

# A Conversational Agent for an Online Mental Health Intervention

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**Abstract.** This study investigated suitability of chatbots for a mental health intervention, specifically alcohol drinking habits assessment. The target group was young adults 18–25 years, the highest consumers of alcohol per capita in Australia. A chatbot program was developed to perform a standard assessment of alcohol drinking habits (AUDIT-C, 3 items rated on 5-point scale) to determine the level of health risk. Additionally, the chatbot provided information and education on responsible alcohol use, giving recommendations and feedback post-assessment using a pre-populated database of factual response contents. Usability and user-satisfaction were determined by a cohort study of 17 volunteer participants. Overall, the trial indicated strong positive reception of the intervention by users.

## 1 Introduction

Mental health conditions in Australia are on an upward spiral with around 7.3 million or 45 % of Australians aged between 16 and 85 experiencing a common mental health illness such as depression, anxiety or substance use disorder [1]. With mental health illnesses comes many barriers to receiving treatment (such as social stigma) and whilst substance abuse disorders are one of the most common mental health problems in the Western World, there are many individuals not receiving treatment [2].

The prevalence of mental health disorders is the highest in people aged up to 25 years old with 13 % having a substance use disorder [3]. The three common mental health disorders amongst young adults include anxiety disorders which affect 14.4 % of the population, affective disorders affecting 6.2 % and substance use disorders which affects 5.1 %. In Australia, it has been found that the 27 % of 18–25 year old age group suffers a mental health disorder [4]. Alarming a substantial proportion of these young adults consume alcohol at high risk levels.

Comorbidity of mental health disorders and substance abuse is common and the two occur together very frequently while impacting negatively on one another [5]. A common form of comorbidity includes conditions whereby substance abuse issues co-occur with other mental health disorders such as depression, bipolar disorder or anxiety [6].

Online health is a rapidly expanding alternative to orthodox medical consultation for consumers to seek professional health services and advice. In recent years, there has been an increase in the use of interactive real-time online health interventions to improve psychological functioning and well-being of clients [7]. This approach is becoming more widely accepted as it can provide the client with anonymity, security, immediate access to information, reliability and non-biased recommendations.

Conversational agents (such as chatbots and avatars) are an effective means to counteract the barriers for young adults requiring professional treatment and advice relating to mental health illnesses. Conversational agents have existed since ELIZA which was created in 1966 and more recently the ALICEbot which was introduced in 1995 [8]. Conversational agents have been used successfully in a range of areas such as education, information retrieval, business and e-commerce [9]. An example of a chatbot in health has been developed to support interpersonal skills-training components of depression treatment programs [10].

This work is focused on development of a simple chatbot to address substance abuse via alcohol misuse by young adults. Simplicity was a primary criterion, to allow ease of implementation. The chatbot has two main functionalities, namely providing alcohol education and performing an alcohol risk assessment on the user. The risk assessment is based on the three item questionnaire used by therapists internationally known as the AUDIT-C [11], which assesses drinking habits via alcohol consumption levels and frequency of drinking.

The conversational approach by the chatbot accentuates an interview style of questions which in turn has the capability to mimic a pragmatic consultation or session with a health care professional. The assessment is based on an individuals' pre-existing drinking behaviour and on conclusion the chatbot is able to distinguish a persons' level of risk based on their responses. The relevant recommendation and information is then relayed to the user as a form of feedback.

While a chatbot can be seen as convenient, reliable and accessible, our intervention was not designed with the potential or intention of replacing medical practitioners such as counsellors or therapists. Instead, it would more plausibly act as an initial encounter and direct the user to seek medical assistance if they are deemed to be at risk of a mental health illness.

## 2 Methods

The purpose of this research was to investigate whether a simple chatbot can be used as a suitable delivery mechanism for creating an effective online mental health intervention for alcohol abuse. The significance of the chatbot developed here is the approach of logically structuring conversations to allow the user to determine whether they need to seek additional professional advice, as well as providing immediate information to the user. This approach offers a means to limit the barriers which currently exist between an individual and a health care professional as it provides confidentiality, anonymity and a wide array of information and data regardless of the physical location or state of the user [12].

User requirements for the chatbot were determined by an expert panel to be as follows:

- (a) A secure, anonymous and immediate advice and/or information exchange on a users' alcohol related issues which is derived from a trusted and non-biased source;
- (b) A personality whereby the chatbot is seen as a friendly adviser or mentor to the user rather than a therapist or health care professional;
- (c) A unique and logical conversation based on individual inputs;
- (d) A simple means to communicate with an artificially intelligent agent, structuring the conversation to require little input from a user to carry on a conversation.
- (e) A mechanism that provides feedback and/or advice based on their alcohol assessment and web links to relevant government agencies and private organizations for more information on how to seek help with alcohol misuse.

A prototype chatbot was implemented using AIML as for ALICE [13]. The emphasis of the research was on creating a structured conversation that allowed the user to converse with a chatbot in a human-like manner. The chatbot conversation structure was realised in four modules:

- (i) initiating the conversation,
- (ii) providing alcohol education information and advice exchange,
- (iii) performing an AUDIT-C risk-assessment and
- (iv) concluding the conversation.

The overall intention was to test the chatbot competency in achieving acceptable levels of:

- (i) sophistication,
- (ii) structure and flow of conversation,
- (iii) logic and reasoning.

Initiating and concluding the conversation are achieved with simple predefined greeting utterances and questions to determine user name and personal; profile details. The Alcohol Education module would normally be entered first and commences by asking the user to set a topic, after which the chatbot prompts the user to ask a question to which it gives an appropriate response, and then encourages further questions to be asked. Three main alcohol education topics were implemented: Standard Drinks, Managing Drinking and Consequences of Alcohol, as shown in Fig. 1 below.

The Alcohol Risk Assessment module has three core components: (i) brief introduction to the risk assessment; (ii) administering the AUDIT-C questions; and (iii) providing the user with feedback, which are executed sequentially as shown in Fig. 2.

The purpose of the chatbot knowledge base used to manage conversational utterances in this module is to allow the user to receive information on their drinking habits, patterns and possible alcohol misuse after receiving alcohol education. The chatbot has been designed in such a way to make the user feel like the conversation is remembered and that the chatbot is behaving with context awareness. This functionality is achieved by the chatbot performing one of two actions:

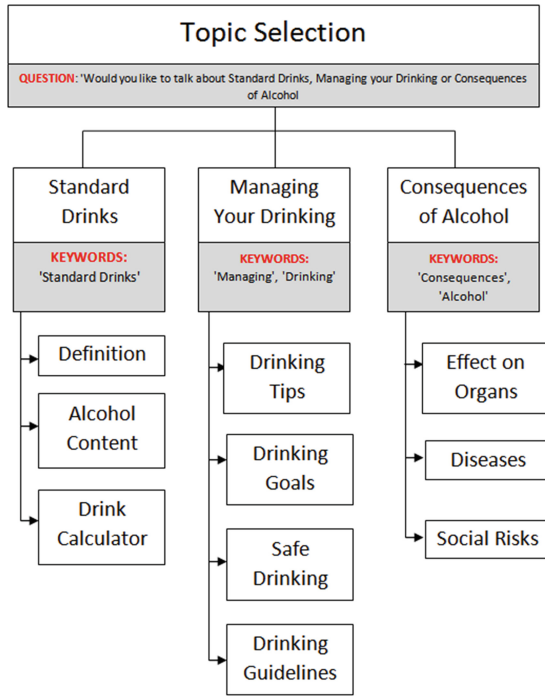


Fig. 1. Alcohol education conversation map

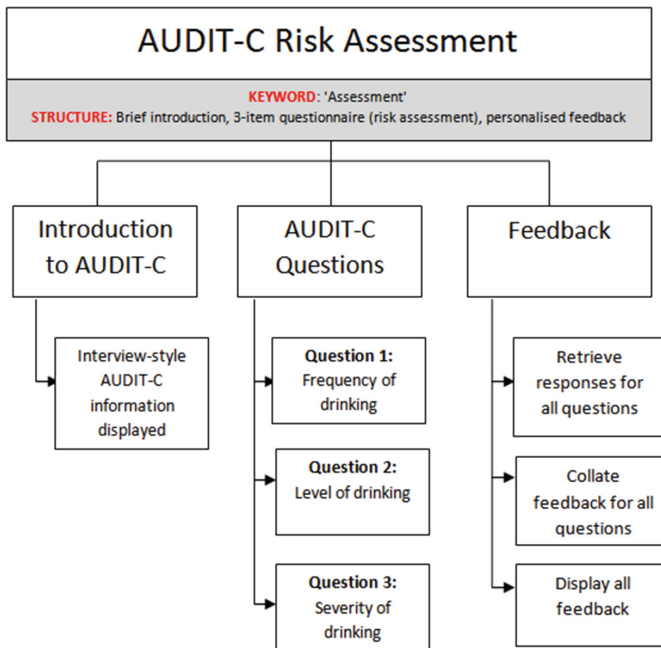


Fig. 2. Alcohol risk assessment conversation map.

- (a) Storing the response the user has given if the chatbot believes it a sufficient answer. This is determined on the basis that the AUDIT-C is a multiple choice questionnaire, thus a sufficient answer will be deduced once the chatbot is able to map a response back to one of the possible multiple choice answers. If this process is successful then the chatbot will prepare and collate the relevant feedback for the response.
- (b) If the answer is not sufficient then the chatbot will attempt to collect the appropriate response from the user. If the question being asked is open ended then the chatbot will clarify that question by re-wording the question in a way that simplifies what is being asked. In contrast, if the question is close-ended then the chatbot will re-pose the question so that the user can re-read what is being asked and then ask them to say 'Yes' or 'No' as their answer. Once this process is complete then step (a) is repeated for the next question and so forth.

### 3 Results

User testing was conducted on 17 participants aged 18–25 (10 male, 7 female) who passed a pre-screening to establish them as low to medium risk (<5 drinks per day). The sample sized was due to availability of volunteers rather than statistical powering, and there was no control group.

Each participant was allocated a 30 min session, with 12 min allocated to user testing based on their interaction with the chatbot. The first step in the user testing process involved introducing the chat interface to the user. The interface of the chatbot is very similar to many interfaces that are commonly used on mobile phones devices and online social media websites. This meant that most users readily understood and accepted how to use it. Next, the user was given a brief demonstration on how the a conversational interaction between the chatbot and individual takes place. This introductory phase took approximately 2 min. Thereafter, the user was allowed to freely interact with the chatbot at their own will. They were given no specific conversations or words to say but instead were told to interact with the chatbot in a way they feel would be suitable for them to use for the purpose of exploring the topic of their alcohol consumption. It was anticipated that they would spend approximately 5 min for the alcohol education part and a further 5 min for the AUDIT-C assessment part. All individuals had the opportunity to ask questions during user testing and interrupt the process if assistance was required.

At the conclusion of the user testing, the individual was then asked to complete an 8 item questionnaire and undergo an interview in the remaining 15 min of the session. The purpose of the questionnaire was to assess the users' overall satisfaction with the chatbot responses in the alcohol education and alcohol risk assessment functions. Additionally, the questionnaire was also designed to investigate the effectiveness of the conversation structure in influencing user satisfaction. The questionnaire was designed based on the well known Client Satisfaction Survey which was created in 1979 to assess client satisfaction with health and mental health services [14]. The questions from the original Client Satisfaction Survey were altered to suit the context of an online

service being delivered in the form of a conversational agent. This was achieved by substituting words from the original survey such as ‘our service’ with the phrases more relevant to the project such as ‘the chatbot’s questions and answers’.

Interviews were undertaken after the questionnaire completion and allowed further information to be gathered on the users’ level of satisfaction with the chatbot. There was an emphasis placed specifically on determining any elements that contributed to dissatisfaction in the chatbots’ conversation structure. The interview was structured with four questions:

*Question 1:* The level of user satisfaction, including what aspects of the conversational agent influenced satisfaction or dissatisfaction.

*Question 2:* The overall experience with using the chatbot in terms of the terminology and conversational reasoning/understanding; this includes identifying and explaining any undesirable results and/or outcomes that the chatbot may have produced during the user testing.

*Question 3:* The degree of simplicity and ease of use of the chatbot; this includes user friendliness, terminology and navigating through the conversation.

*Question 4:* To provide any suggestions and/or comments on how to improve the chatbot conversational structure and ability to converse.

User responses to the questionnaire are summarised in Table 1, and when converted to positive-high scores on a 4 point scale, the corresponding statistics are shown in Table 2. As can be seen, user satisfaction is generally high (mean 3.29–3.76) and

**Table 1.** Questionnaire results summary

Responses				
	Excellent	Good	Fair	Poor
Q1	12	9	0	0
Q2	No, definitely	No, not really	Yes, Generally	Yes, Definitely
	0	0	13	8
Q3	Almost all needs	Most needs	Only a few needs	None of my needs
	15	5	1	0
Q4	No, definitely	No, I don't think so	Yes, I think so	Yes, Definitely
	0	2	9	10
Q5	Quite dissatisfied	Indifferent or mildly dissatisfied	Mostly satisfied	Very satisfied
	0	0	6	15
Q6	Yes helped great deal	Yes helped somewhat	No they didn't really help	No they seemed to make things difficult
	8	11	2	0
Q7	Very satisfied	Mostly satisfied	indifferent/mildly	quite dissatisfied
	15	6	0	0
Q8	No definitely not	No I don't think so	Yes I think so	Yes, Definitely
	0	2	11	8

**Table 2.** Questionnaire results statistics

Responses	Mean	Std	Variance
Q1	3.57	0.51	0.26
Q2	3.38	0.50	0.25
Q3	3.67	0.58	0.33
Q4	3.38	0.67	0.45
Q5	3.67	0.48	0.23
Q6	3.29	0.64	0.41
Q7	3.76	0.51	0.26
Q8	3.29	0.64	0.41
<b>Total</b>	<b>3.55</b>	<b>0.57</b>	<b>0.33</b>

consistent (std 0.50–0.67), but an absolute conclusion on the significance of these values cannot be drawn without controls. It is also not possible to validate the accuracy of the AUDIT-C assessment in this case.

The overall results of the interview are shown in Table 3 and have been grouped using topic analysis into four categories: professional as it provides confidentiality, anonymity and a wide array of information and data regardless of the physical location or state of the user [12].

**Table 3.** Interview results summary

All Participants Interview Topic Analysis				
Keywords and topics				
Positives	Negatives	Comments	Suggestions	
Knowledge base was informative	Too much information	Personalisation was Good	Suggestion Pictures	
15	5	2	2	
Simple-Guided Conversation	Conversation caused confusion	Humanlike Conversation	Recognising more keywords	
15	3	5	6	
Quick Response Time	Undesirable Interface	Reliability and Accuracy	Suggestion Voice Recognition	
8	5	3	1	
Clear to comprehend	Incorrect/Inappropriate Response	Simple Language		
4	1	9		
Ease of use				
4				

- (a) *Positives*: these are any factors that were mentioned by participants as elements of the chatbot that contributed to user satisfaction;
- (b) *Negatives*: these are any factors that were mentioned by participants as elements of the chatbot that produced undesirable effects and contributed to user dissatisfaction;
- (c) *Comments*: these are general comments which have been made by participants;
- (d) *Suggestions*: these are any suggestions that participants offered to improve the usability, reliability or accuracy of the chatbot.

It can be seen that there is good agreement with the findings of the questionnaire, with many strong positive reasons offered for user satisfaction. However a major source of user dissatisfaction was the nature of the user interface: users were frustrated by the need to type their utterances rather than speak naturally: this could be overcome by a speech recognition interface variant. Some users criticized the inability of the chatbot to recognize different keywords that those with which it had been programmed, and more generally that there was too much information, resulting from use of the highly structured conversation maps. This would require a far more sophisticated artificial intelligence approach to be used to drive the system, such as reinforcement learning or natural language processing.

## 4 Conclusion

The intention of the trial was not to determine the accuracy of the assessment or measure subsequent behaviour change, rather it was to assess the suitability of having a relatively real and believable conversation with a simple online chatbot as a human surrogate for a health professional. Overall, the trial indicated positive reception of the intervention by users and that availability of chatbot variants with different behavior and sophistication in their conversational ability would further enhance user satisfaction and perceived usefulness. Further work could explore this more complex modeling of the conversational agent's reasoning. In addition, a larger sample size and inclusion of controls would enable richer statistical analysis.

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