ArguMessage: A System for Automation of Message Generation using Argumentation Schemes

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Abstract. This paper describes a system that uses argumentation schemes and limited user input to automatically generate persuasive messages that encourage behaviour change. We have used this system in the domain of healthy eating, but are also exploring its use in other domains such as behaviour change for cyber-security. The argumentation schemes used have been selected and amended by mapping them to Cialdini's principles [5].

1 Introduction

Individuals are increasingly recognising the importance of healthy eating and its effects on well-being. However, many find it difficult to eat healthily, leading to negative outcomes such as diabetes and obesity. Personalised messages have previously been shown to impact on positive health behaviour, and so may be used to promote healthy eating habits [8]. Researchers have investigated the personalisation of messages by adapting which of the widely used Cialdini principles of persuasion should be applied [4, 6]. The number of Cialdini principles is limited, and so the question arises as to whether the far more detailed and structured logical statements commonly used in everyday dialogue, i.e., argumentation schemes, could be used to provide finer-grained personalisation.

In our previous studies [4], we manually created and validated[2] messages for each Cialdini principle (which was extremely time consuming). Since argumentation schemes have a definite structure with easily modifiable variables, it may be easier to automate the process of message creation after the initial validation of message types. In addition, variables can be substituted with alternatives that can help in building a large corpus of messages that can be used by, for example, intelligent healthy eating trainer software. Our primary research objective is to automate personalised persuasive messages that will be able to sustain behaviour change. This could be achieved by incorporating Cialdini's principles of persuasion [1] and argumentation schemes [7, 11]. In this paper, we illustrate the system build on the basis of the mapped argumentation schemes.

2 Related work

Cialdini's Principles and Argumentation Schemes. The six principles of persuasion formulated by Cialdini [2] were Reciprocation; Commitments and Consistency; Social Proof; Liking; Authority; and Scarcity. In our previous studies [4] we decided to exclude Reciprocation and Scarcity from the follow-on studies. Only 2 Reciprocation messages validated with Kappa $\geq$ 0.4, and these were positive and negative framings of different message contents, making them hard to use for comparison in follow-on studies. Whilst 4 Scarcity messages validated with reasonable agreement (Kappa $\geq$ 0.4), none validated with Kappa $\geq$ 0.7. Additionally, both these principles are difficult[3] to use in a healthy eating persuasive context. Table 1 illustrates the four remaining Cialdini principles.

Table 1: Four Cialdini's Principles [3]

Cialdini's Principles	Description
Commitments and Consistency (COM)	"It is easier to resist at the beginning than at the end". When a person makes a dedication, he or she will experience individual and social strains to act in accordance with that initial choice.
Social Proof (SOC)	"Where all think alike, no one thinks very much". People confirm what is acceptable by knowing what others believe as acceptable.
Liking (LIK)	"The main work of a trial attorney is to make a jury like his client". We are likely to comply to requests put forward by the ones we recognise and like.
Authority (AUT)	"Follow an expert". The symbol of power linked to a person will make people adhere to their advises.

Argumentation schemes [11] are rules leading from assumptions to conclusions that are often found in everyday dialogues. Some schemes provide extremely strong support for their conclusion (such as deductive inference). However, many schemes are defeasible; if the assumptions hold, then the scheme conclusions are *probably* true, but exceptions to the conclusion do exist. This latter type of scheme is increasingly used in artificial intelligence and intelligent system applications [10].

3 Implementation

3.1 Background

The mapping of Cialdini's principles to the argumentation schemes is summarised in Table 3. We developed a message generation system using this mapping as its foundation. Given below is an explanation of one of the argumentation schemes [5].

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[2] Over 150 participants classified the messages into the six principles and the Free-Marginal Kappa [9] was used to validate how effectively (1 complete agreement, 0.7-1 exceptional agreement and 0.4-0.7 reasonable agreement) our messages were classified. A message's Kappa had to be greater than 0.4 for a reasonable classification.

[3] Reciprocation is hard to apply in a system, as it requires a plausible favour and Scarcity may not be plausible in real life.

Major Premise	**Actor A** is committed to **Commitment C** according to **Goal G**.
Minor Premise	When **Actor A** is committed to **Commitment C**, it can be inferred that **Actor A** is also committed to **Action N** which contributes to **Commitment C**.
Conclusion	**Actor A** is committed to **Action N**.
Message Structure	As **Actor A** wants to achieve **Goal G**, **Actor A** is committed to **Commitment C**. So, **Actor A** is also committed to **Action N** as it helps **Actor A** achieve **Commitment C**.

Table 2: Argument from commitment with goal, and corresponding message.

Table 3: Cialdini's Principles Mapping to Argumentation Schemes [5]

Cialdini's Principles	Argumentation Schemes
Commitments and Consistency	Argument from commitment with goal Practical reasoning with goal Argument from waste with goal Argument from sunk cost with action Argument from values with goal
Social Proof	Argument from popular opinion with goal Argument from popular practice with action
Liking	Practical reasoning with liking Practical reasoning with goal and liking Argument from position to know with goal and liking
Authority	Argument from expert opinion with goal Argument from rules with goal Argument from position to know with goal Argument from memory with goal

Argument from commitment with goal. This scheme states that the proposed "action" supports the "actor" in fulfilling a "goal" they committed to previously. In the domain of healthy eating, this scheme can be used to encourage users to commit to a positive healthy eating "action" backed by their previous "commitment". The generated message is developed using a message structure created for each argumentation scheme, as demonstrated in Table 2 for the "argument from commitment with goal" argumentation scheme.

To create automated messages for the argument from commitment with goal scheme, we needed to describe a specific"commitment", "goal" and "action" for the "actor" who would be the intended subject of the message. Our aim is to crowd-source such messages, and our system therefore — as shown in Figure 1 — presents a user with a sample message using the message structure, and poses questions to instantiate the scheme's variables. In this argumentation scheme (see Figure 1), we asked three questions:

Q1. What is the goal of the user?
A. The goal of the user is to _____. This provides the input for Goal G.
Q2. What is the user therefore committed to do?
A. The user is committed to _____. This provides the input for Commitment C.
Q3. What specific action contributes to achieve this commitment?
A. The user should _____. This provides the input for Action A.

To instantiate the variables appropriately, the user's answers are required to be in a verb form. To achieve this, we provided the user with the first part of the answer (e.g., stating that "The goal of the user is to . . . " for Question 1).

The Appendix illustrates the remaining 13 argumentation schemes, and the questions for the users along with the answer structures that we have developed.

3.2 Using the system

We intend to use the system within a set of user studies. The participant is presented with the summary of the study instructions which states that they required to generate a total of three messages with three "recipes" (argumentation schemes) by answering some questions that provide the input for generating messages. Next, they are shown the explanation of a "recipe" . This is followed by a set of questions which require a small amount of participant input to generate the message. An example of the completed participant inputs is shown in Figure 1. Then, the participant presses the 'Create Message' button, which takes them to the second step which shows the generated message. In this case the message generated would be "As you want to improve skin texture, you are committed to consume sources rich in Vitamin C and potassium. So you're also committed to consume fruits such as kiwis and bananas as it helps you to consume sources rich in Vitamin C and potassium". The system uses template-based natural language generation to produce these messages. Participants provide their level of satisfaction with the message generated on a 5-point Likert scale that ranges from not satisfied to totally satisfied. In addition, they may provide detailed feedback, as input to further improve the system. When the participant presses the 'Submit' button, they are taken to the next randomly selected recipe. The same process is repeated to generate a set of three messages per participant in total.

4 Future work

We will conduct studies with lay people; argumentation scheme experts; and domain experts (e.g., dieticians) to generate a corpus of messages using the developed system, and investigate the extent to which the system makes it easy to produce good messages. We will validate the messages produced with argumentation scheme experts, to check they correspond to the argumentation schemes used to generate them. Next, the pre-validated messages will be validated as 'well-advised' or appropriate in discussions with the domain experts. Finally, we will investigate the perceived persuasiveness of these messages with respect to different types of user, to form the basis of personalized message algorithms. The latter extends the work we conducted in [4] to investigate the impact of personality on persuasiveness of messages produced from Cialdini's principles.

Whilst our initial research was focussed on the healthy eating domain, the system and the messages it generates can also be used in other domains. For example, we have started to apply it in the behaviour change for cyber-security domain [3]. The argumentation schemes used in the system are all adapted from [11]. Given Walton et al.'s schemes are mostly developed for general purposes, it is likely that domain specific argument schemes can be proposed for use by

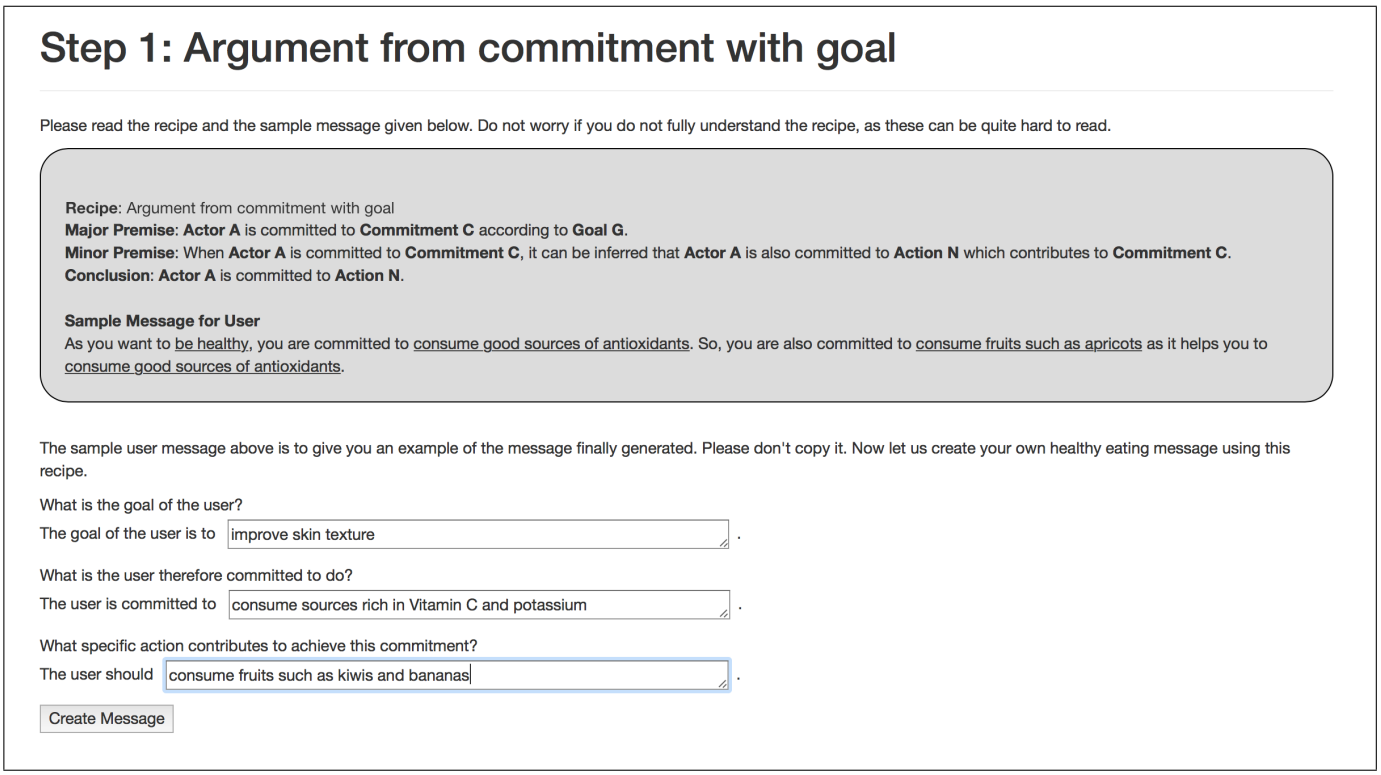

Figure 1: Explanation of argumentation scheme and questions

the proposed system. So, schemes specifically for healthy eating and cyber-security could be developed and incorporated.

The system is currently only used to generate individual persuasive messages. These messages could then be used by a dialogue system. This raises interesting questions on how to pick the best next argument.

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Appendix

The tables below illustrates the remaining argumentation schemes and the questions.

Table 4: Practical reasoning with goal

Major Premise	**Actor A** has **Goal G**.
Minor Premise	Carrying out **Action N** is a means to realise **Goal G**.
Conclusion	Therefore, **Actor A** ought to carry out **Action N**.
Message Structure	If **Actor A** performs **Action N**, it helps **Actor A** to achieve **Goal G**. So, **Actor A** ought to do this.

Table 5: Questions

Practical reasoning with goal
1. What is the goal of the user?
A. The goal of the user is to _____.
2. What is the desired action from the user?
A. The user should _____.

Table 6: Argument from waste with goal

Major Premise	If **Actor A** stops trying to realise **Goal G** now, all of **Actor A**'s previous efforts to realise **Goal G** will be wasted.
Minor Premise	If **Actor A**'s previous attempts to realise **Goal G** are wasted, that would be a bad thing.
Conclusion	Therefore, **Actor A** ought to continue trying to realise **Goal G**.
Message Structure	If **Actor A** stop trying to achieve **Goal G** now, all **Actor A**'s previous efforts will be wasted. Therefore, **Actor A** ought to continue trying to do that.

Table 7: Questions

Argument from waste with goal
1. What is the goal of the user? A. The goal of the user is to _____.

Table 8: Argument from sunk cost with action

Time T1	Time of **Actor A**'s commitment to **Action N**.
Time T2	Time of **Actor A**'s confrontation with the decision whether carry out **Action N** or not.
Major Premise	There is a choice at **Time T2** between **Action N** and not-**Action N**.
Minor Premise	At **Time T2**, **Actor A** is pre-committed to **Action N** because of what **Actor A** did or committed to at **Time T1**.
Conclusion	Therefore, **Actor A** should choose **Action N**.
Message Structure	**Actor A** has a choice whether or not to perform **Action N**, however **Actor A** was committed to do so earlier. So, **Actor A** should choose to **Action N**.

Table 9: Questions

Argument from sunk cost with action
1. What did the user commit to do? A. The user is committed to _____.

Table 10: Argumentation from values with goal

Major Premise	**Value V** is positive as judged by **Actor A**.
Minor Premise	The fact that **Value V** is positive affects the interpretation and therefore the evaluation of **Goal G** of **Actor A**.
Conclusion	**Value V** is a reason for **Actor A** retaining commitment to **Goal G**.
Message Structure	If **Actor A** achieves **Goal G**, it will help **Actor A** to realise **Value V**, which is regarded as positive by **Actor A**. This justifies that **Actor A** should achieve **Goal G**. Therefore, **Actor A** should retain **Actor A**'s commitment to it.

Table 11: Questions

Argument from values with goal
1. What does the user regard as important in their life? A. The user regards to _____ as important in their life. 2. What is the goal of the user that is related to the above? A. The goal of the user that is related to the above is to _____.

Table 12: Argument from popular opinion with goal

Major Premise	**Actor A** has **Goal G**. **Action N** is generally accepted as contributing to **Goal G**.
Minor Premise	If **Action N** is generally accepted as contributing to **Goal G**, that gives a reason for **Actor A** to do **Action N**.
Conclusion	There is a reason for **Actor A** to do **Action N**.
Message Structure	It is generally agreed that if **Actor A** performs **Action N**, this will help **Actor A** to achieve **Goal G**. So, **Actor A** should perform **Action N**.

Table 13: Questions

Argument from popular opinion with goal
1. What is the goal of the user? A. The goal of the user is to _____. 2. What is the action taken by the user achieve their goal? A. The user should _____.

Table 14: Argument from popular practice with action

Major Premise	**Action N** is a popular practice among **Actor B**.
Minor Premise	If **Action N** is a popular practice among **Actor B**, that gives a reason for **Actor A** to think that **Action N** is acceptable.
Conclusion	Therefore, there is a reason for **Actor A** to accept **Action N**.
Message Structure	**Actor B** performs **Action N**. **Actor A** should therefore do likewise.

Table 15: Questions

Argument from popular practice with action
1. What is a popular good practice? A. A popular good practice is to _____.

Table 16: Practical reasoning with liking

Major Premise	**Actor B** will appreciate it if **Actor A** carries out **Action N**.
Minor Premise	Carrying out **Action N** is a means to realise **Actor A**'s affinity towards **Actor B**.
Conclusion	Therefore, **Actor A** ought to carry out **Action N**.
Message Structure	**Actor A**'s **Actor B** will appreciate it if **Actor A** performs **Action N**. So, **Actor A** ought to do that.

Table 17: Questions

Practical reasoning with liking
1. Who does the user like? A. The user likes their _____. 2. What action should the user undertake to gain appreciation from that person? A. The user should _____.

Table 18: Practical reasoning with goal and liking

Major Premise	**Actor A** has **Goal G**. **Actor B** will appreciate it if **Actor A** realises **Goal G**.
Minor Premise	Carrying out **Action N** is a means to realise **Goal G** and **Actor A**'s affinity towards **Actor B**.
Conclusion	Therefore, **Actor A** ought to carry out **Action N**.
Message Structure	If **Actor A** performs **Action N** it helps **Actor A** to achieve **Goal G** and **Actor A**'s **Actor B** will appreciate it. So, **Actor A** ought to do that.

Table 19: Questions

Practical reasoning with goal and liking
1. What is the goal of the user? A. The goal of the user is to _____. 2. What is the desired action from the user to help achieve their goal? A. The user should _____. 3. Who does the user like? A. The user likes their _____.

Table 20: Argument from position to know with goal and liking

Major Premise	**Actor A** has **Goal G**. **Source S** is in position to know about things in a certain **Domain D** containing **Action N** which contributes to **Goal G**.
Minor Premise	**Source S** asserts that **Action N** will attain **Goal G**.
Conclusion	There is a reason for **Actor A** to do **Action N**.
Message Structure	**Actor A**'s **Source S** suggests that **Actor A** performs **Action N** to achieve **Goal G**. So **Actor A** should follow **Source S**'s suggestion.

Table 21: Questions

Argument from position to know with goal and liking
1. What is the goal of the user? A. The goal of the user is to _____. 2. Who is the experienced person liked by the user to help achieve their goal? A. The experienced person is their _____. 3. What do they recommend? A. The user should _____.

Table 22: Argument from expert opinion with goal

Major Premise	**Actor A** has **Goal G**. **Source S** is an expert in **Domain D** containing **Action N** which contributes to **Goal G**.
Minor Premise	**Source S** asserts that **Action N** will attain **Goal G**.
Conclusion	There is a reason for **Actor A** to do **Action N**.
Message Structure	**Source S** recommends that **Actor A** performs **Action N** to achieve **Goal G**. So **Actor A** should follow **Source S**'s recommendation.

Table 23: Questions

Argument from expert opinion with goal
1. What is goal of the user? A. The goal of the user is to _____. 2. Who is the professional with expertise in this field? A. The professional is a _____. 3. What do they recommend? A. The user should _____.

Table 24: Argument from rules with goal

Major Premise	**Actor A** has **Goal G**. If carrying out types of actions including **Action N** is the established rule for helping to achieve **Goal G**, then, A must carry out **Action N**.
Minor Premise	Carrying out types of actions including **Action N** is the established rule for helping to achieve **Goal G**.
Conclusion	**Actor A** must carry out **Action N**.
Message Structure	**Actor A** should perform **Action N** since it is an established rule that helps to achieve **Goal G**.

Table 25: Questions

Argument from rules with goal
1. What is the goal of the user? A. The goal of the user is to _____. 2. What action according to an established rule helps to achieve the goal of the user? A. The user should _____.

Table 26: Argument from position to know with goal

Major Premise	**Actor A** has **Goal G**. **Source S** is in position to know about things in a certain **Domain D** containing **Action N** which contributes to **Goal G**.
Minor Premise	**Source S** asserts that **Action N** will attain **Goal G**.
Conclusion	There is a reason for **Actor A** to do **Action N**.
Message Structure	**Source S** suggests that **Actor A** performs **Action N** to achieve **Goal G**. So **Actor A** should follow **Source S**'s suggestion.

Table 27: Questions

Argument from position to know with goal
1. What is goal of the user? A. The goal of the user is to _____. 2. Who has personal experience to help the user achieve their goal? A. The experienced person is a _____. 3. What do they recommend? A. The user should _____.

Table 28: Argument from memory with goal

Major Premise	**Actor B** recalls **Action N** contributed to **Goal G**.
Minor Premise	Recalling that **Action N** that contributed to **Goal G** is a clear reason for **Actor A** to believe **Action N** is good.
Conclusion	It is reasonable for **Actor A** to believe **Action N** is good.
Message Structure	**Actor A**'s **Actor B** recalls that **Action N** helped **Actor B** to achieve **Goal G**. So, **Actor A** should believe that **Action N** is good.

Table 29: Questions

Argument from memory with goal
1. Who does the user know? A. The user knows their _____. 2. How did they achieve that goal? A. They achieved that goal by _____. 3. What goal was achieved by that person? A. The goal achieved by that person was _____.