

Dolores: A Mobile Chatbot for People Living with Chronic Pain

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Abstract. We provide an outline of the Dolores chatbot designed to gather data and provide information to people living with chronic pain. Dolores is equipped with selective language levels to provide language appropriate responses for all ages. A recent pilot study (N = 60) of adolescents, young-adults and adults was completed and the frequented topics that were accessed are summarised here.

Keywords. Chronic pain, chatbot, conversation agent, remote monitoring

1. Introduction

As of 2018, 3.24 million Australians were living with chronic pain [1]. While pain is commonly thought of as a symptom resultant from injury or disease, chronic or persistent pain is considered a disease in its own right [2]. The disease presents as a complex, common and expensive health problem [1] and is the main reason people seek medical care [3].

There is limited pharmaceutical treatment options for long-term chronic pain that is beneficial. While opioid based medications offer effective short-term relief, their abuse is becoming problematic particularly in Australia where there are more deaths associated with prescription opioids than heroin, cocaine, or other illicit drugs [1].

Most approaches to the management of chronic pain incorporate psychoeducation or pain neuroscience education as a key treatment component or a stand-alone treatment [4]. Education aims to shift one's conceptualization of pain from that of an indicator of tissue damage or disease to a function of the central nervous system designed to protect the body [5]. Thus, pain education is a clinical tool to facilitate understanding and empower individuals with pain to self-manage their condition [6].

In order to reach a large population with minimal cost, our research efforts are in the development of a chatbot, or more formally conversation agent. Chatbots are computer systems that emulate natural language discourse with additional

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communication modalities such as videos, images, and interactive user-interface widgets. The versatility of these communication modalities enhances the potential application of educational chatbots in healthcare settings across a variety of target populations, ranging from young children to older adults [7]. Chatbot development, however, in any context is arduous, even more so when they operate in the health domain where users are often emotionally vulnerable and have higher rates of suicide ideation compared to a typical population. Responses that are caring, informative and supporting are paramount.

This paper introduces the chatbot *Dolores* that was designed to be utilised across different age groups and language levels for conversing about topics on chronic pain. *Dolores* is built to hold a large repository of evidence-based information (Figure 2) that may be accessed by natural language utterances such as “Why do I feel pain?” in a timely manner.

2. Methods

The chatbot framework used to build *Dolores* is an in-house framework developed at the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia. This framework has been used in other health related chatbots such as *HARLIE* for autism spectrum disorder and Parkinson’s disease [8]. The development processes underpinning our health chatbots have been described previously, in a chatbot for genomic health care delivery [9].

Dolores differs from our other health chatbots in that she is programmed with multiple responses to the same input utterance. The selected response is determined by a case-based reasoner that considers the language setting set by the clinician, the particular utterance and its sentiment, and conversation topic. When *Dolores* doesn’t have a match in her brain, sentiment analysis is used to determine whether to refer the user to a human or request more information.

The design and development of *Dolores*’s brain was collaborative process amongst a group of health professionals (speech therapists, physiotherapists and occupational therapists) who had diverse experiences with clients of different ages including clinical experience within multidisciplinary pain centres. In CSIRO’s previous chatbot development [8,9] the personality of the person entering the data was evident in the chatbot through subtle language cues. We found that users disengaged quickly unless a vibrant and friendly programmer wrote the script. Having clinicians collaborate on the responses for their respective client base provides consistency, portraying the chatbot as a warm conversation partner with a unique personality. *Dolores*’s (uncompiled) brain is a collection of text files organized by topic allowing for easy modification and updating.

Dolores was built to be used as a stand-alone mobile app. *Dolores* generated responses using a combination of speech and written outputs with a “chat bubble” produced as typically seen in a conventional online chatting program. The user could interact with *Dolores* through text, speech, drawing and optional interactive buttons. Screenshots of this is given in Figure 1.

A mind-map of the major topics and anticipated user utterances that make up the ‘brain’ of *Dolores* includes understanding pain and self-management approaches such as exercise, mental health care, diet and alternate therapies (Figure 2).

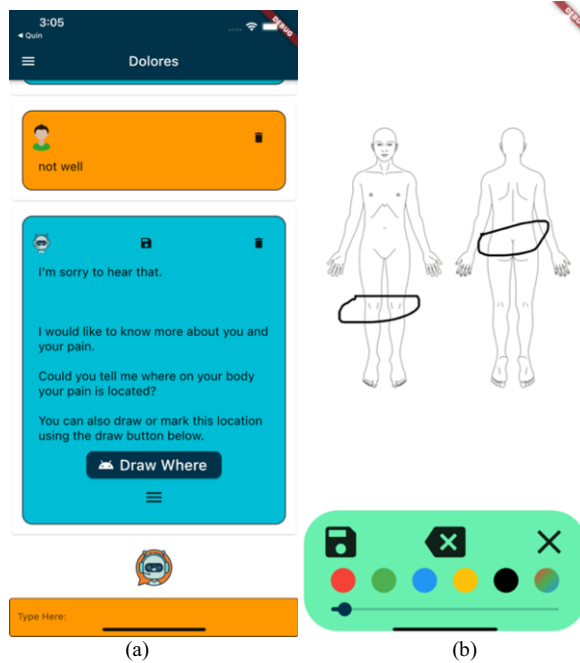


Figure 1. Screenshots of the Dolores chatbot mobile application. (a) Dialogue conversation. (b) Drawing widget with human body overlay allowing the user to indicate where the pain is.



Figure 2. Mind-map of the majority of topics Dolores is programmed with.

A total of 60 individuals with chronic pain who attended an outpatient clinic at a one of two pain centers located in large tertiary hospitals in Australia were recruited. The inclusion criteria for this sample were: 1) persistent non-cancer pain for at least 3 months, 2) 10 years of age and over, and 3) good comprehension of English and clear verbal English skills. Twenty paediatric participants (10-18 years), 20 young adults (19-35 years), and 20 adults (over 35 years of age) with persistent pain were recruited. Consenting participants were taken to a private treating space and given an iPad with the Dolores app installed. Participants then spent 20-30 minutes completing the two interactive chatbot experiences (i.e., the pain history interview and education session).

3. Results

The topics accessed by users in each cohort are shown in Figure 3. Sleep (21/60), exercise (19/60) and mental health (18/60) were the most frequently selected topics for the combined groups. Adolescents accessed the most topics (14) followed by young-adults and adults (9). In adolescents, mental health information (7/20) and understanding (biological) reasons for pain (6/20) were more frequently accessed compared to the other cohorts. Moreover, adolescents selected additional topics that were not accessed by the other cohorts such as bed rest, communicating and helping their clinical pain team, and medications. Young adults and adults accessed sleep (8/20; 11/20, respectively), preventing flareups (4/20; 7/20 respectively) and managing flareups (8/20; 5/20 respectively) more frequently than adolescents. The majority of participants (91%) provided comments about their experience by responding to the open-ended questions.

4. Discussion

Overall acceptability ratings were high across the three age groups and the effect of age group on all acceptability ratings was small and not statistically significant. All negative comments pertained to the quality of Dolores's voice which was perceived as "poor" and "digitized". Each age cohort showed a diversity of topics selected.

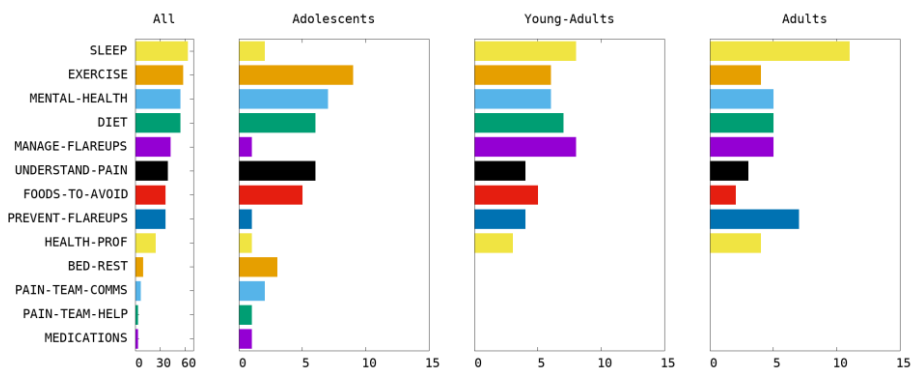


Figure 3. Histogram of the topics accessed for each age cohort.

5. Conclusions

It is apparent a repertoire of mental health information with helpful responses is required for all users, especially adolescents, that is language appropriate for the communication ability of the user. For young and mature adults, information and strategies for better sleep and managing pain flareups is apparent. This body of work will allow prioritization of future development to enable richer and more productive discourse between a person living with chronic pain, their treating clinicians and chatbots such as Dolores.

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