www.temi.com
[4] https://transcribe.wreally.com/

deductive approach, the researcher is familiar with the content of the discussions and has developed an understanding of the context. Hence, the codes or themes are known beforehand. In the inductive approach, the researcher reads through the conversation and figures out the common words, semantics and context before grouping them into themes to define the coding framework.

The next step is to decide whether to code the exact words or phrases from the conversation as codes or themes or to go deeper and understand the underlying meaning of the dialogue content and define that as a code. The former is known as manifest analysis, where the codes are the exact content; the latter is latent analysis, where the researcher goes under the surface and defines the codes according to the research aims (Bengtsson, 2016).

3.4 Coding Approach

The goal of this research is to find empathic cues in live patient-therapist conversations. Empathy is expressed in verbal and non-verbal behaviours and has been the subject of research in human psychology for many decades and more recently in ECA research. The present research approach is deductive latent analysis, which means that codes relevant to verbal behaviours leading to empathy will be extracted from a literature review and will have associated dialogues for further analysis. Each dialogue can be placed in multiple codes as well, depending upon the hidden context of utterances.

According to the literature (Graneheim & Lundman, 2004), the trustworthiness of the qualitative analysis approach is measured by three factors – credibility, dependability and transferability. The main components of credibility are the participants' demographics, the study focus and the data collection mechanism (Polit and Hungler, 1999). The data provided by the experienced health specialists of CHW is not only original but also reflects the actual medical process from gathering the patient's background to providing remedies for recovery. Since the specialists are seven individuals with different demographics and the patients were also randomly selected in terms of age, gender or medical condition, they are unbiased and generalizable, hence, trustworthy.

Credibility also depends upon how the selection of themes and coding is done and how well it covers the entire dataset. The present approach relies on themes extracted from qualified researchers and encompasses the paradigm of empathy to its maximum potential (i.e. full range of empathic cues).

The third most important credibility mechanism is how similar or dissimilar the coding results are when another person tries to reproduce the results. While qualitative methods do not claim to be reproducible,

one way to improve credibility is to seek agreement between different researchers who do the coding independently and then establish a consensus. The approach is not to validate the coding quantitatively but to open the forum for discussion in which all experts agree to each other's way of coding (Woods and Catanzaro, 1988). It is not a question of verification but of confirmability.

The dependability aspect of trustworthiness is actually how consistent the data collection settings are over time and other factors such as different participants (e.g. different doctors). The data for this study was collected over six months (June–November 2020) and the data collection settings and process remained consistent, but the coding went through a process of analytical stability. There were iterations while drawing on the literature and discussions between the coders.

The transferability factor of trustworthiness ties in with the extent to which the results are reproducible if the analysis is undertaken by another group (Polit and Hungler, 1999, p. 717). One factor supports the present research that is the core concept of empathy, which originated from psychology, remains the same even if the settings, objective or purpose of the study changes. This concept of empathy is domain-independent, which gives confidence that it can be applied in more than one field.

The next decision point is how many codes will be sufficient? This depends on the research questions and how many codes can give insights for those research aims and objectives.

3.4.1 Coding Process

The coding phase in qualitative analysis begins by analysing the dialogues one by one to find themes according to the literature review on verbal and non-verbal behaviours found during conversations. In this study, the focus is on verbal behaviours because audio recordings cover only the verbal aspects of conversation. While finding themes, the focus is on the element of empathy; hence, all behaviours that exhibit empathy will be considered (e.g. politeness, inclusive pronouns). It is important to consider both task-oriented and social empathy.

After defining and distinguishing themes from the literature to avoid overlaps, 16 themes were identified in relation to expressing empathy through dialogue: 10 themes from (Bickmore et al., 2005), including 'expressing empathy for the user, social dialogue, reciprocal self-disclosure, humour, meta-relational communication (talk about the relationship), expressing happiness to see the user, talking about the past and future together, continuity behaviours (appropriate greetings and farewells and talk about the time spent apart), reference to mutual knowledge and specific language constructs (inclusive pronouns,

politeness strategies and greeting and farewell rituals)'(p.3), and six themes from (Richards & Caldwell, 2017), including empathy, motivational/encouraging adherence/confirming language, decision-making/empowerment/clarifying consequences/giving options, everyday conversational dialogues, informational dialogues/educative /explanation and tasks (previous treatments)/current health status/medical history/treatment adherence/recommendations (future treatments)/family history. Four of the parent themes are divided into 13 sub-themes (Figure 3).

1.Task Based
- 1.1 Future Treatments
- 1.2 Previous Treatments
- 1.3 Medical History
- 1.4 Family History
- 1.5 Treatment Adherence

2 Empathy

3 Continuity

4 Inclusive Pronouns

5 Motivation
- 5.1 Confirmation
- 5.2 Affirmation
- 5.3 Encouraging Adherence

6 Information Dialogues
- 6.1 Explanation
- 6.2 Education

7 Expressing Happiness To See the Patient

8 Reciprocal Self-disclosure

9 Politeness

10 Everyday Dialogues

11 Social Dialogues

12 Greetings & Farewells

13 Mutual Knowledge

14 Past& Future

15 Humour

16 Decision-making
- 16.1 Giving Options
- 16.2 Clarifying Consequences
- 16.3 Empowerment

Figure 3: A breakdown of parent themes and sub-themes derived from the literature.

3.4.2 Coding in NVIVO and Discursis

The conversational analysis involving coding and role-based analysis of different speakers/characters will be done in NVIVO and Discursis.[5] While NVIVIO helps in building themes around the codes and representing them in visualisations, Discursis helps in character and role understanding as can be seen in the example from (Angus, 2019) in Figure 4. It uses the concept of recurrent analysis, which means taking repetition into context and associating it with the relevant characters.
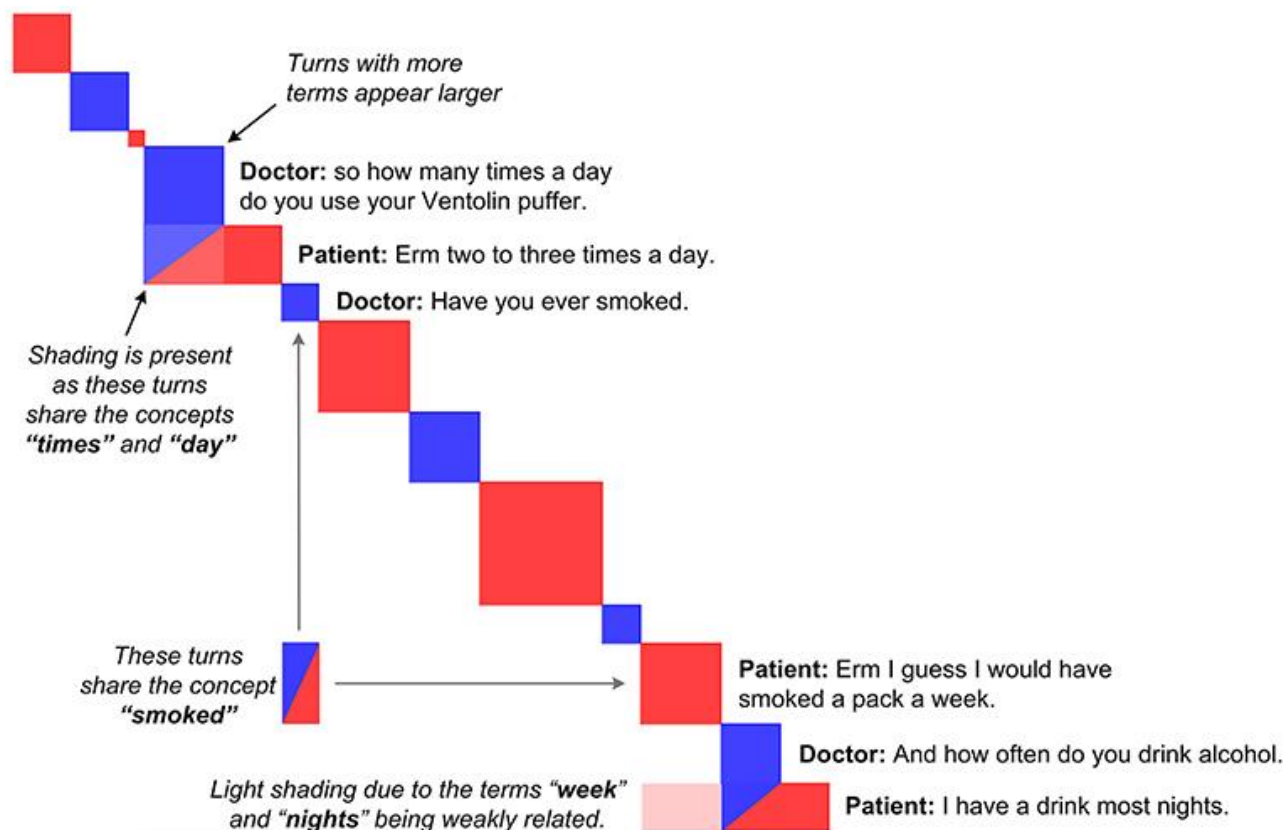
Figure 4: Example of conceptual recurrence plot of a doctor-patient interaction (Angus, 2019, p3)

Coding in NVIVO begins with building a framework of nodes, cases and roles based on the research questions. I will work with 16 codes derived from literature that will be looked into for each case and each role. The idea is to go into as much granularity as possible and do a bottom-up approach for generalising and validating hypotheses such as whether the presence of two therapists in a session

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[5] https://eshop.uniquest.com.au/discursis-individual-academic-use/

generates more empathy. For simplicity and further relative comparison of codes within roles, each dialogue is coded in one theme only. The sub-themes are also given preference over the parent theme. For example, in case of motivational dialogue, the sub-themes are encouraging adherence, giving options and clarifying consequences. Preference has been given to the sub-theme assignment to the dialogue. Only in rare cases where the dialogue is motivational but does not fit any sub-theme is it assigned to the parent theme. In the end, sub-theme dialogues are aggregated to create the count of the parent theme.

Discursis helps plot the conversations in a sequence diagram that keeps the order of the dialogues intact, and snippets from the beginning, middle or end can be analysed by simple clicks. The main advantage of this tool is that it places the concepts or repetitive utterances in a single stacked format in the Discursis plot; hence whenever the same concept is discussed again it is placed underneath the section selected for it, visualising the timing and recurrence in a very understandable manner. The size of the blocks and colour codes analyse different characters and how many utterances are said by any character. Most of the research questions are around role dynamics, impact of empathic cues on utterances, topic sequencing and word embedding that can assist in building impact scores. Some impact scores are also defined in Discursis software, such as engagement, which can also be used with other quantitative matrices to compare the impact of empathy.

The coding in NVIVO and analysis in Discursis will generate quantified data that will be sliced and diced further in Excel to calculate normalised percentages and frequency histograms to be grouped according to each empathic cue.

3.4.3 Independent Coders' Agreement through Cohen's Kappa

In order to seek agreement between how similar or dissimilar coding is, two researchers (myself and my supervisor) took part in the validation process. I was the main coder who had the context of approximately 50,000 dialogues. The second is an expert in qualitative analysis approaches but had not coded the whole dataset. After 200 dialogues were randomly selected from the first coder's assessment, the second coder was briefed on the codes' description, but the context remained missing until the first kappa was calculated so that consensus could be established in later discussions. The idea is to see how much the dialogues resonate with the theme even if the context is not given so that a more generalised coding can be obtained in the first iteration. The aim was not to validate the coding quantitatively but to open the forum for discussion in which all experts agree to each other's way of coding (Woods and Catanzaro, 1988).

Cohen's kappa was selected as a measure of the agreement between the coder's independent coding. An unweighted kappa score is calculated, which calculates the percentage agreement and the measure of coding by chance in each theme (Warrens, 2015). The most commonly used guidelines are given by Landis and Koch (1977): 0.00–0.20 indicates slight agreement, 0.21–0.40 fair agreement, 0.41–0.60 moderate agreement, 0.61–0.80 substantial agreement and 0.81–1.00 almost perfect agreement. However, it should be noted that these guidelines are generally considered arbitrary.

Initially, a kappa score of 0.61 was calculated on 200 dialogues with 24 themes. The coders examined the percentage agreement within each theme and agreed that three themes – everyday conversational dialogues, inclusive pronouns and politeness strategies – should be recoded since the dialogues that were coded in them were multi-thematic and were more appropriately placed in other themes like empowerment and motivation. Both coders recoded the original 200 dialogues in these themes. Some confusion remained concerning dialogues that were specifically questions like 'Do you have any more questions?' or 'Are you with me so far?', as they were part of multiple themes. Based on a literature review, it was agreed that the appropriate classification was confirmation.[6] These changes and clarifications resulted in a revised kappa score of 0.75.

The remaining dialogues were reviewed one by one. After discussion about the categories, the second coder agreed to change allocations from affirmation to empathy, encouraging adherence to recommendation and from child theme to parent theme, if a dialogue had more than one child theme representation. Final coding resulted in agreement on 171 dialogues and a kappa value of 0.84.

The remaining cases were resolved through discussion. In most cases, the context was mandatory for the assignment because the dialogues had more than one coding category in them such as affirmation or explanation and the context placed it correctly in empathy.

Following consensus on the 200 dialogues, the main coder reclassified any dialogues in the 50,000 dialogues that had been reassigned to three themes – everyday conversational dialogues, inclusive pronouns and politeness strategies. Finally, the main coder confirmed that all of the dialogues used everyday conversational language and that use of personal pronouns would be automatically calculated by searching for the terms 'us' and 'we' as a rough but quick method of assessment that would enable comparison between roles and individuals.

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[6] https://www.thoughtco.com/confirming-information-1212052

3.5 Empathy versus Sentiments

Sentiment analysis – positive, negative or neutral – can be used as an evaluation criterion for the impact of empathic cues (Alam et al., 2018). Conversations that are devoid of empathy are short and usually task-based. They do not guarantee positive sentiments or shifts from negative to positive sentiments, hence they are mostly neutral in nature. I aimed to analyse sentiments before and after the empathic cues as heat maps, word frequency graphs and stacked bar charts and see whether the positivity in sentiments increased after the empathic cues. This will further validate that using empathic cues in conversations that involve counselling and adherence are more effective (Butow, Maclean, Dunn, Tattersall, & Boyer, 1997). I also intended to analyse utterances quantitatively and see whether more openness is exhibited by the patients once empathic behaviour is manifested in the therapist's dialogues. Talking more openly is considered a sign of comfort and trust from the doctor and will have more weight in designing doctor patient conversations (Langewitz et al., 2002). This analysis could not be done due to the poor quality of the patient or family member recordings and is left as recommended future work with other datasets.

3.6 Empathic Cues: Analysing the Dr Evie and SAM Dialogue Sets

Dr Evie and SAM both have structured dialogues with empathic cues already being a part of their semantics. The hypothesis of this study is that live unstructured sessions can bring out different sentence structures that are more beneficial in creating a level ground of adherence for the patients. This includes a validation process in which Dr Evie and SAM would be thoroughly screened for empathic cues finalised in the prior coding process. A similarity scale would determine the threshold, and based on the similarity scores further empathic cues could be recommended.

The same coding process used in Sections 3.4 will be followed to evaluate these. After normalising the results, a comparison would show how empathic both dialogues are. Sequencing and timing of the utterances would also be evaluated.

3.7 Empathic Cues: Recommendations for Future Agents

The extracted empathic cues will not only improve Dr Evie and SAM but act as a catalyst for fine tuning any future agents. For example, the results can be used to design virtual trainers or virtual patients that can be used by trainee doctors so that they can learn how to communicate with their patients in multiple unseen scenarios. This will be achieved by formulating recommendations based on the statistical findings of the non-parametric tests and the overall schematic inferences from the dialogues.

Chapter 4: Results & Discussions

The results of the analysis of 23 doctor-patient recordings are presented here. Table 2 shows the details of 23 patient's demographics (with age ranging from 9-12 years and gender distribution of 10 patients are females while the rest are males) and consultation details (12 follow-up and 11 new consultations; most session attendees have parents with the patient) for each recording, as well as the session length (average session length of 40 minutes) and the role of the health specialists (15 sessions have one health specialist while 6 sessions have 2 health specialists) in the session.

Table 2: Patient Consultation Session Details with Patient and Health Specialist Information

Patient ID	Provider	Age	Gender	Consultation type	Attendees	Session length
P1	Physio-C and Senior Paed.	9	Female	New	both parents	1 hour 42 minutes
P2	Physio-C and Senior Paed.	12	Male	follow-up	patient and mother	44 minutes
P3	Physio-C	12	Male	New	patient and mother	1 hour 56 minutes
P4	Physio-C	11	Male	follow-up	mother only	1 hour 7 minutes
P5	Senior Paed. and Registrar	9	Male	follow-up	both parents	44 minutes
P6	Senior Paed. and Physio-C	12	Male	follow-up	mother only	20 minutes
P7	Senior Paed. and Physio-C	15	Female	New	patient only	1 hour
P8	Senior Paed.	8	Male	Follow-up	patient and mother	22 minutes
P9	Senior Paed. and Physio-C	5	Female	New	patient and mother	30 minutes
P10	Nurse	9	Female	Follow-up	mother only	44 minutes
P11	Physio-C	13	Male	New	patient and mother	1 hour 9 minutes
P12	Senior Paed.	12	Male	Follow-up	patient and dad	20 minutes
P13	Nurse and Senior Paed.	7	Female	New	mother only	1 hour
P14	Senior Paed.	10	Female	New	patient and mother	1 hour 43 minutes
P15	Nurse	8	Female	New	patient and mother	1 hour 14 minutes
P16	Paed.	9	Male	Follow-up	patient and mother	15 minutes
P17	Physio-C	10	Male	Follow-up	patient and mother	30 minutes
P18	Nurse	8	Female	New	patient and mother	1 hour 2 minutes
P19	Senior Paed.	9	Male	Follow-up	patient and mother	17 minutes
P20	Nurse	7	Male	Follow-up	patient and mother	54 minutes
P21	Physio-C	8	Male	Follow-up	patient and mother	30 minutes
P22	Registrar	9	Female	New	patient and mother	46 minutes
P23	Senior Paed. and Physio-B	10	Female	New	patient and mother	56 minutes

The role of the medical specialist and whether the consultation was a new or follow-up meeting are used for the comparison of results. The findings from the recorded consultations are discussed in Sections 4.1 to 4.3. Section 4.4 analyses results from the recorded consultations with the Dr Evie and SAM dialogues. In Section 4.5 the dialogue structure and topic sequencing is formulated into the coding framework.

4.1 Percentage Distribution of Relational Dialogues

The use of relational dialogues is categorised into 15 main themes and 16 sub-themes. There was a further reduction in the number of main themes since humour was removed in the very beginning due to its non-existence in the data. The independent coder's agreement process (Section 3.4.3) further resulted in removal of everyday conversational dialogues and expressing happiness to see the user themes because it was deemed that all of the dialogues used everyday conversational language and expressing happiness to see the user overlapped/coincided with other themes such as continuity. The length of patient consultations varies widely, resulting in variation in patient consultation dialogue count for each session; therefore, dialogue usage has been normalised so that the results are comparable.

The percentage of dialogue usage was compared for the following six categories:

1. Senior doctor's consultations with first-time patients (Figure 5)

2. Senior doctor's consultations with follow-up patients (Figure 6)

3. Average usage of relational cues by the senior doctor with follow-up versus new patients (Figure 7)

4. Physiotherapist's consultations with patients (Figure 8)

5. Nurse's consultations with patients (Figure 9)

6. Usage of relational cues in sessions where both the senior doctor and physiotherapist are present (Figure 10).

It is evident from the coding percentages in Figure 5 that patients who visit the clinic for the first time need more information about their health issue and its remedies. The senior doctor uses more informational and motivational dialogues and decision-making is also encouraged. The health specialist also needs to know a new patient's medical history and current health status more than for the follow-up

31

patients. Thus, Figure 5 shows that the senior doctor uses more task-based dialogues to get to know the patient and devise future steps.
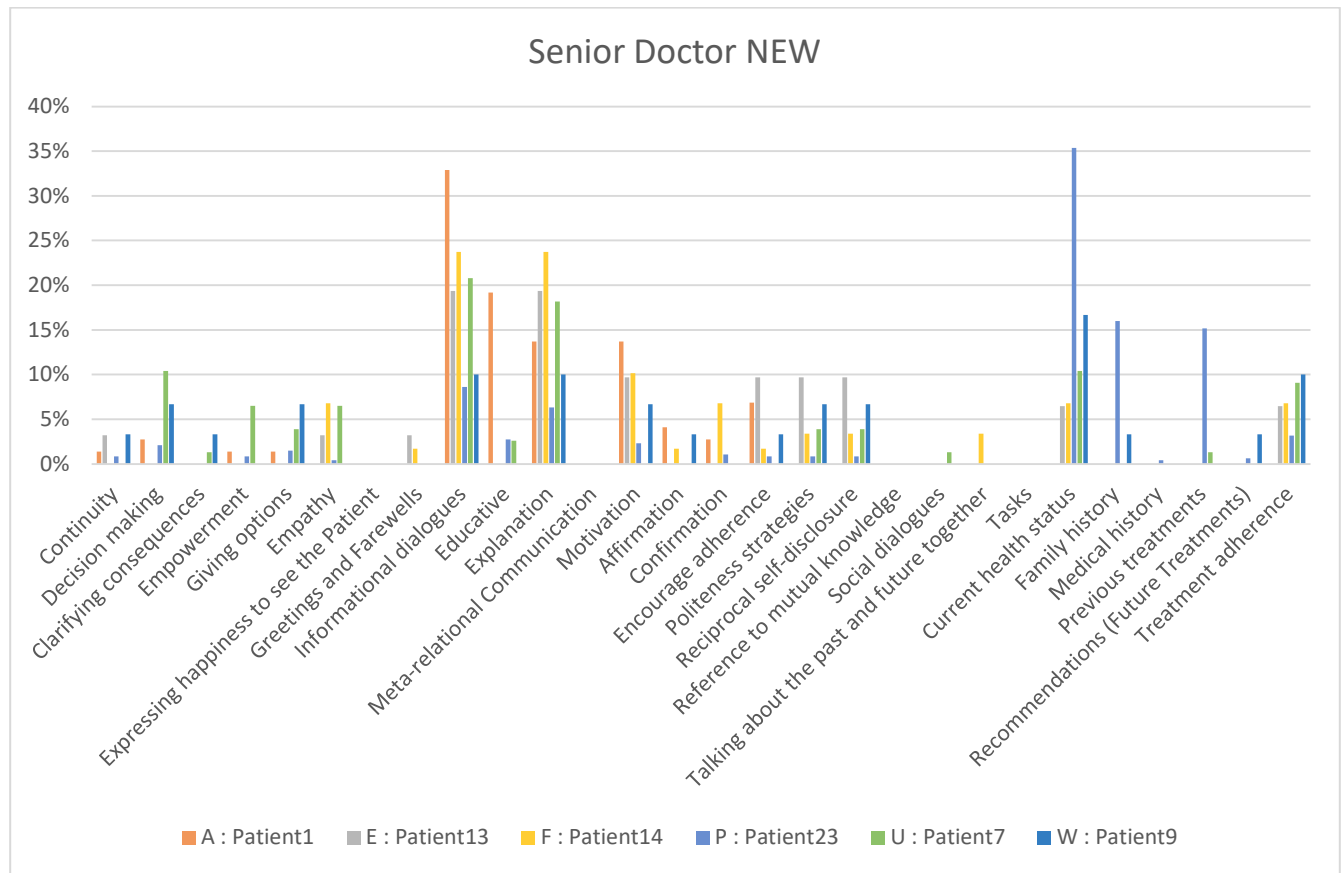
Figure 5: Senior doctor's relational cues with six first-time patients.

For follow-up patients (Figure 6), the percentage usage of cues is more variable as it depends on how many sessions the patient has had before and their progress to date. For some patients, it is more about encouraging adherence to a treatment discussed in previous sessions. For others, the effects of new recommendations need clarification and dialogues confirm their understanding. For the senior doctor, task-based dialogues are prevalent in both new and follow-up patients, as shown in Figures 5 and 6.
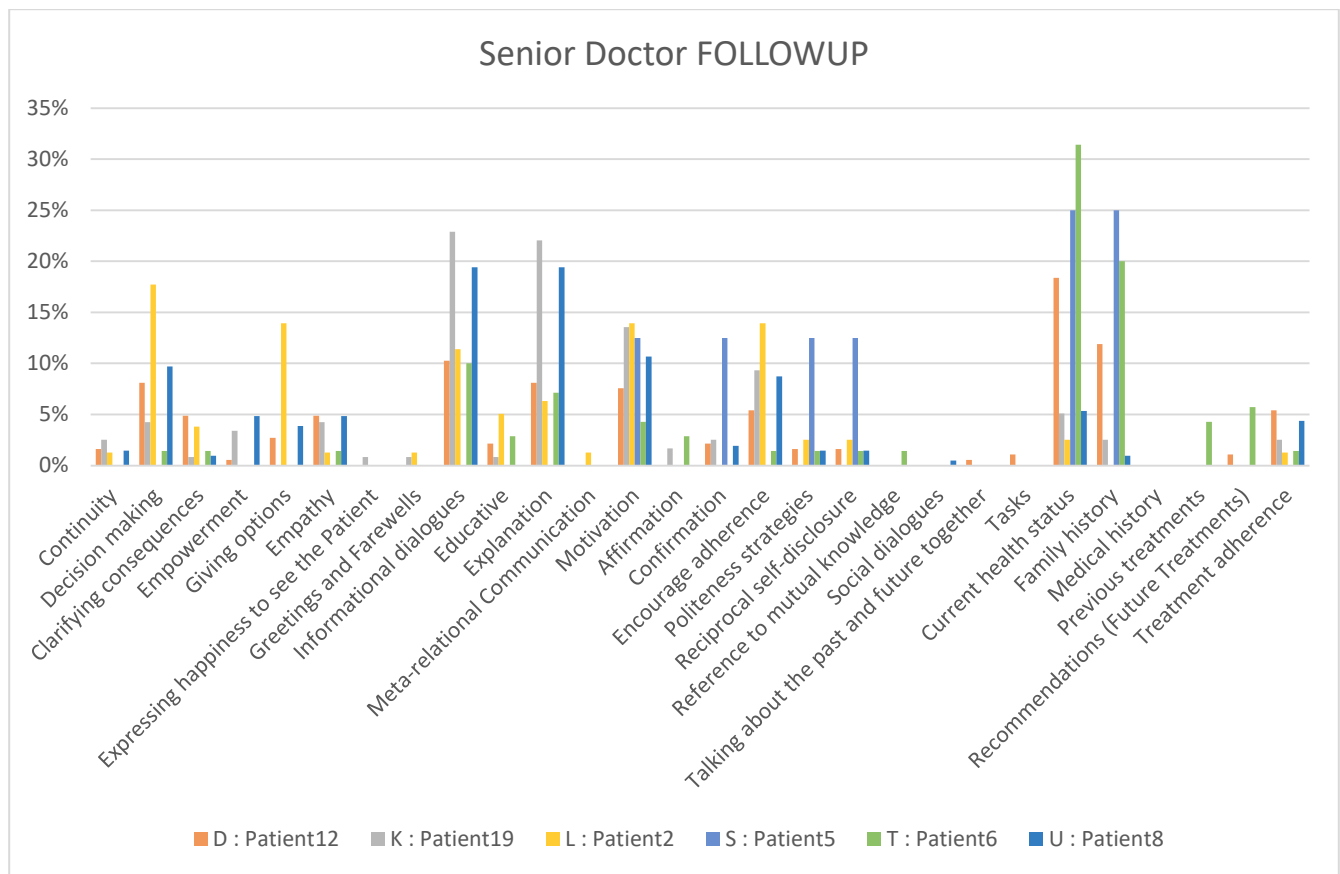
Figure 6: Senior doctor's relational cues usage with six follow-up patients.

Figure 7 shows that the senior doctor's empathic cues usage is the same for both new and follow-up patients but the difference lies in encouraging adherence and informational and motivational dialogues. Informational dialogues are more for new patients, whereas motivational and decision-making cues are more for follow-up patients. The reciprocal self-disclosure and social dialogues feature less in percentage usage but they are relatively more used for first-time patients.
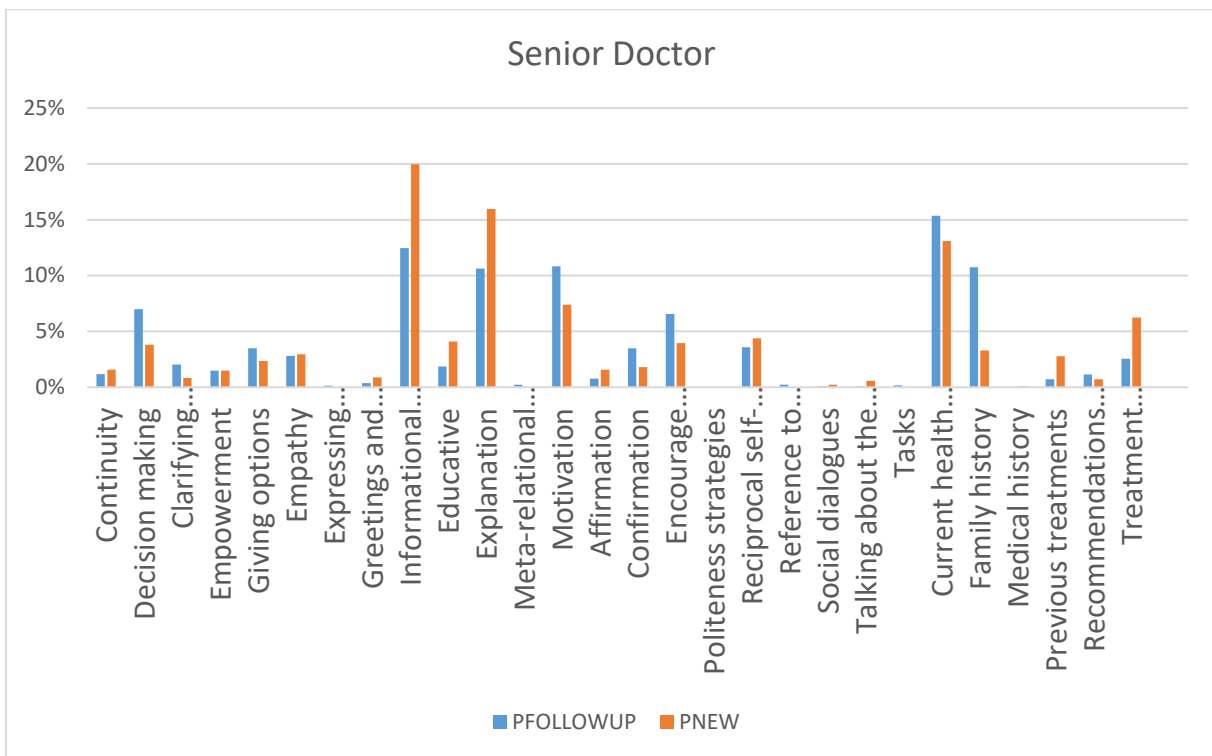
Figure 7: Senior doctor's average usage of relational cues with first-time (PNEW) and follow-up (PFOLLOWUP) patients.

The physiotherapist is the second most frequent role found in the consultations. The health specialist has fewer years of experience than the senior doctor but is a proficient subject matter expert in incontinence. As shown in Figure 8, there are more empathic cues, politeness and social dialogue for new patients.

The nurse – another frequent role in the consultations – is also a proficient subject matter expert and a junior doctor in practice. Figure 9 shows the nurse uses more empathic cues than other roles and other non-task-based cues, such as continuity and social, informational and motivational dialogues.

In consultations where both senior doctor and physiotherapist appear, as shown in Figure 10, the physiotherapist uses more task-based dialogues and the senior doctor uses more adherence and decision-making dialogues. Social dialogues are uttered more by the physiotherapist, but empathic cues are uttered more by the senior doctor.
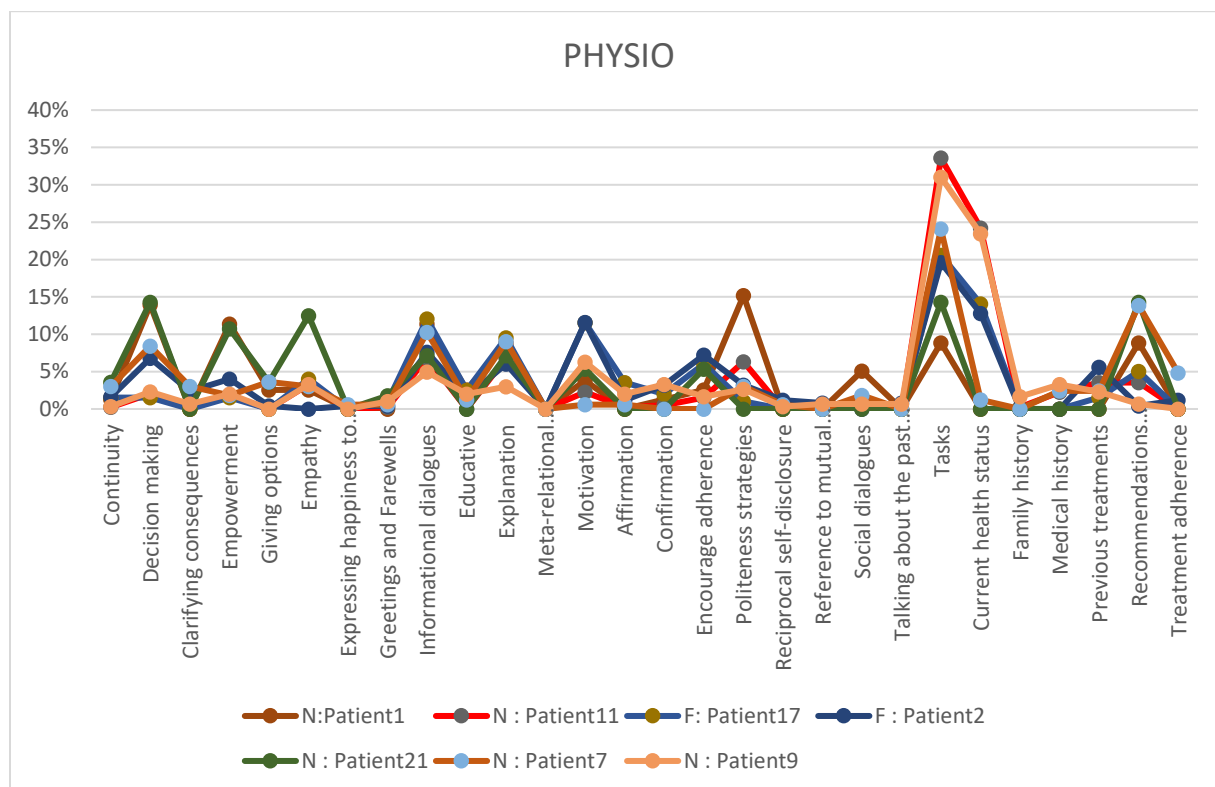
Figure 8: Physiotherapist's relational cues usage in seven consultations (N=new, F=follow-up).
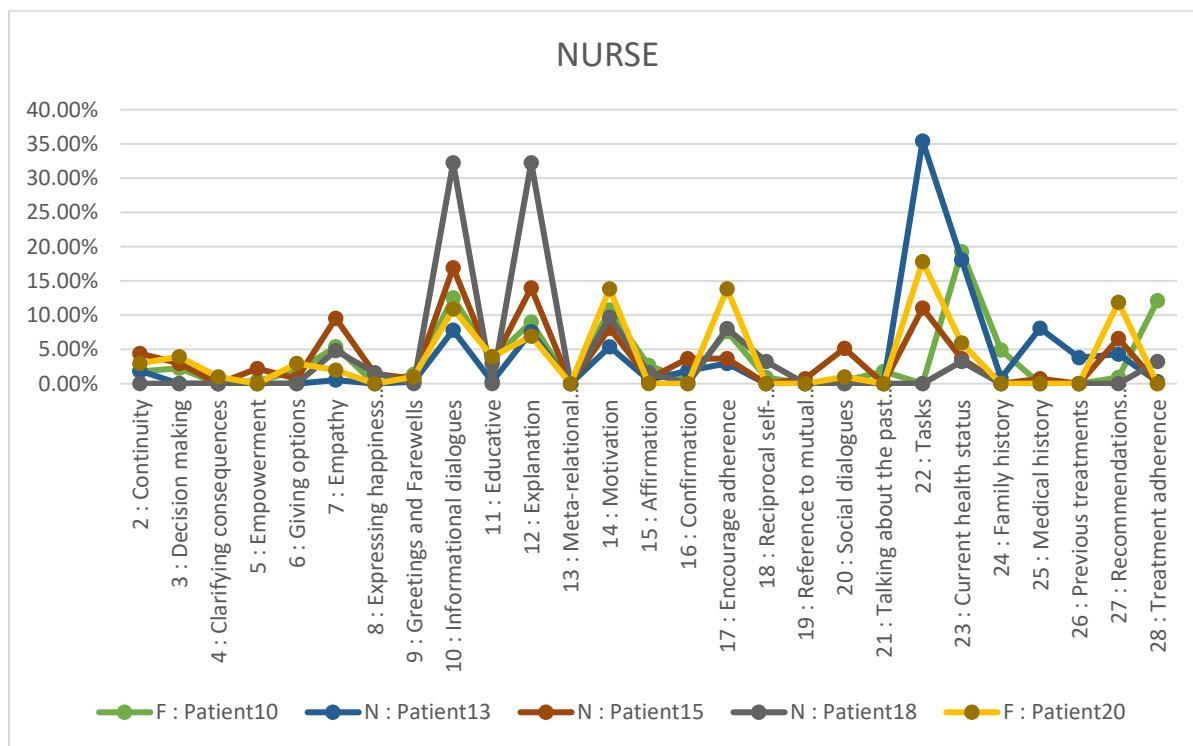
Figure 9: Nurse's relational cues usage in consultations with five patients.
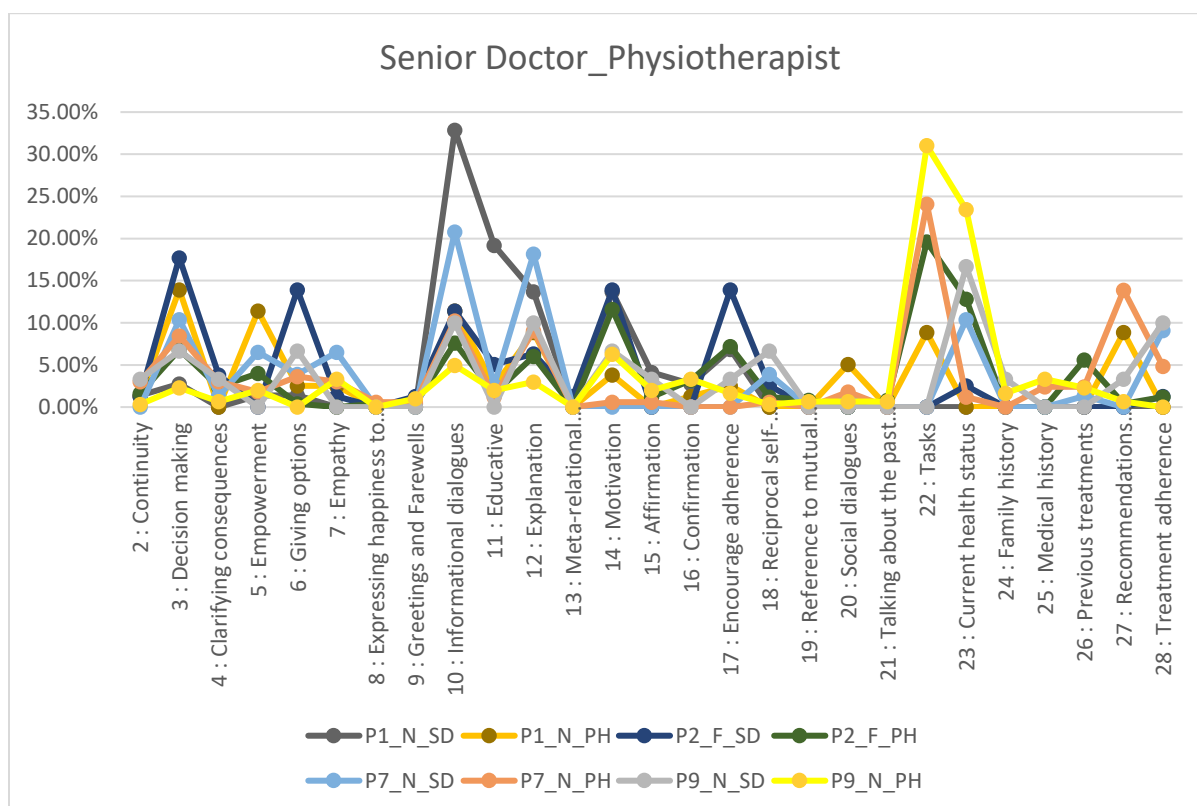
Figure 10: Usage of relational cues in four consultations that have two health specialists.

4.2 Role Differences and Similarities in the Use of Relational Dialogues

The data helps in analysing the use of relational cues in multiple roles. In total, there were six roles to analyse, with more consultation sessions for the senior doctor, physiotherapists and nurse. The remainder of the medical team – a paediatrician, registrar and male physiotherapist – had only one consultation each. More data is needed to analyse their use of relational cues, but for the purpose of this research they are grouped into one category under 'others'.

Owing to few data samples and lack of confirmation of normal distribution in the usage of a particular theme within a category under observation, non-parametric (i.e. Mann Whitney U) tests were chosen to understand the differences and similarities in the use of relational dialogues. The Mann Whitney U test compares outcomes between two independent groups based on the median of two distributions.[7] The test was performed on all relational cues. The scores are shown in Table 2 to summarise the differences between roles with respect to the use of relational cues. The senior doctor is compared with junior doctors

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[7] https://sphweb.bumc.bu.edu/otlt/MPH-Modules/BS/BS704_Nonparametric/BS704_Nonparametric_print.html

and then with the 'others'. Due to space limitations, Table 2 includes only the results that are significant at the 90% confidence level or have high U-values.

Table 3: Non-parametric Test Scores for Different Roles v. the Senior Doctor

Group	U-value	p-value	z-score
Senior Doctor versus Physiotherapists			
Empowerment	22	**0.075**	-1.775
Explanation	26	0.147	1.445
Social dialogue	25	0.126	-1.528
Reciprocal self-disclosure	12	**0.009**	2.601
Family history	19	**0.04**	2.02
Treatment adherence	14	**0.015**	2.436
Senior Doctor versus Others			
Reciprocal self-disclosure	17	**0.029**	2.188
Future recommendations	18	**0.035**	-2.106
Medical history	22	**0.075**	-1.775
Clarifying consequences	20	**0.052**	1.940

The categories in Table 3 were further analysed to determine whether the senior or junior doctors used more of these cues. Dominance is defined as the higher usage percentage of the relational cue in most of the sample points for that role. Examples of visualisations that support the statistics are presented in Table 4.

The differences and similarities between roles can also account for how much an individual varies or modifies their language in different contexts, essentially tailoring their dialogues to the patient based on consultation type (e.g. new or follow-up) or demographics (e.g. gender and age). Statistics for all the data points and relational cues were analysed for both consultation types and three roles. For simplicity, I have summarised the highly variant relational cues for new and follow-up consultations by the senior doctor, physiotherapist and nurse in Table 5. The other cues, which have little or no difference between the average and standard deviation, are not shown. The difference column is colour coded to segment the relational cues; hence, green segments have the highest variation in relational cues usage, whereas the red ones have the lowest variation.

Table 4: Role Dominance of Senior Doctor (left); Selected Graphs (right)

Senior Paediatrician versus Physio	Dominant role	
Empowerment	Physician	
Explanation	Senior doctor	
Social dialogue	Physician	
Reciprocal self-disclosure	Senior doctor	
Family history	Senior doctor	
Treatment adherence	Senior Doctor	
Senior Paediatrician versus Others	**Dominant role**	
Reciprocal self-disclosure	Senior doctor	
Future recommendations	Others	
Medical history	Others	
Clarifying consequences	Senior doctor	
X-axis represents specific patients, Y-axis is percentage of relational cue usage		

It is evident from Table 5 that for all roles the use of informational dialogues varies highly since explanation and education is dependent on many other factors like a patient's gender, age and medical history. In the case of follow-up consultations, the use of relational dialogue is highly associated with the stage of the treatment and severity of the disease. The cues that empower the patient also vary and in case of the senior doctor a greater range of giving options is observed.

Table 5: Relational Cues with High Variation in Usage Based on Mean and Standard Deviations

Consultation type	Role	Code	Average	STD	Difference
New	Senior Doctor	Informational dialogues	19.98%	9.00%	10.98%
		Explanation	15.95%	6.89%	9.06%
		Previous treatments	2.77%	6.15%	3.38%
Follow-up		Giving options	3.50%	5.55%	2.05%
		Informational dialogues	12.48%	8.08%	4.40%
		Motivational dialogues	10.83%	4.08%	6.75%
New	Physio	Empathy	3.07%	0.46%	2.61%
		Informational dialogues	11.21%	5.70%	5.51%
		Explanation	7.75%	2.87%	4.88%
		Task-based dialogues	10.83%	4.08%	6.75%
Follow-up		Informational dialogues	12.35%	7.88%	4.47%
		Family history	3.74%	7.02%	3.28%
		Previous treatments	3.88%	6.47%	2.59%
New	Nurse	Informational dialogues	19.00%	12.34%	6.66%
		Explanation	17.93%	12.81%	5.12%
		Motivational dialogues	7.72%	2.16%	5.56%
Follow-up		Continuity	2.38%	0.83%	1.55%
		Giving options	2.38%	0.83%	1.55%
		Informational dialogues	11.72%	1.18%	10.55%
		Educative	3.77%	0.26%	3.51%
		Explanation	7.95%	1.44%	6.51%
		Motivational dialogues	12.31%	2.19%	10.12%
		Encouraging adherence	10.74%	4.41%	6.33%

4.3 Demographic Influence on Use of Relational Dialogues

The influence of patient demographics on the use of relational dialogues has been analysed using Mann-Whitney U scores (Table 6). New and follow-up consultations, although they are not the demographics of the patient, also have a major influence on the usage of relational cues. The new patients needed to be walked through the whole treatment details and were encouraged to speak up about their current health issues. The follow-up patients were either asked for time and volume charts or about their adherence to a certain treatment that had been discussed before.

The highlighted categories are further analysed through multiple plots such as line and box plots to mark the dominant group in terms of usage of relational cues. Table 7 shows the percentage usage of two patient groups and presents the dominance of usage of a particular cue in the groups. Only a few line plots have been shown in the thesis due to space limitations. For example, the Explanation line plot shows that a health specialist uses more explanation dialogues with female patients than with male patients.

Table 6: Mann-Whitney U Analysis – Summary of Significant Themes in Demographically Segregated Patient Cohorts

Group	U-value	p-value	z-score
Males versus Females			
Motivational dialogues	49	0.044	-2.014
Explanation	54	0.077	1.771
Age <10 versus Age >=10			
Previous treatments	39	0.014	-2.464
Clarifying consequences	56	0.095	-1.674
New versus follow-up			
Motivational dialogues	35	0.007	-2.693
Encouraging adherence	50	0.049	-1.965
Medical history	51	0.055	1.917

Table 7: Role Dominance for Demographically Segregated Categories in Significant Cues Derived through the Mann Whitney U Test

Males versus Females		
Motivational dialogues	Male patients receive more motivation	
Explanation	Female patients receive more explanation	
Age <10 versus Age >=10		
Previous treatments	Older children have more previous treatments	
Clarifying consequences	Older children are given more decision-making dialogues	
New versus Follow-up		
motivational dialogues	Follow-up sessions receive more motivational dialogues	
encouraging adherence	Follow-up sessions receive more encouragement to adhere	
medical history	New sessions discuss medical history more than follow-up	

Explanation (line chart: Female vs Male, x-axis 1–14, y-axis 0.00–0.50)

Encourage Adherence (line chart: Followup vs New, x-axis 1–14, y-axis 0.00–0.20)

4.4 Comparison of Dr Evie's and SAM's Dialogues with Live-call Dialogues

Dr Evie's dialogue set consists of multiple treatment-based dialogue streams, including alarm training, bowel program, caffeine intake, fluid increase, medication and time voiding. The same coding framework

used for the recorded consultations was applied to the dialogues used in Dr Evie to facilitate a comparison between the usage of relational cues on live clinical calls and Dr Evie. Since the dialogue sets are those used for creating the Dr Evie application, they cannot be compared in terms of actual sessions that patients have with Dr Evie. The whole dataset provides a statistical presence of relational cues, which are shown in the Figure 11.
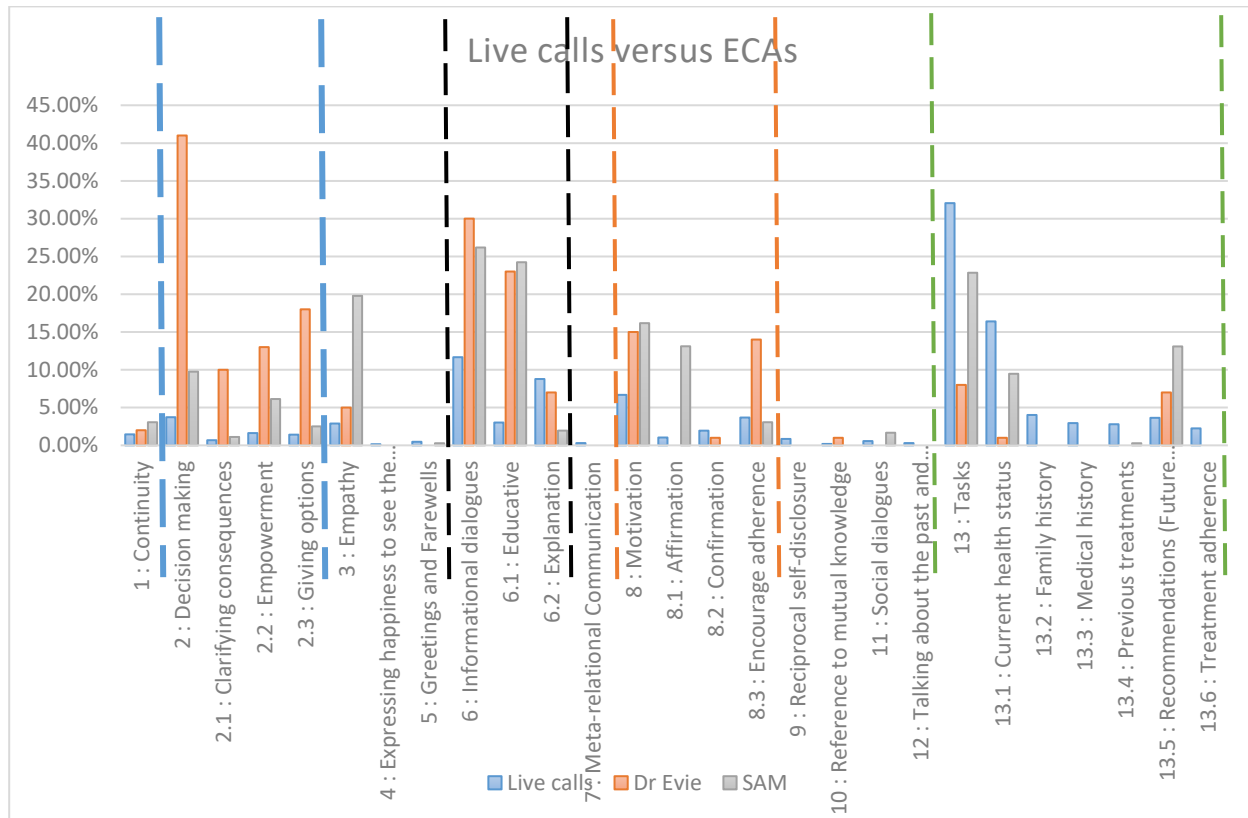

Figure 11: Coding comparison of live calls, Dr Evie and SAM.

Note. Dotted segregation is for each parent theme and sub themes. Sub themes counts add up to make parent theme counts.

The dialogue set of Dr Evie was designed by experienced health professionals who are experts in incontinence and other related disorders; hence, percentage usage of dialogue cues in live clinical calls is similar to that of relational cues in Dr Evie, especially for education, empowerment, encouraging adherence and giving options. The live clinical calls had a lower percentage usage of cues such as reference to mutual knowledge, greetings and farewells and the same can be seen with Dr Evie. The other cues such as empathy, explanation, recommendation, confirmation and clarifying consequences are also

present in Dr Evie in good proportion and comparable with their usage in live clinical calls. Relational cues such as talking about the past and future together and social dialogues are missing in Dr Evie's context, Dr Evie's use of relational cues could be enriched by recommendations from live calls.

SAM's dialogue sets are mostly around sleep routine management and diet options: caffeine intake, regular sleep, night terrors, sleep hygiene and snoring issues. The recommendations are also about the sleep routine and diet habits. The dialogue flows have informational dialogues, current health assessment and recommendation dialogues incorporated in empathic language (e.g. 'I understand' and 'I know this is hard but'). SAM's dialogues are rich in empathic cues and affirmation dialogues, but lack cues for encouraging adherence, clarifying consequences and explanation. Live calls dialogue cues for these themes can be used to enrich SAM's dialogue set.

4.5 Structure, Topic and Inter-speaker Relationship Analysis

Health consultations have a defined and specific structure that exhibits the ontology of the subject area (Bickmore et al., 2005). In order to embed relational cues in a logical manner, it is important to understand the conversational structure, topic variance and inter-speaker contribution in the overall consultation. The recurrence of topics and the time taken by speakers determine the level of engagement and understanding among the participants.

The dialogue structure in health consultations presented in Baker, Richards, and Caldwell (2014a) places the dialogue cues from Bickmore et al. (2010) into a structure found in real consultations. Starting with greetings and farewells, social dialogues and previous treatment-related dialogues, it continues into more empathic dialogues and reciprocal self-disclosure cues. The last part of the conversation is more about future recommendations, adherence and continuity of the consultations. Our dataset is also mapped onto this logical structure to validate its existence in live calls, which suggests that even if the ECAs are built on natural language instead of structured questions, they would follow a similar structure (Figure 12).

Discursis has been explored to build dialogue structures of three types of conversations, as shown in Figure 13. The graphs show utterances based on most frequent words, deemed as themes. Given the focus on discussing treatments and health status in the dialogues, these themes are primarily task based as the frequency of non-task-based themes and empathic cues is low comparatively. For example, greetings and farewells are only used at the beginning and end of a conversation and spoken once. Continuity and social dialogues, which are lower in frequency than other cues, are not visible in the extracted maps. As the dictionary of words used for relational cues is very small compared to the task-based word frequencies,

it is not highlighted in the maps. The utterance semantics of the dialogue, which is one of the metrics for determination of the relational cue's existence, is also not extracted by this tool.
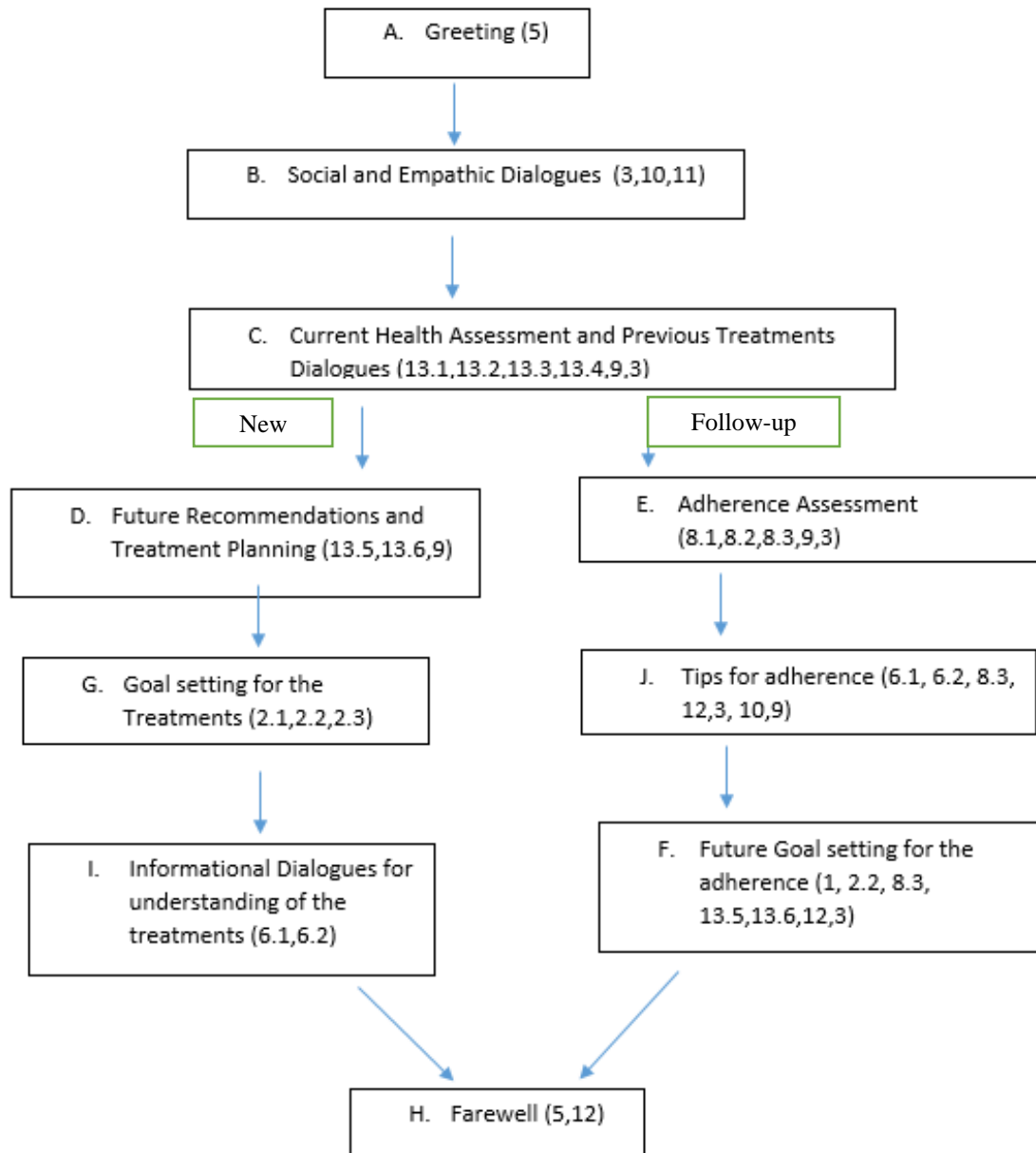

Figure 12: Dialogue flow of a conversation between a health specialist and patient in live calls with mapped relational cues from Figure 3 (adapted from (Baker, Richards, & Caldwell, 2014b))
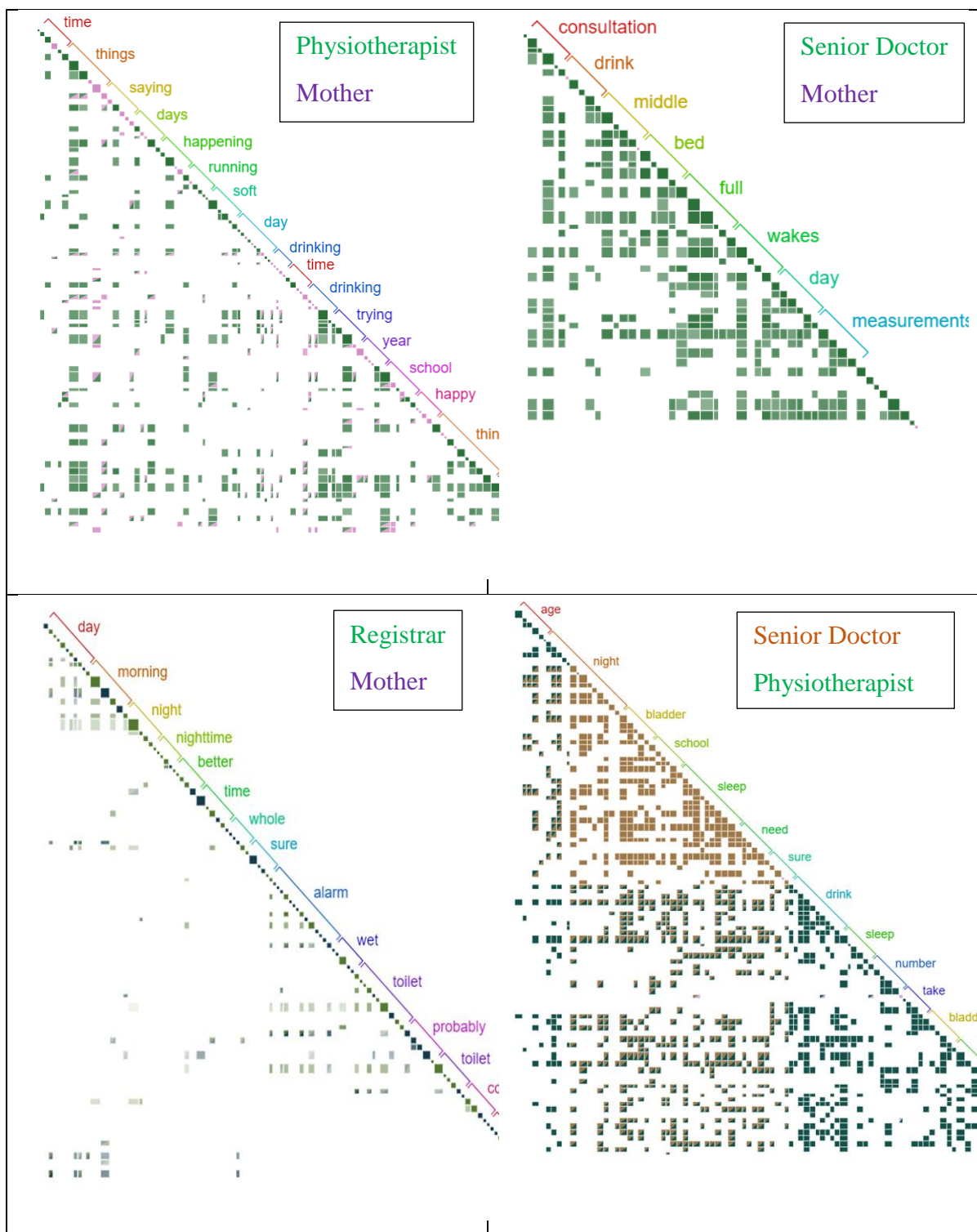
Figure 13: Discursis plots highlighting most frequent words and colour coding by role.

Chapter 5: Conclusion

The main goal of this project has been to investigate the usage of relational cues from human dialogues recorded in patient-doctor sessions. The resultant insights can be used to validate and inform the design of dialogues for ECAs that play a similar role. Empathic interactions are vital for building rapport during conversation. The recommended relational cues help build the empathic interactions needed so that ECAs can communicate and respond like humans. The pragmatics and semantics of these dialogues have been analysed through a literature review and qualitative analysis. Some cues were found to be more frequent in usage, such as explanation and education dialogues in comparison to social dialogues.

This chapter addresses the five research questions through a review of the relevant literature and findings from both the qualitative coding of themes and the quantitative statistical analysis in previous chapters. The research questions consider the use of relational cues by different health specialists, consultation types and ECAs versus live-call analysis, leading to the development of recommendations that can be used to train young health specialists or improve/build ECAs with a humanlike dialogue set. The chapter also considers the study's limitations and future research prospects and concludes by linking the contributions of this thesis back to its original motivations presented in Chapter 1.

5.1. Answering the Research Questions

This section addresses the research questions presented in Chapter 1, drawing on the literature review in Chapter 2, methodology in Chapter 3 and the qualitative analysis of the relational cues and statistical analyses in Chapter 4.

5.1.1 RQ1: What is the Role of Relational Cues in Patient-Therapist Conversations?

The role of relational cues was analysed by the percentage of their occurrence in conversations. Figures 5, 6, 7, 8 and 9 show that two relational cues are used in all conversations but their percentage of usage is very low – greetings, farewells and continuity. This confirms the (Laver, 1975) finding that social dialogues are uttered mainly during the greeting and farewell phases of a conversation. Four relational cues were used very rarely in all conversations – expressing happiness to see the users, reference to mutual knowledge, talking about the past and future together and reciprocal self-disclosure. These cues are highly connected to how long term the relationship is with the patient and the level of comfort. For example, the use of self-disclosure is reserved for long-term and trusting relationships, as it involves vulnerability on the part of the disclosing person and their knowledge of the individual's likely response

to their disclosure (Audet & Everall, 2010). The highest usage of relational cues is for empathy and motivational, informational and decision-making codes.

Relational cues differ according to the session type and whether it is with a new or follow-up patient (Norfolk, Birdi, & Walsh, 2007). A new patient needs to be on-boarded with more communication related to treatment mechanics and education of the health issues. A follow-up patient needs more encouragement and dialogues related to clarifying consequences.

5.1.2 RQ2: Do Different Individuals or Roles in the Medical Team use Relational Cues Differently?

The nature of expertise and years of experience indicating seniority in the profession have been found to impact the selection of verbal cues by novices and experts (Kee et al., 2003). The dataset consisted of three main (i.e. frequent or common) roles: senior doctor, physiotherapist and nurse. Tables 3-5 show that in sessions where there is more than one health specialist present, the percentage use of relational cues can be differentiated with respect to the role. The most frequent cues are explanation, encouraging adherence and empowerment. In sessions where two health specialists are present, the relational cues such as explanation and encouraging adherence are used more by the senior doctor. In these sessions, the junior doctor – the physiotherapist or nurse – uses more continuity and task-based dialogues. It appears that when a senior doctor joins a session being conducted by junior staff, the purpose of their dialogue is also to train the junior staff and affirm/explain the information and instruction they provide to the patient.

5.1.3 RQ3: How Do the Medical Team's Conversations Compare with the ECAs' Dialogues?

The success of an ECA is dependent on its ability to communicate in a humanlike manner (Alam et al., 2018; Laranjo et al., 2018). Dr Evie and SAM are two ECAs whose dialogue structure has been analysed in lieu of insights from the live clinical calls. Figure 11 shows that live clinical calls have a higher percentage of task-based dialogues, including those gathering information on current health and previous treatment. Thus, live calls (i.e. human conversations) are highly customised, involving real-time collection of the patient's situation, and this context determines the next course and flow of conversation. They provide a wider variety of options and decisions and are not limited to the scenarios scripted in the ECAs. In non-task-based relational cues, live calls have more opportunity for reciprocal self-disclosure, confirmation and explanation dialogues than might be possible in scripted ECA dialogues. Figure 11 also shows that SAM is the most empathic of all. This is not surprising, as SAM has been developed specifically to include empathic cues and to capture knowledge about the user's goal and beliefs to deliver behaviour change (Abdulrahman & Richards, 2019). Its dialogues can be used as recommendations for

training doctors to empathise during live sessions. Dr Evie has the most decision-making dialogues because it covers the whole subject area of incontinence. Figures 12 and 13 show the frequent topics and sequence of conversation with respect to the relational cues. There exists a high level of similarity between the ECAs' dialogue structure (Baker et al., 2014b) and live call utterances, as shown in Figures 12 and 13 in terms of word usage and the sequence in which words are uttered. The only visible difference is the level of interactivity in live calls, since patients can respond without being bound to a few choices. This difference can help to expand the patient's response dataset for the ECAs and to add variation to health specialists' dialogues.

5.1.4 RQ4: What Improvements Can Be Made to the Dr Evie and SAM Dialogues Based on Actual Human Conversations?

Tables 3 to 7 provide detailed findings on roles and demographics in the live calls. These insights can be used to create customised responses for different gender and age groups. Two factors that make the ECAs humanlike are their appearance and intelligence (Raval, 2020), which depend highly on dialogue management producing dialogues similar to actual human dialogues. The live calls were more contextualised and customised. They included cues such as self-disclosure, confirmation and explanation. If the ECA dialogues were modified to capture more of a patient's context, these cues could be used to enrich Dr Evie and SAM dialogues.

Multiple roles can be introduced in Dr Evie and SAM, as the senior doctor uses more explanation and empowering cues and the junior doctor takes care of certain routine tasks. This can make dialogue sets more empathic. To implement an approach where multiple ECAs can support a patient in different ways to provide holistic care, the Council of Coaches platform could be used (Op Den Akker et al., 2018) where multiple ECAs review the patient's situation together and have separate conversations with the user according to their specific area of expertise or role (e.g. dietician, physiotherapist, friend).

5.1.5 RQ5: What Recommendations can be made Concerning the Design of Future ECA Relational Dialogue and/or the Training of Health Professionals in Patient-Therapist Communication?

The above suggested extensions to Dr Evie and SAM, such as more data gathering leading to more personalised use of relational cues, can be applied more widely to the design of other ECAs. This would involve the inclusion of user/patient models that persist between consultations, which allow the knowledge of the ECA to grow and be updated each time it meets the patient. This would also allow the ECA to tailor its social dialogue to the interests of each human. The relational cues and approach used in

this thesis can be used to evaluate other ECAs and more relational cues could be incorporated to improve the relationship built with the user, with the aim of improving health outcomes.

Another contribution of this project is the capture of valuable datasets. The dataset and findings can be used by others in different ways. It is evident that live calls contain relational cues (e.g. disclosure and social dialogue) and dialogue patterns that could be used to design relational dialogue for ECAs. This dataset can also be used in machine learning and AI-based agents (Van Welbergen, Yaghoubzadeh, & Kopp, 2014), which can learn to respond and formulate conversation using natural language generation.

The live-call transcripts could also be used for the medical training of patient-doctor communication. This would be an alternative or supplement to approaches that offer guidance for health practitioners such as those provided by Rogers' (1959) client-centred therapy, which includes empathy, genuineness and unconditional acceptance. There is clear overlap in some of the relational cues and in the approach suggested by Rogers.

Finally, live clinical calls provide utterances from various roles. These roles include not only health specialists but also patients. Hence, the data can be used to build multiple ECAs that have different roles to facilitate the training of practitioners. While the quality of the recordings of patients and family members was too poor to allow transcription and qualitative analysis and outside the scope of this study due to its focus on practitioner use of relational cues, some specific calls in the live-call dataset can be used to build virtual patient ECAs, so that doctors can practise and refine their patient-doctor conversational expertise.

5.2. Limitations and Future Directions

The dataset of live clinical calls was collected during the COVID-19 timeframe when normal clinical practice was disrupted. Live clinical consultations became the new norm, which made their recording possible. Nevertheless, not all patients or practitioners were comfortable with this form of consultation, and it is possible that the dialogues were different to what might have been recorded in live face-to-face sessions in consultation rooms. The delay at the start to obtain consent prior to recording may have also inhibited the naturalness of the conversation and relationship. Furthermore, running online consultations had some technical and ethical restrictions, as certain software with no recording feature was mandated by CHW for conducting consultations. Since this software did not enable recording, a second product on a mobile phone was used in the consultation room, which was not able to capture high-quality sound recordings, particularly of the patient and their family who were in another location. This made it

impossible to analyse the patient responses to evaluate the Dr Evie options or to conduct the sentiment analysis originally planned (Section 3.5). These awkward recording arrangements that added to the workload of the medical team resulted in a failure to record many consultations through forgetfulness or technical or human error. The original plan to validate the coding scheme on the sleep clinic dialogues was abandoned as only six short consultations were recorded in the end.

In total, 18 hours were recorded, but the sample size of 23 is a limitation. A larger sample size might provide more diverse insights, especially with wider population representation, including more male medical staff examples. Along with more data in general, more substantial conclusions can be established. For example, there is only one consultation with the paediatrician and only one in which the patient appeared herself, while the others were mainly conducted by parents. Also, our results show that the statistical coding percentages differ gender wise. One example is that with female patients more dialogues with explanation are used, while with male patients motivational dialogues are dominant. Findings like these can be investigated further in the literature to determine if gender-specific differences in the use of relation cues have been previously found similar to what has been visible in our results.

Moreover, clinical calls cover only one domain – incontinence – in children's health. We had also gained ethics approval for capturing live calls for the Sleep Clinic at CHW, however, insufficient calls (in terms of number and duration) were recorded to allow meaningful comparison. In the future, new studies can be conducted using the coding framework to provide a more generalised view of the use of relational cues in children's medical conditions. Also, some cues were used less frequently and some were not used at all in our incontinence dataset. Unless relational cues in more domains are explored, the generalisation remains questionable.

Similarly, the ECAs for incontinence and sleep have been studied in conjunction with live calls, but more ECAs in domains specific to children should be explored to establish the use of relational cues especially in terms of the health specialist.

Conversational unit interfaces (CUIs) in health care are able to analyse natural languages (Laranjo et al., 2018) and to build responses according to the patient's situation and history. As we move into the digital era, reliance on virtual agents that talk and understand like humans is a big research area (Sas, Whittaker, & Zimmerman, 2016). Dr Evie uses scripted dialogues, whereas SAM uses more sophisticated technology that takes into account the user's goals and beliefs. The architecture SAM uses also allows preferences, medical history and other contextual features to be included in the ECA's reasoning and to

provide explanations (Abdulrahman & Richards, 2019). SAM uses fixed choice responses, primarily to ensure patient safety and accuracy, which is a current risk in health domains due to limitations in natural language processing (Xu et al., 2020). In the future when these limitations are addressed, safe and reliable solutions that use natural language input can be evaluated with a mix of controlled responses.

This thesis raises many questions regarding the use of ECAs, such as how humans react to a virtual agent (Novielli, de Rosis, & Mazzotta, 2010) that is only task-based compared to one that uses relational cues. Does a task-based virtual agent gain empathy in response to the support it is offering or does it make the patient feel more frustrated or misunderstood?

In the future, the recommendations for ECA dialogue design can be utilised to produce more dialogue sets that can be generalised over certain situations and cultures. Since negative thoughts can aggravate health issues, an empathic ECA that is personalised to the individual could help both mental and physical well-being. Hence, future agents for all health issues can potentially benefit from the relational cues and their usage presented in this thesis.

5.3. Final Remarks

ECA humanlike conversation building is a challenging area for task-oriented domains that involve the consideration of numerous factors for the interaction to be beneficial. In clinical consultations, in order to achieve useful outcomes, the health specialist needs to establish a sense of rapport with the patient. Paediatric incontinence is a common issue especially in children aged 3–18. Live consultations were recorded by CHW, offering the possibility to analyse verbal dialogues in real-time scenarios. Although Dr Evie is an ECA developed for incontinence by the same team of experts, analysis of the relational cues used in live calls has provided recommendations to enhance the dialogue set of Dr Evie and other ECAs like SAM.

The recommendations from this analysis were promising. A substantial percentage of empathic dialogue cues were found in all consultations, especially for first-time patients. With further future enhancements including more data and generalisation of the same coding framework to more subject areas in the medical domain, this framework will provide a testing framework for measuring multiple factors that have been found to be important in establishing successful doctor-patient dialogues. For example, with the addition of reciprocal self-disclosure dialogues and more social dialogues, the ECAs will have the ability to respond in a more human like manner with more scenario handling and dialogue selection according to the severity of the situation and emotions of the patient. Towards these broader goals, this

thesis has provided a coding framework that an ECA can use to build its relational cues and provide emotional benefit to the patient. Furthermore, it has evaluated the design and value of empathic relational cues and raised important questions for future research.

References

Abdulrahman, A., & Richards, D. (2019). *Modelling working alliance using user-aware explainable embodied conversational agents for behavior change: framework and empirical evaluation*. Paper presented at the 40th International Conference on Information Systems, ICIS 2019.

Abramovitch, H., & Schwartz, E. (1996). Three stages of medical dialogue. *J Theoretical Medicine, 17*(2), 175-187.

Al Owayyed, M. A. (2020). *Motivating PhD candidates with depression symptoms to complete thoughts-strengthening exercises via a conversational agent.* (PhD), TU Delft Electrical Engineering, Mathematics and Computer Science; TU Delft Interactive Intelligence, Retrieved from http://resolver.tudelft.nl/uuid:c5ed5bde-e118-4b73-9f4b-85531920f19a

Alam, F., Danieli, M., & Riccardi, G. (2018). Annotating and modeling empathy in spoken conversations. *J Computer Speech Language, 50*, 40-61.

Almohanna, A. A., Win, K. T., & Meedya, S. (2020). Effectiveness of Internet-Based Electronic Technology Interventions on Breastfeeding Outcomes: Systematic Review. *Journal of Medical Internet Research, 22*(5), e17361.

Angus, D. (2019). Recurrence methods for communication data, reflecting on 20 years of progress. *Frontiers in Applied Mathematics and Statistics, 5*, 54.

Audet, C. T., & Everall, R. D. (2010). Therapist self-disclosure and the therapeutic relationship: A phenomenological study from the client perspective. *British Journal of Guidance & Counselling, 3*(3), 327-342.

Baker, S., Richards, D., & Caldwell, P. (2014a). *Putting a new intelligent virtual face on a medical treatment advice system to improve adherence*. Paper presented at the 2014 Conference on Interactive Entertainment, Newcastle.

Baker, S., Richards, D., & Caldwell, P. (2014b). *Relational agents to promote ehealth advice adherence*. Paper presented at the Pacific Rim International Conference on Artificial Intelligence, Gold Coast.

Bardovi-Harlig, K. (2010). Exploring the pragmatics of interlanguage pragmatics: Definition by design. *J Pragmatics across languages cultures, 7*, 219-259.

Bengtsson, M. (2016). How to plan and perform a qualitative study using content analysis. *J NursingPlus Open, 2*, 8-14.

Bennett, J. K., Fuertes, J. N., Keitel, M., & Phillips, R. (2011). The role of patient attachment and working alliance on patient adherence, satisfaction, and health-related quality of life in lupus treatment. *Patient education and counseling, 85*(1), 53-59.

Bevacqua, E., Mancini, M., & Pelachaud, C. (2008). *A listening agent exhibiting variable behaviour*. Paper presented at the Intelligent Virtual Agents.

Bickmore, T., Gruber, A., & Picard, R. (2005). Establishing the computer–patient working alliance in automated health behavior change interventions. *Patient education and counseling, 59*(1), 21-30.

Bickmore, T. W. (2004). Unspoken rules of spoken interaction. *J Communications of the ACM, 47*(4), 38-44.

Bickmore, T. W., Caruso, L., & Clough-Gorr, K. (2005). *Acceptance and usability of a relational agent interface by urban older adults*. Paper presented at the CHI'05 extended abstracts on Human factors in computing systems.

Bickmore, T. W., Puskar, K., Schlenk, E. A., Pfeifer, L. M., & Sereika, S. M. (2010). Maintaining reality: Relational agents for antipsychotic medication adherence. *J Interacting with Computers, 22*(4), 276-288.

Bickmore, T. W., Schulman, D., & Sidner, C. L. (2011). A reusable framework for health counseling dialogue systems based on a behavioral medicine ontology. *J Journal of biomedical informatics, 44*(2), 183-197.

Bosco, F. M., Gabbatore, I., Lamm, C., Morese, R., Silani, G., & Loukusa, S. (2015). Social cognition: from empathy to pragmatic ability. *4th EuroAsianPacific Joint Conference on Cognitive Science, 2015, Symposium 7*.

Butler, R. J. (1998). Night wetting in children: Psychological aspects. *The Journal of Child Psychology Psychiatry Allied Disciplines, 39*(4), 453-463.

Butow, P., Maclean, M., Dunn, S., Tattersall, M., & Boyer, M. (1997). The dynamics of change: cancer patients' preferences for information, involvement and support. *Annals of Oncology, 8*(9), 857-863.

Cameron, R. A., Mazer, B. L., DeLuca, J. M., Mohile, S. G., & Epstein, R. M. (2015). In search of compassion: a new taxonomy of compassionate physician behaviours. *Journal of Health Expectations, 18*(5), 1672-1685.

Cassell, J., Bickmore, T., Billinghurst, M., Campbell, L., Chang, K., Vilhjálmsson, H., & Yan, H. (1999). *Embodiment in conversational interfaces: Rea*. Paper presented at the Proceedings of the SIGCHI conference on Human Factors in Computing Systems.

Cassell, J., Vilhjálmsson, H. H., & Bickmore, T. (2004). Beat: the behavior expression animation toolkit. In *Life-Like Characters* (pp. 163-185): Springer.

Chatzimina, M., Koumakis, L., Marias, K., & Tsiknakis, M. (2019). *Employing Conversational Agents in Palliative Care: A Feasibility Study and Preliminary Assessment*. Paper presented at the 2019 IEEE 19th International Conference on Bioinformatics and Bioengineering (BIBE).

Chi, D., Costa, M., Zhao, L., & Badler, N. (2000). *The EMOTE model for effort and shape*. Paper presented at the Proceedings of the 27th annual conference on Computer graphics and interactive techniques.

Coker, D. A., & Burgoon, J. (1987). The nature of conversational involvement and nonverbal encoding patterns. *Journal of Human Communication Research, 13*(4), 463-494.

Coulehan, J. L., Platt, F. W., Egener, B., Frankel, R., Lin, C. T., Lown, B., & Salazar, W. H. (2001). "Let me see if i have this right...": words that help build empathy. *Ann Intern Med, 135*(3), 221-227. doi:10.7326/0003-4819-135-3-200108070-00022

Cruz, M. P. (2014). On the social importance of phatic utterances: Some considerations for a relevance theoretic approach. In.

Dainton, M., & Stafford, L. (2016). Routine Maintenance Behaviors: A Comparison of Relationship Type, Partner Similarity and Sex Differences. *Journal of Social and Personal Relationships, 10*(2), 255-271. doi:10.1177/026540759301000206

DeVault, D., Artstein, R., Benn, G., Dey, T., Fast, E., Gainer, A., . . . Lhommet, M. (2014). *SimSensei Kiosk: A virtual human interviewer for healthcare decision support*. Paper presented at the Proceedings of the 2014 international conference on Autonomous agents and multi-agent systems.

Eisenberg, N., & Strayer, J. (1990). *Empathy and its development*: CUP Archive.

Gilbertson, J., Dindia, K., & Allen, M. (1998). Relational continuity constructional units and the maintenance of relationships. *Journal of Social and Personal Relationships, 15*(6), 774-790.

Graneheim, U. H., & Lundman, B. (2004). Qualitative content analysis in nursing research: concepts, procedures and measures to achieve trustworthiness. *Journal of Nurse education today, 24*(2), 105-112.

Gratch, J., & Marsella, S. (2004). A domain-independent framework for modeling emotion. *Journal of Cognitive Systems Research, 5*(4), 269-306.

Greer, S., Ramo, D., Chang, Y.-J., Fu, M., Moskowitz, J., & Haritatos, J. (2019). Use of the chatbot "Vivibot" to deliver positive psychology skills and promote well-being among young people after cancer treatment: Randomized controlled feasibility trial. *Journal of JMIR mHealth uHealth, 7*(10), e15018.

Halpern, J. (2007). Empathy and patient–physician conflicts. *Journal of general internal medicine, 22*(5), 696-700.

Harter, S. (1982). A developmental perspective on some parameters of self-regulation in children. *Self-management behavior change: From theory to practice*, 165-204.

Hartmann, B., Mancini, M., & Pelachaud, C. (2005). *Implementing expressive gesture synthesis for embodied conversational agents*. Paper presented at the International Gesture Workshop.

Havens, L. (1988). *Making contact: Uses of language in psychotherapy*: Harvard University Press.

Hoffman, M. L. (2001). *Empathy and moral development: Implications for caring and justice*: Cambridge University Press.

Horsch, C., Brinkman, W.-P., Eijk, R. v., & Neerincx, M. (2012). *Towards the usage of persuasive strategies in a virtual sleep coach*. Paper presented at the The 26th BCS Conference on Human Computer Interaction 26.

Jeffrey, D., & Downie, R. (2016). Empathy-can it be taught? *Journal of the Royal College of Physicians of Edinburgh, 46*(2), 107-112.

Kee, F., Jenkins, J., McIlwaine, S., Patterson, C., Harper, S., & Shields, M. (2003). Fast and frugal models of clinical judgment in novice and expert physicians. *Medical Decision Making, 23*(4), 293-300.

Kowatsch, T., Nißen, M., Shih, C.-H. I., Rüegger, D., Volland, D., Filler, A., . . . Brogle, B. (2017). Text-based healthcare chatbots supporting patient and health professional teams: preliminary results of a randomized controlled trial on childhood obesity. *Persuasive Embodied Agents for Behavior Change (PEACH2017)*.

Krämer, N. C., Lucas, G., Schmitt, L., & Gratch, J. (2018). Social snacking with a virtual agent–On the interrelation of need to belong and effects of social responsiveness when interacting with artificial entities. *International Journal of Human-Computer Studies, 109*, 112-121.

Kraus, S. (2015). *Intelligent Agents for Rehabilitation and Care of Disabled and Chronic Patients.* Paper presented at the AAAI.

Kredlow, M. A., Capozzoli, M. C., Hearon, B. A., Calkins, A. W., & Otto, M. W. (2015). The effects of physical activity on sleep: a meta-analytic review. *Journal of behavioral medicine, 38*(3), 427-449.

Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Journal of biometrics*, 159-174.

Langewitz, W., Denz, M., Keller, A., Kiss, A., Rütimann, S., & Wössmer, B. (2002). Spontaneous talking time at start of consultation in outpatient clinic: cohort study. *Journal of Bmj, 325*(7366), 682-683.

Laranjo, L., Dunn, A. G., Tong, H. L., Kocaballi, A. B., Chen, J., Bashir, R., . . . Lau, A. Y. (2018). Conversational agents in healthcare: a systematic review. *Journal of the American Medical Informatics Association, 25*(9), 1248-1258.

Laver, J. (1975). Communicative functions of phatic communion. *Organization of behavior in face-to-face interaction*, 215-238.

Lisetti, C. L., Yasavur, U., De Leon, C., Amini, R., Visser, U., & Rishe, N. (2012). *Building an On-Demand Avatar-Based Health Intervention for Behavior Change.* Paper presented at the Twenty-Fifth International Florida Artificial Intelligence Research Society Conference.

Looije, R., Neerincx, M. A., & Lange, V. d. (2008). Children's responses and opinion on three bots that motivate, educate and play. *Journal of Physical Agents, 2*(2), 13-20. doi:DOI:10.14198/JoPha.2008.2.2.03

Maatman, R., Gratch, J., & Marsella, S. (2005). *Natural behavior of a listening agent.* Paper presented at the Intelligent Virtual Agents.

Madson, M. B., Loignon, A. C., & Lane, C. (2009). Training in motivational interviewing: A systematic review. *Journal of substance abuse treatment, 36*(1), 101-109.

Malhotra, N. R., Kuhlthau, K. A., Rosoklija, I., Migliozzi, M., Nelson, C. P., & Schaeffer, A. J. (2020). Children's experience with daytime and nighttime urinary incontinence–A qualitative exploration. *Journal of Pediatric Urology, 16*(5), 535. e531-535. e538.

Mamarimbing, S. N. (2021). *The humanistic approach by Erin Gruwell in the freedom writers movie.* Widya Mandala Surabaya Catholic University,

Maternik, M., Krzeminska, K., & Zurowska, A. (2015). The management of childhood urinary incontinence. *Pediatric Nephrology, 30*(1), 41-50.

McDaniel, S. H., Beckman, H. B., Morse, D. S., Silberman, J., Seaburn, D. B., & Epstein, R. M. (2007). Physician self-disclosure in primary care visits: enough about you, what about me? *Archives of Internal Medicine, 167*(12), 1321-1326.

McRorie, M., Sneddon, I., de Sevin, E., Bevacqua, E., & Pelachaud, C. (2009). A Model of Personality and Emotional Traits. In *Intelligent Virtual Agents* (pp. 27-33).

Neff, M., Wang, Y., Abbott, R., & Walker, M. (2010). *Evaluating the Effect of Gesture and Language on Personality Perception in Conversational Agents*, Berlin, Heidelberg.

Norfolk, T., Birdi, K., & Walsh, D. (2007). The role of empathy in establishing rapport in the consultation: a new model. *Medical education, 41*(7), 690-697.

Novielli, N., de Rosis, F., & Mazzotta, I. (2010). User attitude towards an embodied conversational agent: Effects of the interaction mode. *Journal of Pragmatics, 42*(9), 2385-2397.

Ochs, M., Pelachaud, C., & McKeown, G. (2017). A User Perception--Based Approach to Create Smiling Embodied Conversational Agents. *ACM Transactions on Interactive Intelligent Systems, 7*(1), 1-33. doi:10.1145/2925993

Omdahl, B. L. (2014). *Cognitive appraisal, emotion, and empathy*: Psychology Press.

op den Akker, H., op den Akker, R., Beinema, T., Banos, O., Heylen, D., Bedsted, B., . . . Kyriazakos, S. (2018). *Council of coaches a novel holistic behavior change coaching approach.* Paper presented at the 4th International Conference on Information and Communication Technologies for Ageing Well and e-Health, ICT4AWE 2018.

Paiva, A., Dias, J., Sobral, D., Aylett, R., Woods, S., Hall, L., & Zoll, C. (2005). Learning by feeling: Evoking empathy with synthetic characters. *Applied Artificial Intelligence, 19*(3-4), 235-266.

Planalp, S., & Benson, A. (1992). Friends' and acquaintances' conversations I: Perceived differences. *Journal of Social and Personal Relationships, 9*(4), 483-506.

Raval, R. (2020). An Improved Approach of Intention Discovery with Machine Learning for POMDP-based Dialogue Management. *arXiv preprint arXiv:.09354*.

Ravichander, A., & Black, A. W. (2018). *An empirical study of self-disclosure in spoken dialogue systems.* Paper presented at the Proceedings of the 19th Annual SIGdial Meeting on Discourse and Dialogue.

Richards, D., & Caldwell, P. (2017). *An empathic virtual medical specialist: It's not what you say but how you say it.* Paper presented at the 2017 23rd International Conference on Virtual System & Multimedia (VSMM).

Richards, D., & Caldwell, P. (2017). Improving health outcomes sooner rather than later via an interactive website and virtual specialist. *IEEE journal of biomedical health informatics, 22*(5), 1699-1706.

Rojas-Barahona, L., Tseng, B.-H., Dai, Y., Mansfield, C., Ramadan, O., Ultes, S., . . . Gasic, M. (2018). Deep learning for language understanding of mental health concepts derived from Cognitive Behavioural Therapy. *arXiv preprint arXiv:.00640*.

Rossini, N. (2011). Patterns of Synchronization of Non-verbal Cues and Speech in ECAs: Towards a More "Natural" Conversational Agent. In *Toward Autonomous, Adaptive, and Context-Aware Multimodal Interfaces. Theoretical and Practical Issues* (pp. 96-103).

Roth, T. (2007). Insomnia: definition, prevalence, etiology, and consequences. *Journal of clinical sleep medicine, 3*(5 suppl), S7-S10.

Sas, C., Whittaker, S., & Zimmerman, J. (2016). Design for rituals of letting go: An embodiment perspective on disposal practices informed by grief therapy. *ACM Transactions on Computer-Human Interaction (TOCHI), 23*(4), 1-37.

Stafford, L., & Canary, D. J. (1991). Maintenance strategies and romantic relationship type, gender and relational characteristics. *Journal of Social Personal relationships, 8*(2), 217-242.

Theunis, M., Van Hoecke, E., Paesbrugge, S., Hoebeke, P., & Walle, J. V. (2002). Self-image and performance in children with nocturnal enuresis. *European urology, 41*(6), 660-667.

Thibodeau, B. A., Metcalfe, P., Koop, P., & Moore, K. (2013). Urinary incontinence and quality of life in children. *Journal of Pediatric Urology, 9*(1), 78-83.

van Kuppevelt, J., Dybkjær, L., & Bernsen, N. O. (2005). *Advances in natural multimodal dialogue systems* (Vol. 30): Springer Science & Business Media.

Van Welbergen, H., Yaghoubzadeh, R., & Kopp, S. (2014). *AsapRealizer 2.0: The next steps in fluent behavior realization for ECAs.* Paper presented at the International Conference on Intelligent Virtual Agents.

Vogel, D., Meyer, M., & Harendza, S. (2018). Verbal and non-verbal communication skills including empathy during history taking of undergraduate medical students. *BMC medical education, 18*(1), 157.

Warrens, M. J. (2015). Five ways to look at Cohen's kappa. *Journal of Psychology Psychotherapy, 5*(4), 1.

Wispé, L. (1987). History of the concept of empathy. *Empathy and its development, 2*, 17-37.

Xu, J., Ju, D., Li, M., Boureau, Y.-L., Weston, J., & Dinan, E. (2020). Recipes for safety in open-domain chatbots. *arXiv preprint arXiv:.07079*.

Yin, L., Ring, L., & Bickmore, T. (2012). *Using an interactive visual novel to promote patient empowerment through engagement*. Paper presented at the Proceedings of the International Conference on the Foundations of Digital Games.

Zhanghong, X., & Qian, W. (2018). Pragmatic Empathy as a Grand Strategy in Business Letter Writing. *English Language Teaching, 11*(8), 14-27.

Appendices

A1.1 Ethics Approval Letter

The Sydney children's Hospitals Network
care, advocacy, research, education

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6 April 2020

Associate Professor Patrina Caldwell
Nephrology
The Children's Hospital at Westmead

Dear Associate Professor Caldwell,

HREC Reference:	**HREC/18/SCHN/360**
Project title:	**eADVICE (electronic Advice and Diagnosis Via the Internet following Computerised Evaluation), an interactive eHealth program for reducing waiting times in paediatric outpatient clinics**
Site/s:	**The Children's Hospital at Westmead** **Sydney Children's Hospital** **John Hunter Children's Hospital**

I acknowledge receipt of your project amendment submitted 30 March 2020, requesting approval for:

> *We propose to add an additional component to our study. We seek permission to audio-record the virtual clinic conversations at the continence and sleep clinics now being conducted at the Children's Hospital at Westmead (as a response to the Covid 19 crisis) and to use that data to aid our artificial intelligence experts in designing the online conversations that the eADVICE avatar will have with patients.*

The amendment/s was reviewed at the meeting of the Executive Committee of the Sydney Children's Hospitals Network Human Research Ethics Committee (SCHN HREC) at its meeting held on 2 April 2020.

I am pleased to advise that the documents reviewed and approved at the meeting were:

Documents Reviewed	Version	Date
eADVICE-Incontinence Parent Information Sheet for Dialogue	1	30 March 2020
Ethics Amendment Form	-	31 March 2020
Protocol	6	30 March 2020

56

The Sydney
children's
Hospitals Network

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This lead HREC is constituted and operates in accordance with the National Health and Medical Research Council's *National Statement on Ethical Conduct in Research Involving Humans* and the *CPMP/ICH Note for Guidance on Good Clinical Practice*.

This letter constitutes ethics amendment approval ONLY. A copy of this letter must be forwarded to the Research Governance Officer at each site for governance approval.

This application has been assessed in accordance with, and meets the requirements of the National Statement on Ethical Conduct in Human Research (2007).

Should you require any further information, please do not hesitate to contact the Research Ethics Office at SCHN-ethics@health.nsw.gov.au or on (02) 9845 1253.

Yours sincerely,

Associate Professor Sarah Garnett
Chair, Sydney Children's Hospitals Network Human Research Ethics Committee
Sydney Children's Hospitals Network Human Research Ethics Committee

CC: Sana Hamilton