A dialogue game for multi-party goal-setting in health coaching

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Abstract. Goal-setting is a frequently adopted strategy in behaviour change coaching. When setting a goal, it is important that it is understood and agreed upon by all parties, and not simply accepted as-is. We present here a dialogue game for multi-party goal-setting, in which multiple health coaches can contribute in order to find a goal that is acceptable to both the patient, and the coaches themselves. Our proposed game incorporates three important aspects of goal-setting and health coaching, (1) coaches can query each other's proposed goals, (2) the patient takes ownership of the goal, and (3) the patient themselves can propose goals.

Keywords. Medical dialogue, coaching, dialogue game, formal dialectical systems

1. Introduction

One of the aims of health coaching is to bring about *behaviour change*; for instance, encouraging a patient to adjust their diet, give up smoking, or perform more daily physical activity. A common strategy to bring about behaviour change is *goal-setting* [1,2], where healthcare professionals and/or specialised coaches attempt to motivate the patient into making the change by suggesting, revising and ultimately agreeing manageable goals.

A key feature of goal-setting is *commitment* – that is, goals must be understood and agreed upon if they are to be effective. It is not sufficient to simply give someone a goal and expect them to achieve it; a discussion should take place to ensure the goal is mutually acceptable. From a dialogical point of view, such discussions are akin to negotiation in the Walton & Krabbe typology [3], but will also contain elements of persuasion (especially in the context of behaviour change [4,5]), and possibly other dialogue types.

We present in this paper a dialogue game in which two or more health coaches can work together with a patient in arriving at an acceptable goal for that patient. The proposed game is motivated by examples extracted from simulated consultations between health professionals and patients, combined with principles of commitment and goal ownership from health coaching and goal-setting theory. The game has subsequently been implemented in Dialogue Game Description Language (DGDL) [6], and will be initially deployed within a technical demonstrator for the *Council of Coaches* project [7].

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2. Background and motivation

2.1. Health coaching

One of the biggest challenges in health care is the increasing average age of the population [8]. With the possibility to treat more and more illnesses, there are also more people that live while suffering from one or more chronic illnesses for a longer period of time. Coaching people towards a healthy lifestyle can serve as an effective means of preventing or delaying chronic illnesses, or to improve the quality of life for those who have them. With limits to the health care personnel available, providing cost-effective access to support for everyone can be a challenge, which is where e-coaching applications can be a useful addition.

Successful coaching solutions should be able to cope with complex reasoning and argumentative structures, as the underlying theories and strategies are often equally complex in nature. Behaviour change techniques such as the goal-setting theory [1] form a fitting example, but many different approaches exist [2] and are applied in various e-coaching applications used to coach people towards healthier lifestyles. The domain is also not limited to snacking, as the concept of e-coaching is applied to many different target domains and end-users. Examples of user types include the elderly [9], and chronic conditions such as diabetes type 2 or COPD [10], while common application domains include physical activity [11], healthy eating [12], or even a combination of domains, such as the Council of Coaches approach, which is the context of this work [7].

2.2. Dialogue and argumentation

The use of dialogue and argumentation in the context of doctor-patient interactions has been widely studied (see e.g. [13], or [14] for an overview of the area). From a dialogical standpoint, doctors and patients commonly employ persuasion in an attempt to convince each other [15,16]; however goal-setting, where the aim is to arrive at a goal all parties find acceptable [1,2], has more obvious parallels with negotiation dialogues, where the aim is to arrive at a deal with each participant aiming to get the best out of it for themselves [3]. There are nevertheless certain key differences between the two.

Firstly, formalisms and computational implementations of negotiation dialogues generally focus on negotiating over outcomes, such as in [17]. In goal-setting, the participants negotiate over a goal. Goals differ from an outcomes insofar as while a goal might be agreed, it isn't yet carried out, whereas when an outcome is agreed, it is an immediate consequence of the dialogue. Secondly, similar to dialogues found in domains such as dispute mediation [18], there is an asymmetry in the roles in goal-setting, where a layperson (in the present work, the patient) is negotiating with experts (the coaches). Finally, there is a fluidity of roles in a goal-setting dialogue. At the outset, there are parties representing two sides: the patient, and (as a collective) the coaches. As the dialogue progresses, however, a coach might effectively swap sides by openly challenging a goal proposed by another coach. While in some negotiation contexts this might be seen as a weakness, in goal-setting it is a strength because it demonstrates a willingness to arrive at the best outcome for the patient, and includes them as an equal in the negotiation.

3. Patient Interviews

Consider the following truncated excerpt from a transcript of a simulated session between a patient, Kate, and two health coaches. Note that these simulated sessions involved real healthcare professionals in consultation with a patient portrayed by an actor, playing to a specified persona. The professionals were instructed to behave as they would normally with a real patient so as to make the collected data as close to real as possible.

> ***Colin (motivation coach):*** *"Okay, so you don't see any relation between your low-carb diet and your blood sugars dipping?"*
> ***Kate (patient):*** *"Is this your way of trying to get me to take carbs?"*
> ***Barbara (diet coach):*** *"Maybe more focus should be put on the types of carbohydrates we're having rather than whether we have them in our diet or not... wholemeal granary breads, wholemeal pasta, wholemeal rice, beans and pulses."*
> ***Kate:*** *"Now, that's something I would try...beans and pulses"*

This is a relatively straightforward exchange where Colin has previously suggested to Kate that she eat more carbohydrates to try and stabilise her blood-sugar levels. Kate, being on a "low-carb" diet, is wary of doing this. Barbara therefore proposes alternative foods that incorporate a different type of carbohydrate; Kate accepts trying beans and pulses. At a more general level, this demonstrates a goal being proposed, the patient expressing uncertainty, causing the goal to be revised then accepted. Important to the acceptance is the patient taking ownership of the goal — they, without further prompting, chose a specific goal from a list of options.

In some coaching scenarios, it isn't necessarily the patient that challenges a proposed goal; instead, it is another coach. Consider the following excerpt from a different simulated session between a patient, Linda, and two health coaches:

> ***Linda (patient):*** *"But I'd probably have two [chocolate bars] a day and I just sort of crave that sugar rush...I look forward to that."*
> ***Jane (diet coach):*** *"...if you're having that at the same time every day, what you're developing there is a habit. And don't get me wrong, habits are pretty easy to develop, but actually to break them is a really, really tricky thing."*
> ***Alan (general practitioner):*** *"So, are you suggesting...you just cut [chocolate bars] out? Because that seems a bit harsh!"*
> ***Jane:*** *"It does seem a little bit harsh, I suppose...we could have a discussion about what would be a realistic target for [Linda]."*

Here, Linda has revealed that she eats two chocolate bars a day; Jane, her diet coach, has implied that she might be able to give up chocolate completely; Alan, a general practitioner, challenges this, prompting Linda to reconsider the goal. This is an example of a coach sympathising with the patient by querying the advice of another coach.

These two exchanges provide short examples of goal-setting in practice, and while they are taken from different sessions with different patients and coaches, they could realistically occur in a single coaching session; consider the following constructed example:

> ***Helen (patient):*** *"I eat snacks at the same time every day."*
> ***Florence (diet coach):*** *"That's a habit that should be easy to break."*

Ben (diabetes coach): *"Are you suggesting she stop eating snacks? That seems harsh!"*
Florence: *"It does seem a little bit harsh; we can discuss a realistic target."*
Helen: *"Is this your way of trying to get me to stop snacking?"*
Florence: *"Maybe look at the types of snacks...you can have healthy snacks such as nuts, apples, carrots and protein shakes that are still tasty and filling."*
Helen: *"Now, apples, that's something I would try."*

This exchange combines the two previously illustrated aspects of coaching: a coach expressing concerns about another coach's proposed goal, with new goals being suggested; and the patient taking ownership of the goal. In e-coaching, where the coaches are virtual, AI-driven agents, it is important to be able to accurately replicate dialogues such as this, to ensure a realistic and engaging experience for the user.

4. A dialogue game for health coaching

4.1. General description

We present in this section the formal specification for our proposed dialogue game. The structure of the game is motivated by the examples dialogue excerpts provided in Section 3, with certain minor modifications designed to ensure a realistic dialogue flow. The first of these modifications is the assignment of a *Lead Coach*, who takes the initiative by proposing an initial goal for the patient. The second is that we allow a patient to themselves revise a goal proposed by the coaches. This is justified by the principle of a patient ultimately needing to take ownership of a goal; explicitly suggesting their own revision, instead of relying on those suggested by the coaches, reinforces this ability.

Following the proposal of a goal, the patient can either accept it outright, or express uncertainty. Following acceptance, the dialogue terminates; where an agent is unsure, a more sophisticated stage of the dialogue commences, where the coaches and the patient engage in a discussion aimed at arriving at a goal agreeable to both parties (the patient, and the coaches as a collective).

4.2. Participants

The participants in a coaching dialogue consist of the Patient (P), and a set of coaches (χ), where a single $C \in \chi$ is designated as the "Lead Coach" (LC). The Lead Coach is the coach whose expertise is most closely aligned with the specific issue for which a goal is currently being determined[2]; for instance, a goal related to activity a coach with sports expertise (e.g. a fitness coach, activity coach, etc.) would be designated the Lead Coach.

Coaches, as autonomous agents, will have access to a shared knowledge base, containing general information about the patient, and their own individual knowledge base, containing specific information in their domain of expertise. These knowledge bases will also contain rules that allow valid justifications and revisions to be determined.

Henceforth, we refer to the Patient as P and the Lead Coach as LC. When referring to any coach *including* the Lead Coach we use $C \in \chi$; when referring to any coach *excluding* the Lead Coach we use $C \in \chi \setminus \{LC\}$.

[2]We assume that a "pre-dialogue" takes place that leads to this designation being made.

LR1	$C \in \chi$ can justify a goal (*Justify*), revise a goal (*Revise*), challenge a goal (*Challenge*), or accept a goal (*accept*): 1. $Justify(g,r)$ when they justify the goal g with reason r 2. $Revise(g,g')$ when they revise the goal g to new goal g' 3. $Challenge(g)$ when they challenge a goal g proposed by another coach, or the patient 4. $Accept(g)$ when they accept a goal g proposed by a patient
LR2	*LC*, in addition to those locutions available to all coaches, can propose a goal (*Propose*): 1. $Propose(g)$ when they propose the goal g
LR3	*P* can accept a goal (*Accept*) and be unsure about a goal (*Unsure*): 1. $Accept(g)$ when they accept a goal g 2. $Unsure(g)$ when they are unsure about a goal g 3. $Revise(g,g')$ when they revise the goal g to a new goal g'

Table 1. Locution rules

4.3. Locution rules

The type of moves that participants can perform are defined by the locution rules, which are provided in Table 1. Individual locutions are composed of two elements: the propositions (or propositional contents), indicated by lowercase letters, and the illocutionary force. These are represented by a function of type $IllocForce(content(,content))$.

All coaches can justify, revise and challenge goals, while the proposing a goal is restricted to the Lead Coach only. We impose this restriction because it allows the Lead Coach to take charge of the conversation, given they have been allocated to that role based on their expertise in the subject under discussion.

4.4. Commitment rules

Commitment stores are a useful way of detecting when consensus on an issue has been reached [3]. In the present work, commitment stores allow the patient and coaches to determine when a proposed goal is acceptable to both the patient and the Lead Coach.

Two commitment stores are used in the dialogue game: one for the patient, denoted CS_P, and one for the coaches as a collective, denoted CS_χ. We choose a single commitment store for the coaches because while one coach can potentially challenge a goal proposed by another, it is still necessary for all coaches to ultimately be in agreement; thus the commitment store represents everything to which coaches are jointly committed. The commitment rules are shown in Table 2.

In general, a goal that is proposed or put forward as a revision of a previous goal is added to that speaker's commitment store; a goal that is challenged or revised is removed from that speaker's commitment store (in both cases counting coaches a collective).

4.5. Structural rules

The structural rules for the dialogue game are shown in Table 3. A dialogue begins with *LC* proposing a goal that the *P* should aim to achieve (SR2). *P* can accept the goal outright, or express uncertainty over it (SR3). If the goal is accepted, the dialogue successfully terminates[3]; if uncertainty is expressed, the dialogue progresses.

[3]We permit this because if the patient is prepared to outright accept a goal proposed by the Lead Coach, it would be counter-intuitive for another coach, less knowledgeable in the area, to question that goal.

CR1	Following a $Propose(g)$ by LC, $g \in CS_\chi$
CR2	Following a $Justify(g,r)$ by $C \in \chi$: $r \in CS_\chi$ and $r \rightarrow g \in CS_\chi$
CR3	Following a $Revise(g,g')$ by $C \in \chi$: $g' \in CS_\chi$ and $g \notin CS_\chi$
CR4	Following a $Challenge(g)$ by $C \in \chi$, $g \notin CS_\chi$
CR5	Following an $Accept(g)$ by $C \in \chi$, $g \in CS_\chi$
CR6	Following an $Accept(g)$ by P, $g \in CS_P$
CR7	Following a $Revise(g,g')$ by P, $g' \in CS_P$

Table 2. Commitment rules

SR1	All players can perform only one move per turn
SR2	LC moves first with $Propose(g)$
SR3	After LC performs $Propose(g)$, P can perform: (1) $accept(g)$, or (2) $Unsure(g)$
SR4	After P performs $Unsure(g)$, $C \in \chi \setminus \{C_1\}$, where C_1 is the (possibly Lead) Coach to whom P responded, can perform: (1) $Challenge(g)$; or C_1 can perform (1) $Justify(g,r)$
SR5	After $C \in \chi \setminus \{C_1\}$ performs $Challenge(g)$, where C_1 is the (possibly Lead) Coach to whom the challenge is aimed, C_1 can perform: (1) $Justify(g,r)$, or (2) $Revise(g,g')$
SR6	After C_1 performs $Justify(g,r)$, $C \in \chi \setminus \{C_1\}$ can perform: (1) $Challenge(r)$, or (2) $Revise(g,g')$; or P can perform: (1) $Accept(g)$, or (2) $Revise(g,g')$
SR7	After $C \in \chi$ performs $Revise(g,g')$, P can perform: (1) $Accept(g')$, or (2) $Unsure(g')$; or $C_1 \in \chi \setminus \{C\}$ can perform: (1) $Challenge(g')$
SR8	After P performs $Revise(g,g')$, $C \in \chi$ can perform: (1) $Accept(g')$, or (2) $Revise(g',g'')$

Table 3. Structural rules

Where P expresses uncertainty over the goal, LC can justify the goal, or another coach (C) can themselves challenge it (SR4); LC can then justify or revise the goal (SR6). Where a goal is justified, another coach can subsequently challenge the justification, or revise the original goal (SR7). Should a coach revise a goal, P can, as with a proposed goal, accept outright, or express uncertainty over the revision, or another coach can challenge it (SR8). If P revises a goal, a coach can either accept it, or revise it again (SR9).

4.6. Termination, turntaking and outcome rules

A goal-setting dialogue can terminate at any time, regardless if a goal has been accepted by the patient or not. Informally, we impose a constraint that a dialogue cannot terminate if P is the last speaker — in other words, a coach will always respond to what the patient says. This constraint will be enforced at the application-level, rather than at the logical-level. Turntaking will also be managed at the application-level because determining who should speak (when permitted to do so) will be influenced by the precise context of the dialogue. For instance, where the user and a coach both have valid moves, the coach may only decide to speak after first giving the user the opportunity to do so.

The outcome of a goal-setting dialogue is determined by whether or not a goal is accepted both by the coaches (collectively) and the patient, as shown in Table 4. Acceptance (non-acceptance) is determined by the presence (non presence) of the goal in either commitment store. Since the patient can chose to terminate a dialogue at any time, it is possible for a dialogue to terminate without the user accepting a goal. Depending on precisely when the dialogue terminated, this can take one of two forms – either the coaches accept a goal that the user did not, or the user accepts a goal that the coaches did

Outcome	Conditions
Goal (g) agreed	$g \in CS_P$ and $g \in CS_\chi$
Goal (g) not agreed	$g \notin C_P$; and/or $g \notin C_\chi$

Table 4. Outcome rules

not (insofar as the coaches did not have an opportunity to agree with a goal suggested by the patient).

5. Conclusions and future work

We have in this paper proposed a formal dialogue game for multi-party goal-setting in the context of health coaching. Motivated by examples from semi-real coaching sessions and based on the goal-setting theory, we presented a specification that allows a patient and a council of virtual coaches to engage in a dialogue aimed at mutually-agreeing an acceptable goal related to their health.

While the proposed game has similarities to traditional negotiation dialogues, it incorporates two key differences. First, there is an asymmetry in the roles, with a lay patient negotiating with expert coaches. Second, the game allows one coach to challenge a goal proposed by another, despite both ostensibly being on the same side of the negotiation. The game has been implemented in the Dialogue Game Description Language (DGDL) [6] and will be used in technical prototypes in the *Council of Coaches* project.

In future work, we will investigate an extension to our proposed game that permits the patient to outright reject a goal, rather than merely expressing uncertainty. This would in turn would trigger a sub-dialogue in which the coaches would ascertain the patient's reasons for the rejection and, if appropriate, seek to persuade the patient to reconsider. We will also investigate further scenarios in health coaching, and in turn develop dialogue specifications that model interactions found in these scenarios. *Pre-dialogues* between coaches, which lay the groundwork for the main dialogue with the patient, will also be explored. These pre-dialogues take place without the user and will involve identifying the Lead Coach for a coaching session, and, importantly, developing a joint coaching strategy towards a successful dialogue outcome. Investigating these strategies, and how to model them computationally represents a further direction for future work. Furthermore, we will perform full user evaluations to ensure that the dialogue models are natural and generate outcomes that are consistent with user expectations.

Overall, the game specified in this paper represents a crucial first step towards the development of dialogue models that realistically reflect interactions between patients and health coaches, and lays a foundation for the development of a platform for autonomous multi-party health coaching.

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