Generation Of Multi-Party Dialogues Among Embodied Agents To Promote Active Living And Healthy Diet For Subjects suffering from Type 2 Diabetes Based On Theories Of Behavior Change And Behavior Change Techniques

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ABSTRACT

Diabetes Mellitus is a chronic condition that is showing a rise in numbers in terms of prevalence and incidence across both the developed and developing countries of the globe. The condition also contributes towards other detrimental ailments such as cardiovascular diseases, blindness and gangrene in the foot region.This calls for health measures that would enable a proactive, self-management of the condition and aid the individual to lead a normal life and prevent further progression of Diabetes. With the advancements in the Internet and Internet of Things which has led to the development of e-health, the concept of personalized virtual coaching is being looked into. Since the concepts of being proactive and self-management are being discussed to cope with Diabetes, it is necessary for the individuals to feel inspired, motivated and actively involve themselves in the optimal decision-making process for the betterment of their health.
The work done during the course explores the mitigation factors that would control Diabetes Mellitus. It was found out that an active living and a good diet are the corner stones in the treatment of this condition. Thus the Theories of Behavior Change through the Behavior Change Techniques are being applied to motivate the individuals to improve or change their lifestyle and(or) diet. The objective of the course is to develop dialogues based on the Theories of Behavior Change and Behavior Change Techniques, among embodied conversational agents who would play the role of various coaches focusing on virtual user-centric coaching to motivate the users to adopt a healthy lifestyle and diet.
Keywords: Diabetes Mellitus, Behavior Change Techniques, Embodied Conversational Agents, Virtual Coaching,e-health

Introduction

Background

With the advancements in Internet of Things and mobile phone industry, e-health has and continues to gain a lot of momentum. e-health can be perceived as a platform that uses Information and Communication Technology(ICT), to enable health or health care delivery at the local and global level[1]. Recent research indicates that e-health applications have the potential to enhance self-management and aspects such as provider-patient communication and provider efficiency[2]. Self-management of maladies which includes Cardiovascular Diseases, Age related pain which could progress into a lasting condition and stroke to name a few can be classified as chronic conditions. e-health applications can be used for enabling proactive and preventive care which are essential for the self-management of a chronic condition. By using ICT to enable health care, there is a positive effect on medical costs and health care utilization[3].

Diabetes Mellitus

The scenarios of chronic conditions are increasing in the developing nations. The chronic maladies are contributing to the increasing mortality and morbidity rates in the low and middle income countries[4]. Diabetes Mellitus is a classification of a chronic malady. The condition is considered to be chronic because the effects of this condition are long lasting. A classification scheme has been proposed by the American Diabetes Association. The classification can be viewed as four sub-classes: Type 1 Diabetes Mellitus, Type 2 Diabetes Mellitus(T2DM), other special type of diabetes and gestational diabetes[5]. T2DM is characterized by insulin resistance and relative insulin deficiency. T2DM can be seen as the outcome of ineffective use of

insulin. T2DM was formerly known as adult onset diabetes.

Because of the association of high blood glucose levels with this condition, Diabetes can be a determinant in causing maladies such as cardiovascular problems, stroke, blindness, kidney failure, and leg amputation[6]. Hence it is highly crucial to treat the condition of Diabetes and control the progression of the condition. To start the treatment at the correct phase, the diagnosis of the condition is important. It is highly recommended to have Diabetes screening programs[7]. T2DM in specific is associated with obesity, older age, physical inactivity and family history of Diabetes.

Effects of physical exercise and good dietary habits on Diabetes

As mentioned in the above section, obesity and physical inactivity are common determinants of Diabetes. People facing the problem of being overweight are often at a high risk for developing the condition of Diabetes. Considerable research has been implemented in the treatment options for Diabetes. Physical exercise along with medication and good nutrition have proven to be effective in controlling this chronic condition[8].Hence it can be concluded that a good exercise management system is a cornerstone in the treatment and controlling of the condition.The exercises involved can be grouped into four groups: endurance type, passive, resistance and aerobic type exercise.

- **Endurance type Exercise**:It involves delivering the oxygen to the muscles via the cardiovascular system and large group of muscles are involved in the process.
- **Passive type Exercise**: This form of exercise includes an outside force or another person or some other part of the subject's body produces a voluntary effect.
- **Resistance type Exercise**: These exercises are performed against resistance.The exercise depends on the equipment. Weight Lifting is an example of this form of exercise. The main effects of this exercise include the reduction in resistance to insulin and improved glucose control. Additional benefits include the increase of muscle strength and bone mineral density which would help in preventing conditions like osteoporosis. Overall, this exercise is highly recommended for the aged population as it improves the insulin sensitivity in them.
- **Aerobic type Exercise**: These set of exercises include activities such as walking, running, rowing, swimming,cycling and skipping. This type of exercise improves the blood-glucose levels, glycemic control and the lipid profile. Also, the consumption of oxygen is improved thus having a positive effect on the working of an individual's cardiovascular and respiratory system[8].

All these exercises have the capacity to alter the body metabolism actions associated with Diabetes Mellitus especially with T2DM[8].

Along with an active lifestyle, diet also plays a role in the control of obesity and the glucose level regulation. It is highly necessary that a person diagnosed with Diabetes avoid frequent consumption of unhealthy foods containing sugar or excess oil and excessive consumption of alcohol should be avoided as well[9]. For subjects suffering from T2DM, low calorie intake is a critical factor which plays a significant role in controlling the progression of the condition. The calorie levels plays a significant role in the improvement of insulin sensitivity and and in reducing the weight. The latest research indicates that an individualized diet including the consumption of carbohydrates and high fiber is the characteristic of an healthy diet for a subject with T2DM[10].

State of the Art Technology

Diabetes, a chronic condition is seen to be increasing in significant numbers. Diabetes UK, has reported that 1 out of 20 people are living with diagnosed or undiagnosed Diabetes[2]. Because of the rising prevalence, even the budget spent on this chronic condition is rapidly increasing[11].

Self-management is the key to keeping Diabetes under control. Advancements have been made in the area of Lab-On-Chip devices which can be perceived as point-of-care devices that the subjects can use in the comfort of their homes to monitor their glucose and insulin levels and to administer themselves with the insulin dosages[12].The advent of the monitoring of glucose and insulin is a major breakthrough in the field of monitoring this condition. Hospital Information Systems use the combination of patient data and smart technologies, to send reminder texts at the correct time so that the subject does not forget to take meals and medications on time which is very crucial in the case of Diabetic patients.This can be viewed as an instance where the real-time data of the patient is getting monitored from a remote location and the required feedback gets sent to the patient at appropriate time intervals. There are mobile applications and devices which help in monitoring the physical activity of the individual, an example would be the popular Fitbit which tracks the number of steps covered. This device can be seen as an instance of wearable smart technology. Electronic Diary is also popular in this respect. It helps the user to keep track of the diet which is useful to monitor the calories consumed or the amount of sugar-based foods consumed. These ideas aims to induce a behavior change in the user and improves the self-efficacy as well[11,13].

Embodied Conversational Coaches

Lot of studies and research have been conducted and applied in the area of human media interaction and virtual world. It is a known adage that man is a social animal. The term social mainly revolves around the aspect of communication. As mentioned in the previous sections, Diabetes is a malady with which millions of people are living and trying to cope across the world. Therefore receiving of actual personal care for this condition is an highly impossible task. The reason for this is simple and can be attributed to the low ratio of physicians or providers of Diabetic Care to the people living with Diabetes. These days, the actual personal care is replaced by virtual care. This virtual care can be administered through e-health and the associated sub-sets. Reminder text-messages or videos explaining a health condition can be seen as instances of communication with the user. Online forums where various people talk about their health conditions, health remedies are also a form of virtual communication or interaction.

Embodied Conversational Agents(ECAs) are used in the field of Human Media Interaction where the agents can be viewed in the form of virtual characters. These ECAs are having the critical role of engaging the users[14]. The use of ECAs to promote social skills have been tested in areas such as Autism kids and geriatric people with cognitive impairments[14,15].

The ECAs can be used as a a part of the e-coaching to promote better physical activity and nutrition among the subjects and can play a significant role in developing a successful e-health intervention.

The main objective of this paper is to illustrate the Dialogue development which would induce an effective coaching based on the principles of the Theories of Behavior Change and BCTs.

Methods

Theories of Behavior Change

During the course of the work, the theories which would help in bringing about a behavior change were studied. These theories were later used in choosing the BCTs. The collective use of BCTs is to bring about an intervention which would be inducing the desired behavior. For a diabetic patient, a desired behavior would be to use the stairs instead of the elevator. Here the undesired behavior gets changed to desired behavior. In writing the dialogues, which is the main objective the undesired behaviors, the desired behavior and the BCTs were looked into.

The theories used in the dialogues are: Goal Setting Theory, Social Cognitive Theory,Protection Motivation Theory, Information Motivation and Behavioral Skills Model and Health Belief Model.

- **Goal Setting Theory**- is used to relate between a task performance of the individual and the individual's conscious goal(intention). This theory works via four main mechanisms: choice, efforts, persistence and strategy. There are two core factors that should be kept in mind while setting the goal since it will have an effect on the task performance, that is the difficulty level and the specificity of the set goal[16].

- **Social Cognitive Theory**- This theory claims that human behavior is motivated and regulated through self-regulation. Social Cognitive Theory is built of three sub processes: self-monitoring, self-judgment and self-reaction. This theory is integral for highlighting the concept of self-efficacy which is related to the individual's will to exercise control over their behavior and surrounding environment[17,18].

- **Protection Motivation Theory**- This theory explains the reason behind the engagement of unhealthy practices by the people and further suggests ways for changing the behavior. There are two processes that are explored through this theory: Threat(fear appeal) and coping mechanism. This theory provides an educational as well as a motivational aspect. There are two types of prevention this theory targets, the primary prevention which focuses on taking measures that are directly related to the risk of developing an health problem and then the secondary prevention targets at adopting measures that prevent further deterioration of an existing condition[19].

- **Information Motivation and Behavioral Skills Model**- This model was formulated to reduce the risk behaviors associated with the HIV/AIDS condition. The model has stated three factors that have a role in influencing the adoption of the behaviors that reduce the risk of incurring HIV/AIDS. These factors are available information about the topic, motivation to change the behavior and the availability of the behavioral skills that would be needed to perform the required activities. Using the components information and motivation go hand in hand because knowing what a healthy behavior is and how it positively contributes towards a better health would produce a motivation to change the detrimental behavior to a desired behavior[20].

- **Health Belief Model**- This model was developed based on the understanding that an individual would be willing to take an action towards a better health if he feels that this step would be avoiding a negative health condition, has a

positive expectation and that the suggested action can be successfully taken up by him/her. This model also contributes to improving the self-efficacy of the individual[21].

All the above mentioned theories of behavior change can be used as a base to develop the dialogues among the coaches and between the coaches and the diabetic subject.

Behavior Change Techniques

Based on the theories, the BCTs will be chosen from the latest BCT Taxonomy[22]. Many of the BCTs that is being chosen can directly be linked to the above mentioned theories. For example, the BCTs chosen from the group Goals and Planning can be related to the Goal Setting Theory.Similarly few of the BCTs chosen Feedback and monitoring group can be linked to the Social Cognitive Theory, such as Self-monitoring of behavior and Self-monitoring outcome of behaviors.

The BCTs chosen for improving the physical activity and diet of an individual largely belong to the groups of Goal Setting and Planning which aims at setting realistic goals for the individual taking into consideration their current state of health and mind and the problem at hand. Many BCTs are chosen from feedback and monitoring such as Bio-feedback or Self-monitoring of behavior because ideas such as diary tracker, weight measurements are being incorporated in the dialogues. Other than these even BCTs related to Social Support where the family member would be helping the subject has been chosen and BCTs such as Habit Formation, Habit Reversal and Graded tasks have also been chosen[22].

For the course of this work, the ECAs discussed above will take on the role of coaches who has expertise and competence in the area of nutrition, physical fitness and a voluntary worker who is living a normal and healthy life with the condition of Diabetes. Also, to promote a conducive environment to the user(affected individual), the role of a family member has also been considered when developing the dialogue sets. The coaches will communicate verbally, that is they talk with the user based on the user's response thus keeping the user engaged[23]. The role of coaches provide health information with the objective of helping the user lead a healthy life but at the same time they will not provide a feeling of a clinical or a hospital setting to the user(subject).

The main objective is to design the dialogues that are understandable to the user and are easy to use. The dialogues generated should not give the user a feeling that he or she is in a really bad health or that there in a clinical setting to receive help. This has been kept in mind while developing the conversation. The Dialogue sets are discussed in the following section.

Results

The Theories of Behavior Change and the BCTs discussed under the section of Methods are the cornerstones on which the dialogue development has been implemented. The dialogues are written to promote the interaction among the ECAs and between the ECAs and the subject(user). The main objective of the dialogues is to motivate the subject to be physically active and adopt a healthy diet which in turn would result in preventing further progression of T2DM.

For the purpose of the generation of dialogues, three ECAs have been created who would be providing a virtual coaching to the subject. The virtual coaches have expertise in physical exercise and fitness training or are nutritionists. The third ECA is a volunteer who is also a diabetic subject but is dealing with the condition in a successful manner. The former two coaches have been selected because they would be able to provide the coaching in an manner that would not intimidate the subject but at the same time have the positive effect on the subject. Here, the positive effect would be, becoming physically fit and adopting a healthy diet. This would result in reduction of weight in obese subjects which is closely linked to T2DM. A character of volunteer has been chosen so that the volunteer would be able to relate to the subject's condition and weakness, the weakness could be an instance of not being able to give up on sweets and give suggestions accordingly. There is a high chance that the volunteer would be able to empathise with the subject's state of mind and provide the suggestions based on his/her experience. Also, the very presence of a volunteer who is going through the same condition as the subject can create an inspiration and be a cause of motivation to the subject.

In addition to the feature of virtual coaches, a family member(spouse) can also be a part of this coaching module. Since the spouse would be well aware of the subject's condition this option has been considered.

Based on the Theories of Behavior Change, BCTs and the ECAs, five dialogue sets were developed. The first dialogue set focuses on promoting physical activity in the subject. The virtual characters in this set have taken up the role of exercise trainer and exercise counselor. The second dialogue set also focuses on the pursue of physical activity but here along with the exercise trainer, even the volunteer and the spouse is present during the coaching. The third dialogue set has been developed to promote the adoption of healthy diet. Here, there are two virtual characters involved in the coaching process, the volunteer and the nutritionist. The fourth dialogue set which emphasises on a healthy diet adopts only one coach, who is the nutritionist and the spouse is also present during the coaching. In the fifth dialogue set, the dialogues are written combining both the goals

of pursuing the physical fitness and adopting a healthy diet. In the dialogue set, even the volunteer is involved but no family member is present.

In the below dialogue instances, a brief illustration of the interaction between the subject and the coach(exercise trainer/nutritionist) is provided. The BCTs used in the dialogue generation process is also mentioned. In the five dialogue sets, the BCTs used at particular instances are different but the overall theories of behavior change used across all the five dialogue sets are the same.

Subject(with Diabetes): I am not much into exercising. I have never been to a gym. Twice a week I walk for about 2 Kms to go to the market.
Exercise Counselor: I would suggest you to start off by walking. Everyday go for a brisk walk for at least an hour. This would really do you good. Also, use the stairs instead of the lift.

From this dialogue instance, it can be seen that BCTs such as Habit Reversal, Habit Formation, Goal Setting(Behavior) and Action Planning have been used to educate the user about how an active physical lifestyle can be adopted through simple steps.

Subject(Diabetic): I am not able to stick on to the diet plan that you had made and I am not able to cut on the junk food.
Nutritionist: You are not the first to be facing this issue but you need to understand that reducing on junk food is a necessity.

From this dialogue instance,it can be seen that BCTs such as Commitment, Goal Setting(Behavior), Goal Setting(Outcome), Discrepancy between current behavior and goal have been used to discuss the outcomes of the desired behavior.

The complete dialogue sets with the the applied BCTs and theories can be referred to in the section of Appendix.

Discussion

The dialogue sets have been developed for the target population with T2DM Diabetes, male and female, belonging to the age group of 45 to 55 years. While studying the exercises, that would be suitable for patients with T2DM, it was found out that Resistive and Aerobic type of exercises were suitable. In the dialogue sets the main emphasis has been given on the aerobic type exercises since it is applicable for the cardiovascular and respiratory issues as well thus promoting a more holistic wellbeing. With respect to the diet, the dialogues focus on motivating the user to avoid junk food and replacing that with other healthier foods.

The BCTs chosen for the dialogue sets are predominantly selected from the groups: Goals and Planning, Feedback and Monitoring and Social Support. To a large extent,the dialogues have been designed in a manner that only the affected individual can manage the condition without much help from the surrounding people. For this reason, BCTs such as prompts/cues,reduce prompts/cues and remove access to the reward has not been used. Also, it can be seen that in the dialogues, prompts such as social comparison and information about other's approval belonging to belonging to the group of comparison of behavior has not been used because it did not really feel as a proper manner to induce motivation considering that this is a health condition that is being targeted. BCTs such as satiation, exposure and associative learning were not integrated in the dialogue sets because these BCTs use the principle of making the person experience a habit that a person really enjoys or is addicted to. In the case of oily or sugary food, this might not be such a good idea because it might have a negative condition on the condition itself.

The dialogues were designed in such a way that users belonging to the age group of fifty plus will be able to understand it. It has been designed in a simple fashion. Another highlight of the dialogue is that it does not make the user feel that he is sick or ill. The dialogues are written in such a way that the user should feel empowered to tackle Diabetes by not feeling threatened by it. The words used in the dialogues are not scientific or more importantly medical in nature, they have been developed so that the user does not feel intimidated by the condition or his current health state.

While considerable research has been done in the areas of virtual coaching, user-centric coaching and embodied conversational agents, creating a multi-party (coaches) dialogue system goes beyond the current state of the art technology and can be seen as a novel method. During the course of this work, the dialogues generated could not be tested in a lab setting or in a real-time setting. So the next obvious step would be to do a prototype testing which should ideally include potential users who are the stakeholders here. This is really necessary so that the actually functionality of the dialogues can be measured that is evaluated from the user perspective. Based on the outcomes of this user evaluation the dialogues could be modified to further enhance the functionality.

As a part of the prototype testing process, features such as how motivated the user felt and whether they could actually reach their goals such as the weight reduction aspect should be looked into. The idea of involving a volunteer who is also diabetic is a unique feature and the popularity of this role can be tested. The coaches in the dialogue sets are both male and female. As a

part of the testing, the effectiveness of the dialogues delivered by these coaches can also be looked into. To implement this, as a starting step a questionnaire could be developed which would assess the effectiveness, understanding of the dialogues and the functionality of the coaches. To test the feasibility and functionality of the dialogues, only five dialogue sets were developed. Based on the success rate of the dialogue sets, more number of following or modified dialogues can be developed for more different user types.

The method of adopting a multi-party dialogue system based on Human Media Interaction and ICT, does definitely have a potential in the area of user-centric virtual coaching. So, this idea can be translated to other chronic conditions such as age related pain and de-addiction programs for smoking. This method of using the BCTs along with the ECAs through the ICT application setting for a promotion of better health and self-management of the condition can be seen as a step towards acheiving personalized e-coaching thus covering up an aspect of a successful e-health application.

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Appendix

For the purpose of this course, 5 dialogue sets were created, where the subject suffering from T2DM is advised to lead a healthy life through the adoption of an active living and a healthy nutritious diet. The council comprises of people who are in the role of exercise trainers, nutritionist and people who are already living with the condition and know sufficient information to help the subject. The dialogue sets are attached here, with the BCTs and theories of behavior change highlighted.

DIALOGUE SET1

ROLES INVOLVED

A: Senior Exercise Trainer (Male)
B: Exercise Counselor (Female)
C: Patient (Female, about 45 years)

C: Hello A and B, recently I have come to know that I have type II diabetes and I am worried about it.
B: That is a matter of concern but do not worry about it. Diabetes can be controlled through healthy eating and regular exercise.(BCT- Problem Solving)
C: Yes. That is what I have heard from my doctor. I want to know more about how exercising can control Diabetes.
A: Sure C. We can help you with that. But first, we need to know about how comfortable you are in performing exercises.(BCT-Action Planning)
C: Umm. I am not much into exercising. I have never been to a gym. Twice a week I walk for about 2 Kms to go to the market.
A: Okay. C, you should realize that from now regular exercise should be a part of your everyday schedule. This will play a great role in controlling the Diabetes.(BCT-Goal Setting(behavior))
B: A, maybe we could start off by recommending the exercise routine that we had developed for Mrs X who has been visiting us for the last two months.
A: Yes B. That would be a good idea.
A: C, I would suggest you to start off by walking. Everyday go for a brisk walk for at least an hour. This would really do you good.(BCT-Goal Setting(behavior), Action Planning)
B: Yes C, A is right. Also, from now on take the stairs instead of the lift.(BCT-Habit Reversal)
C: Okay. And if I may ask, how will this control my condition?
A: That is a good question!. Walking is an aerobic type exercise and this helps in improving the insulin sensitivity and also in controlling the BP.(BCT-Feedback on outcome of behavior)

C: Okay. I will stick to this schedule. I will note down the number of miles and the time taken in a diary. How long should I stick to this schedule?
B: Maintaining a diary is a really good idea. It will give a clear picture about where you stand. You could visit us again in two weeks.(BCT-Self-monitoring(behavior),Action Planning, Goal-Setting(outcome))
C: Okay. See you guys !.
A: Bye C. Take care.

Theories involved:
Health Belief Model, Social Cognition Theory, Information-Motivation and Behavioral Skills Model, Goal Setting Theory, Protection Motivation Theory. In, the whole dialogue set, the usage of these theories is seen. Based on these theories of behavior change, the BCTs have been chosen.

Note:
There is a possibility that C might say that she might not be able to follow these instructions. She might say that, these plans might not have an influence.
Then the trainers could respond by saying, that the condition would only worsen and the subject might have high risk of developing cardiovascular diseases, glaucoma or Diabetic Retinopathy (pictures of these conditions could be shown).
Here, the theories of Health Belief Model and Information motivation behavioral skill model would be used. The BCTs involved would be Information of health consequences and salience of consequences.

DIALOGUE SET 2

ROLES INVOLVED

D: Exercise Counselor (Male)
E: Volunteer who is also diabetic (Female)
F: Family member: Wife (Female)
A: Patient (Male, about 45 years old)

D: Hello A, how have you been?
A: Hello D. I am doing good although, I have some concerns with the exercises that you had told me to follow.
D: Is it? What is the problem?
A: You had suggested that I go to the gym and I was going. But in the gym, I was asked to lift weights and I found it really difficult and soon gave up going.
D: Oh. That is not good. But wasn't the trainer there with you to monitor your progress? (BCT- Discrepancy between current behavior and goal, Self- monitoring (behavior))
A: Umm. Not really. He just comes and goes.
F: Also, we are checking his weight everyday at home and there is not really much of improvement.(BCT-Self-monitoring(behavior))
E: D, maybe A is not really suitable for the resistive exercise. Maybe you could recommend him some aerobic exercises?(BCT- Problem Solving, Action Planning)
A and F: What is that and how are they different?
D: Lifting weights is a resistive exercise. Along with increasing insulin sensitivity it also improves your resistance to conditions like osteoporosis.(BCT-Information about health consequences)
E: Resistive exercises are machine dependent while aerobic exercises include walking, swimming and cycling and they have equally good effect in managing Diabetes.
A: Okay. E, was it beneficial to you?
E: Yes. Of course. I started off going on brisk walks and then proceeded to cycle. Within a few weeks there was a good difference in my weight. I had lost 5 Kilos.(BCT-Goal Setting (behavior))
F: That sounds really promising. A, I think even you should put a number on the weight loss.
A: Yes. I will do that. I guess, I could start with 5 kilos as wells.
D: Good A, I would suggest that you follow what E has said and additionally I think you and F should do this together. I feel that, it would help you to stay motivated. This strategy has helped a lot of my clients.(BCT- Goal Setting(behavior), Goal Setting(outcome), Action Planning, Social Support(buddy),
Social Support(unspecified))
A: Okay. We will do this.

F: Yes D. In addition, I think it would help us if we were to maintain a journal to record all the details.
D: Yes. That would be great. We will discuss the progress in our next session.(BCT- Feedback, Self-monitoring(behavior),Self-monitoring(outcome)
E: Good luck A!.
A: Thank you. See you.

Theories involved:
Health Belief Model, Social Cognition Theory, Information-Motivation and Behavioral Skills Model, Goal Setting Theory, Protection Motivation Theory. In, the whole dialogue set, the usage of these theories is seen. Based on these theories of behavior change, the BCTs have been chosen.

Note: I could start off by reducing 8 kilos in 1 month by walking for 3 hours a day and cycling for 1 hour a day-A(subject) might say this being over-enthusiastic and over concerned.
The exercise counselor could respond by saying that the subject can start with 1 hour of walking and half an hour of cycling for a week and then slowly increase the number of hours for these activities after seeing their body condition. In this way the subjects will slowly get used to the exercise.
The BCTs involved are action planning, Graded tasks, bio-feedback, self-monitoring of behavior.

DIALOGUE SET 3

ROLES INVOLVED

P: Nutritionist(Female)
Q: Volunteer who is also Diabetic(Female)
R: Patient (Female-45 years)
S: Exercise Counselor(Male)

R: Hello P.
P: Hello R. How have you been doing? You look healthier now compared to the last time.(BCT-Feedback)
R: Thank you P. I have been following all the exercises suggested by S.
S: That is good to hear, R. Are you having any issues with sticking to the exercise plan?(BCT-Goal Setting (Behavior), Goal Setting(outcome), Commitment)
R: No S. I am comfortable with the routine now. Most of the exercises you had recommended falls into place with my daily activities.
R: I am actually more concerned about my diet.
P: Is it? What exactly is the problem?
R: I am not able to stick on to the diet plan that you had made and I am not able to cut on the junk food.
P: You are not the first to be facing this issue but you need to understand that reducing on junk food is a necessity.(BCT-Commitment, Goal Setting(Behavior), Goal Setting(Outcome),Discrepancy between current behavior and goal)
R: Yes. I know but I am not able to stop myself.
Q: R, maybe you should start replacing some ingredients in your food.(BCT- Problem Solving, Action Planning)
P: Yes R. Q is right.
R: Can you give me some examples?
P: Instead of using butter or cream while cooking, you can use olive oil. It is relatively healthier.(BCT-Problem Solving, Action Planning, Information and Health Consequences)
Q: Try avoiding the adding of sugar in tea, coffee and juices.(BCT-Goal Setting(outcome),Problem Solving)
R: Okay. But I am not sure whether I will be able to stick to this plan.
P: R, you need to understand that a good diet plays a huge role in the management of Diabetes. So, you need to take an extra effort.(BCT- Salience of consequences)
Q: R, why don't you follow a personal diet tracker. You can note down, in which occasions you had avoided sugar intake and junk food consumption.(BCT-Self-monitoring(behavior), Action Planning, Goal Setting(Behavior))
P: Yes and then if for 6 days a week you have been following this, then on the 7th day you can have your favorite food. Does this sound like a plan? (BCT-Action Planning, Commitment, Material Incentive(Behavior), Self-Reward)
R: Okay. Now, I feel a little motivated to try this.
P: We must meet after 3 weeks to discuss your progress.

R: Okay. Thank you.

Theories involved:
Health Belief Model, Social Cognition Theory, Information-Motivation and Behavioral Skills Model, Goal Setting Theory, Protection Motivation Theory. In, the whole dialogue set, the usage of these theories is seen. Based on these theories of behavior change, the BCTs have been chosen.

Note:
The subject might respond that the junk food consumption is reduced.
The nutritionist can then set higher levels of goal : maybe incorporate a higher dose of fiber diet and then come up with a cheat day where all the favorite foods can be eaten including a sweet or junk food.
Another way would be for the nutritionist to say that this diet should be continued as it seems to be doing good to them, appreciating them.
BCTs involved would be generalization of a target behavior, behavior substitution, Habit formation and social reward.

DIALOGUE SET-4

ROLES INVOLVED

X: Patient (Male-50 years)
Y: Family member(Wife)
Z: Nutritionist(Male)

Y: Hello Z. My husband is suffering from Diabetes since, around two months now. We need some recommendations to improve his diet.
Z: Sure. Diabetes requires some restriction in the diet but it is manageable. X, generally do you have a lot of junk food?
X: Yes. Sort of. Usually I buy my lunch in the office, which is usually some burger and a soft drink.
Z: Okay. From now, you need to restrain from eating these food items. They are totally not healthy for you and will not improve your condition.(BCT- Goal Setting(Behavior), Information about health consequences)
Z: Y, I would strongly suggest that you keep any source of junk food away from his reach. Include a lot of whole grain and high fiber content in his food.(BCT-Goal Setting(Behavior), Action Planning, Commitment,Remove access to the reward)
Y: Okay. We usually don't have our meals together. Even, I have my lunch at the office.
Z: Is it? I would suggest that, you follow almost the same diet as him because it is necessary for him and it will be good for you as well in the long run.(BCT-Social Support(Practical), Social Support(Emotional))
X: Yes Z. You are right. Eating together might let me stay motivated.
Z: For another two weeks, ensure you don't buy any junk food while you go shopping. Keep a track of whatever you are eating.(BCT-Goal Setting(Behavior), Self-monitoring, Information about antecedents, Habit Reversal)
Y: Okay. I will help him with that.
Z: Also, keep an account of the timings at which you have your meals. Having meals at the same time on each day is important for X.(Habit Formation, Habit reversal)
Y: Okay. Do you suggest that we keep a daily track of his weight as well?
Z: Yes. That would be a great idea. It would help to monitor the progress and be motivated to follow the diet.(BCT-Self monitoring(behavior), Self monitoring (outcome), Biofeedback)
X: Okay. Am, I allowed to have my favorite dish at least once a week?
Z: Of course!. Maybe you can follow the strict diet from Monday to Saturday and on Sunday, you can have your favorite dish but only as a form of reward.(BCT: Material Incentive(Behavior), Material Reward(Behavior))
Y: Okay. I see your point. That way he will stick to his diet for 6 days of the week.
Z: This plan should help you in managing your blood glucose levels and reduce your weight by at least 2 Kilos in the next one month.(BCT-Goal Setting(Outcome), Biofeedback, Behavioral Contract)

Theories involved:
Health Belief Model, Social Cognition Theory, Information-Motivation and Behavioral Skills Model, Goal Setting Theory, Protection Motivation Theory. In, the whole dialogue set, the usage of these theories is seen. Based on these theories of behavior change, the BCTs have been chosen.

DIALOGUE SET -5

ROLES INVOLVED

A: Exercise trainer (Male)
B: Nutritionist (Female)
C: Volunteer (Female)
D: Subject (Female-55 years)

D: Hello. For the last 6 months, I have been suffering from Diabetes and with the medicines prescribed, I tried to take care. But, I guess it is not working.
B: Okay. You don't have to worry. Lot of people who have come to us have been in the same state as you and are now doing much better.(BCT: Social Support)
C: Yes D. Even, I faced a similar situation around 3 years back and with a good exercise and diet plan, I am able to manage the condition really well.(BCT: Social Support)
D: Okay. This sounds promising. From where should I start?
A: D, to keep Diabetes under check, you need to follow both a good exercise plan and diet. Only then would your insulin and glucose levels be under control.(BCT: Goal Setting(outcome), Goal Setting(Behavior), Problem Solving)
C: A is right. Could you tell us a little bit about your comfort with performing exercises?
D: I am not a very athletic person nor do I go to the gym. Once a while I go for walks but most of the time, I drive around.
A: Hmm. Okay. Maybe you could start with a 45 minutes to 1 hour walk every morning. You can follow this time period for 10 days and then gradually increase the duration by about half an hour or so.(BCT- Action planning, graded tasks)
B: Regarding your diet, the first step is to completely cut down on junk food. This means that you should cut down on sugary and oily foods. Work on this for the next three weeks starting from today.(BCT: Goal setting(behavior))
A: Yes. We can see how this goes.
D: okay. I am not very confident about this but I will try my best to stick to this plan.
C: I think you will be fine. I would suggest that you use a diary to write down about all this on a daily basis. It has helped me to stay motivated and get things back on track.(BCT-Self- monitoring(behavior), Self -monitoring(outcome), credible source)
D: Okay. Would you also suggest that I weigh my weight every day and check for the sugar level? B: Yes. That's a good idea and it will help in getting a thorough feedback.(BCT-Bio-feedback, focus on past success, self-monitoring, feedback from others)
D: Okay. See you.

Theories involved:
Health Belief Model, Social Cognition Theory, Information-Motivation and Behavioral Skills Model, Goal Setting Theory, Protection Motivation Theory. In, the whole dialogue set, the usage of these theories is seen. Based on these theories of behavior change, the BCTs have been chosen.

Note: This is a very neutral scenario and the subject has come for the very first time to meet the coaches, so an additional dialogue is not required at this stage

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