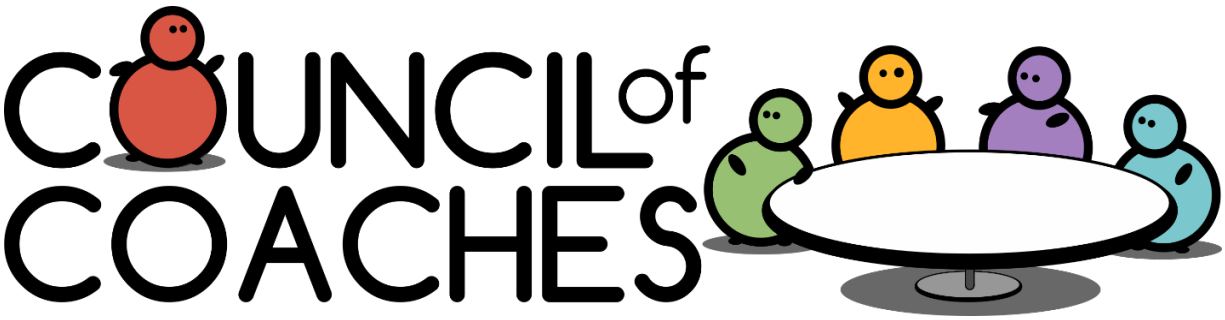

D3.4: Final coaching actions and content

Dissemination level: Public

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Author(s)	Tessa Beinema (RRD), Harm op den Akker (RRD), Stephanie Kosterink (RRD), Silke ter Stal (RRD), Janet van den Boer (CMC)
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Abstract

This document describes the work done in the project related to the content presented by the virtual coaches in the Council of Coaches applications. The document consists of three parts: Part A focuses on the theory behind- and design of the coaches and their coaching domains, as well as their coaching actions and content. Part B describes the underlying dialogue system that has played a crucial role in authoring content for Council of Coaches. In Part C we describe how earlier collected user requirements are addressed in the design of the content for Council of Coaches.

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Symbols, abbreviations and acronyms

ARI	Age Related Impairments
CMC	Centre for Monitoring and Coaching
COUCH	Council of Coaches
CP	Chronic Pain
D	Deliverable
DBT	Danish Board of Technology Foundation
DT2	Diabetes Type 2
EC	European Commission
ISPRINT	Innovation Sprint
M	Month
MS	Milestone
RRD	Roessingh Research and Development
SU	Sorbonne University
UDun	University of Dundee
UPV	Universitat Politècnica de València
UT	University of Twente
WP	Work Package

1 Introduction

This deliverable reports on the final coaching actions and content for the Council of Coaches application. We have structured this deliverable to consist of three parts:

Part A: Design and theory

In the first part of this deliverable, we elaborate on the process of choosing coaching areas and defining coaching domains (section 3). We also report on the design of coaches that are engaging, relatable and representative for these domains (section 4). We then continue with the definition of content for the system, based on guidelines and expert opinions, and finally report the coaching actions that each of our coaches will have available, or more specifically, which topics they will be able to discuss (section 5).

Part B: The WOOL dialogue framework

One of the challenges in developing a coaching system with conversational coaches is to write dialogues that are informative, engaging and adaptable to individual users. In addition, there should be enough dialogues to facilitate longer-term interactions (e.g. for the final evaluation). In this second part of the deliverable, we therefore report on the development of an open-source dialogue framework that aims to make the process of dialogue creation as simple as possible – specifically with non-dialogue system experts in mind (section 6).

Part C: Review of requirements

In this last part of the deliverable, we review the requirements that were gathered and defined at various stages of the project. To be specific, in the various subsections of section 7 this is done for the initial requirements reported in D2.3 (Broekhuis, et al., 2018) and those resulting from the prototype evaluations reported in D2.4 (Beinema, et al., 2018), D2.5 (Beinema, et al., 2019) and D2.6 (van der Kamp, et al., 2019).

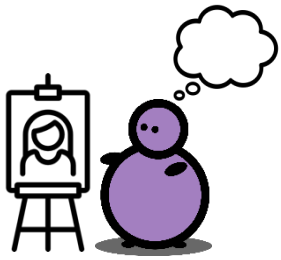
Although the document title suggests that all content for Council of Coaches is finalized, additional dialogue and other content is still being developed. However, the framework and design of content to be used in the final proof of concept study is defined as is.

2 Objectives

The aim of this document is to describe the set of coaching actions and content that is present in the Council of Coaches application.

The deliverable will provide the following:

- A definition of the coaching domains that the coaches in the Council of Coaches represent.
- A presentation of the final set of coaches, that is, their visual appearance, background, expertise and role in the system.
- A description of the methods used to define the coaching content and relevant topics to be discussed per domain.
- An overview of the framework used to author and present the content in the format of dialogues between a user and the coaches.
- An overview of requirements that were defined throughout the project and a short reflection on their inclusion in the final application.



Part A: Design and theory

1. Definition of the final coaching areas
2. Definition of the coaches
3. Design and description of the coaching content and actions

3 Final Council of Coaches coaching areas

The Council of Coaches project aims to deliver a prototype that can demonstrate the advantages of multi-agent coaching for a target audience that is dealing with multi-dimensional issues. Although the project plan clearly defines the target audiences (**Older adults with Age-Related Impairments**, **Chronic Pain**, and **Diabetes Type 2** Patients), the specific domains on which coaching is to be demonstrated are less clearly defined.

In this section, we define which Coaching Areas will be supported in the Council of Coaches prototypes, within the scope of the Council of Coaches project. In this case, we define a Coaching Area as "a set of scenarios for a specific coaching domain and a specific Target Audience that can be supported by a specific set of coaches".

A **Coaching Area** is defined as a set of **Scenarios** for a specific **Coaching Domain** and a specific **Target Audience**, which can be supported by a specific set of **Coaches**.

Consider the following (simplified) examples:

- **Scenario:** "John, who suffers from Diabetes Type 2 asks the Nutrition Coach what he could have for dinner tonight. The Diabetes Coach interjects, and warns that John should be mindful of his caloric intake due to his condition. The Nutrition coach recommends a low-calorie recipe to John, taking this advice into account".
- **Coaching Domain:** Nutrition Domain
- **Target Audience:** Diabetes Type 2
- **Coaches:** Nutrition Coach, Diabetes Coach

And the second, more generic example:

- **Scenario:** "Mary was discussing with the Council of Coaches that she wanted to work on her overall healthy lifestyle. Based on her age, the Physical Activity Coach recommends Mary to slowly work towards an 8,000-steps per day program, starting today with a step goal of 5,000."
- **Coaching Domain:** Physical Activity Domain
- **Target Audience:** Age-Related Impairments, Diabetes Type 2, Chronic Pain
- **Coaches:** Physical Activity Coach

In order to determine which specific Coaching Areas, we will support, and thus what content needs to be created for the Council of Coaches demonstrator, we must first look at the specific domains that will be addressed. In the following section we identify the possible relevant domains from various sources.

3.1 Definition of coaching domains

In order to identify the various relevant Coaching Domains, we perform an analysis of the relevant available documentation, starting with the project plan, and expanding the list with an analysis of the relevant requirements deliverables.

First, the document of action describes the Positive Health model by Huber as a way to measure potential progress that can be made by target users of the Council of Coaches ("*The ultimate aim of the demonstration is to show that the Council of Coaches has a positive effect on health and well-being.*"). This model defines health as having a combination of six dimensions (marked **H1**-**H6**):

1. Bodily Functions (**H1**)
2. Mental Functions & Perception (**H2**)
3. Spiritual/Existential Dimension (**H3**)
4. Quality of Life (**H4**)
5. Social & Societal Participation (**H5**)
6. Daily Functioning (**H6**)

As stated in the Document of Action: "*The demonstration of the project will focus on the 6 dimensions in this scorecard to be able to judge overall improvements to the user's health and well-being on multiple levels in the final demonstration study.*". As for defining the content of the coaches, and the specific setup of different coaching domains (and types of coaches), these 6 dimensions certainly serve as input, but do not necessarily pin the coach-setup down.

The second listing of domains, originating from the Document of Action, as response to the call for proposals, is the division of coaches into the four domains mentioned in the call for proposal, and including the two disease specific domains that match the target audiences (see Figure below). These domains from the proposed coaching Model are marked **M1**-**M6** below:

1. Social (**M1**)
2. Physical (**M2**)
3. Cognitive (**M3**)
4. Mental (**M4**)
5. Chronic Pain (**M5**)
6. Diabetes (**M6**)

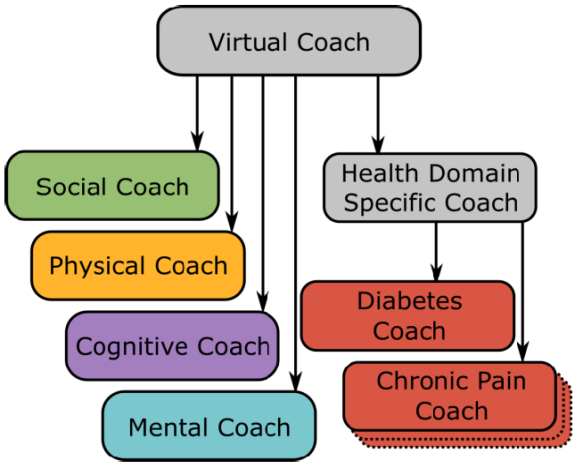


Figure 1: The coaching domains as proposed in the Document of Action.

Third, as examples and use cases throughout the Document of Action, the following six additional potential domains have been identified, marked **D1**-**D6** below.

1. COPD (**D1**)
2. Nutrition (**D2**)
3. Retirement (**D3**)
4. Medication Intake (**D4**)
5. Smoking Cessation (**D5**)
6. Coping with Pain (**D6**)

Finally, Deliverable 2.2 "Report on user and stakeholder needs and expectations" contains various mentions of potential Coaching Domains that may be relevant for the Council of Coaches, listed below as Additional domains **A1**-**A10**:

1. Alcohol Consumption (mentioned as example in D2.2) (**A1**)
2. Suicidal Prevention (mentioned as extreme example in D2.2) (**A2**)
3. Physical Exercising (mentioned as example in D2.2) (**A3**)
4. Ergotherapy Coach (mentioned as professional involved in CP care in D2.2) (**A4**)
5. Social Worker Coach (mentioned as professional involved in CP care in D2.2) (**A5**)
6. Psychologist Coach (mentioned as professional involved in CP care in D2.2) (**A6**)

7. Pedagogical Coach (mentioned as professional involved in CP care in D2.2) (**A7**)
8. General Practitioner (mentioned as professional involved in ARI care in D2.2) (**A8**)
9. Community Nurse (mentioned as professional involved in CP care in D2.2) (**A9**)
10. Lung Physician Coach mentioned as professional involved in COPD care in D2.2) (**A10**)

Table 1 below summarized all the identified Coaching Domains that could potentially be of interest for application within Council of Coaches.

Table 1: Summary of all identified Coaching Domains from the various project sources.

Huber (H)	**Coach Model (M)**	**DoA (D)**	**Additional (A)**
Bodily Functions (**H1**)	Social (**M1**)	COPD (**D1**)	Alcohol Consumption (**A1**)
Mental Functions & Perception (**H2**)	Physical (**M2**)	Nutrition (**D2**)	Suicide Prevention (**A2**)
Spiritual/Existential Dimension (**H3**)	Cognitive (**M3**)	Retirement (**D3**)	Physical Exercising (**A3**)
Quality of Life (**H4**)	Mental (**M4**)	Medication Intake (**D4**)	Ergo therapy (**A4**)
Social & Societal Participation (**H5**)	Chronic Pain (**M5**)	Smoking Cessation (**D5**)	Social Work (**A5**)
Daily Functioning (**H6**)	Diabetes (**M6**)	Coping with Pain (**D6**)	Psychology (**A6**)
			Pedagogy (**A7**)
			General Practitioner (**A8**)
			Community Nurse (**A9**)
			Lung Physician (**A10**)

The 28 potential domains identified and listed in Table 1 above, although partly overlapping, define a scope that is far beyond what can be accomplished within the scope of the project and thus needs to be narrowed down.

In defining the reduced set of Coaching Domains, we first remove the overlap between very similar domains from (**H**)uber, the Coach (**M**)odel, the (**D**)ocument of Action, and (**A**)dditional domains, leading to the reduced set of 10 domains as given below:

1. Physical Domain (**H1** + **M2** + **A3**)
2. Cognitive Domain (**H2** + **M3** + **A6**)
3. Mental Domain (**H3** + **M4**)
4. Social Domain (**H5** + **M1** + **A5**)
5. Quality of Life Domain (**H4** + **H6**)
6. Nutrition Domain (**D2**)
7. Smoking Cessation Domain (**D5**)

8. Alcohol Consumption Domain (**A1**)
9. Chronic Pain Domain (**M5** + **D6** + **A4** + **A5** + **A6** + **A7**)
10. Diabetes Domain (**M6** + **D4**)

This set of 10 Coaching Domains cover the 23 out of the 28 identified domains as highlighted in Table 1 above. The remaining five are left out as potential coaching domains because, first, COPD (**D1**), and Retirement (**D3**) are in fact *target populations* that although could benefit from Council of Coaches, are out of scope of the project. Second, the defined General Practitioner (**A8**), and Community Nurse (**A9**) are coaching roles that cover a wide area of domains, while the identified Lung Physician (**A10**) is only relevant to e.g. a COPD target population that is out of scope of the project.

Based on this extensive identification and selection process as documented here, the conclusion is that there are 10 potentially relevant Coaching Domains that fall somehow within the scope of the project. Combined with the three target populations: Older Adults with Age-Related Impairments (ARI), Diabetes Type 2 (DT2), and Chronic Pain (CP), this yields the Matrix as defined in Table 2 below, where for example, a checkmark in the Physical/DT2 cell would mean that we cover content for Physical coaching for Diabetes Type 2 users. An ultimate aim would thus be to define content that cover all the cells in Table 2 below.

Table 2: Matrix of relevant Coaching Domains and Target Users.

Coaching Domain	Target Audience		
	ARI	DT2	CP
Physical	✓	✓	✓
Cognitive	✓	✓	✓
Mental	✓	✓	✓
Social	✓	✓	✓
Quality of Life			
Nutrition	✓	✓	✓
Smoking Cessation			
Alcohol Consumption			
Chronic Pain	✓	✓	✓
Diabetes	✓	✓	✓

Based on this selection of domains, we have narrowed down the inclusion of coaches to be used in the final proof of concept evaluation to the following list:

- **Physical Activity Coach** – Covers the Physical domain.
- **Nutrition Coach** – Covers the Nutrition domain.
- **Social Coach** – Covers the Social domain.
- **Cognitive Coach** – Covers the Cognitive and Mental domains.
- **Peer and Support** – An additional "coach" that acts as a peer to the user (based on user feedback)
- **Chronic Pain Coach** – Covers the Chronic Pain domain and other domains from the Chronic Pain perspective.

- **Diabetes Coach** – Covers the Diabetes domain and other domains from the Diabetes perspective.

This final coach selection omits the domains “Quality of Life”, “Smoking Cessation”, and “Alcohol Consumption”. For “Quality of Life”, we feel that this domain is too broad to warrant a specific coach. For smoking cessation and alcohol consumption, we feel that we cannot do these topics justice within the scope of the project, and opted for a narrower focus.

The final set of coaches is further defined in the next Section 4.

4 Definition of coaches

The previous section provides the justification for the final set of coaches to be used in the project's proof of concept evaluation study. These coaches are defined here below in Table 3 and the following subsections.

One of the objectives of the project was to develop the coaches as interesting characters – individuals with their own unique characteristics that feel recognizable for the end-user. This deeper character design is reflected mainly in the coaches' back-story and each coach's individual "preferences, likes and dislikes" that are used as a guidebook to author the dialogues for those coaches. The definition of these backstories and characteristics has primarily been a creative process, and driven by the feedback received in the various end-user evaluations (D2.4, D2.5 and D2.6). Our initial set of coaches was deemed to be too young, so a wider variety of ages is now represented in the council. Especially the physical activity coach was deemed too young, as for our older adult end-users it did not feel right to be told to be physically active by a young lady. Her name "Alexa" also had strange associations with the Amazon device, and was therefore also changed. Other coaches such as Francois, the cheese loving, French chef was appreciated from the start, and has beside a visual upgrade been kept largely unchanged.

Table 3: Overview of all Coaches in the Council of Coaches.

Role	Name	Nationality	Gender	Age
Physical Activity Coach	Olivia Simons (§4.1)	Dutch	Female	52
Nutrition Coach	François Dubois (§4.2)	French	Male	45
Social Coach	Emma Li (§4.3)	American	Female	28
Cognitive Coach	Helen Jones (§4.4)	British	Female	64
Peer Support	Carlos Silva (§4.5)	Portuguese	Male	67
Chronic Pain Coach	Rasmus Johansen (§0)	Danish	Male	33
Diabetes Coach	Katarzyna Kowalska (§4.7)	Polish	Female	45
Assistant	Coda (§4.8)	-	-	-

In the screenshot below (Figure 2), all seven coaches and the robot assistant are present in the Council of Coaches house. From left to right, these are: Carlos, Olivia, Emma, Katarzyna, Helen, Rasmus, Coda and François.

Figure 2: A rare moment where all the coaches are present in the Council of Coaches home.

4.1 Physical activity coach (Olivia)

Name	**Olivia Simons**
Occupation	Physical Activity Coach
Gender	Female
Age	52
Height	1.67 m
Weight	65 kg
Place of Birth	London
Likes	Walking with her dog, fitness, shopping, having a drink with friends
Dislikes	Cars, and pollution in general

Backstory	Olivia grew up in the city centre of London. At the age of twenty, she met her now ex-husband Thomas when visiting Amsterdam for work. Three years later, she moved to Amsterdam, where she was married and settled down. Olivia has been working as a secretary at a financial company in Amsterdam for 25 years. Two years ago, Olivia divorced her husband Thomas. Together they have one daughter, Lisa, who is now 23 years old. After her divorce, Olivia had a difficult time. Olivia had always been into fitness and walking. After her divorce, she moved to a small apartment at the outside of the city, together with her dog Brian. This is when she realised how much she enjoys going for a run outside in the fresh air of the nature and how it helped her to clear her mind. During this period Olivia realised she wanted to transfer her positive energy to others and inspire them to stay active. Therefore, she quit her job and started as a personal trainer. Although Olivia likes to be active in nature, she is also really enjoys going into the city. She likes to go shopping or explore the newest restaurants and bars, although the noise and pollution of cars bothers her. In addition, friends often come over to Olivia's place to have dinner together and drink a nice glass of wine.
Role	Educating the user about the benefits of physical activity. Assisting the user in setting personalized goals towards a healthy dose of daily physical activity, and helping him/her reach those goals. Helping the user with daily activity tracking, providing feedback and advice.
Pointers for Dialogue Writing	Olivia is encouraging and often uses sentences, such as: "Yes, well done!", "Almost there!" and "Come on!" However, she can have a slightly strong undertone and she tends to pressure people to push their boundaries; helping them towards their goals using small, but quickly increasing steps.
Coach Selection Blurb	If you're looking to work on your physical activity, Olivia is the perfect fit for you. She is full of enthusiasm, advice and knowledge on how to reach a physically active lifestyle. She helps you set goals and helps you stick to them.

4.2 Nutrition coach (François)

Name	**François Dubois**
Occupation	Nutrition Coach
Gender	Male
Age	45
Height	1m74
Weight	84kg
Place of Birth	Pau, France
Likes	Food, Cheese, French Music
Dislikes	Talking about himself

Backstory	His grandfather was a chef, his father was a chef, so there was never any doubt as to what François was to become when he grew up. François did turn out to become a very successful chef, but his heart was never really truly into it. As a young chef, François spent some time in Montpellier on France's southern Mediterranean coast where he was working as an apprentice under a well-known traditional French Michelin star chef. His father sent him here after a few youthful rebellious incidents while working in his father's own restaurant. Now that François is older, he has set his life priorities straight, and has come to terms with his feelings that he doesn't like preparing fancy dishes for the rich, entitled and fancy people that used to visit his Michelin Star restaurant in France. And so, François finally wanted to do something truly useful for the world. Because food and cooking are the only things he knows, he has decided to become a Nutrition Coach in the Council of Coaches. Although François isn't a "health expert" per se, he can talk for hours about healthy and delicious meals. Growing up under the pressure of his family's Chef lineage, François is rather incapable of talking about his emotions and feelings, and thus has grown a habit of changing the subject to food whenever things get too emotionally complicated.
Role	Educating the user about the benefits of a healthy diet. Assist the user in tracking dietary habits and providing feedback and information on nutrition. Provide personalized recipes, and assist the user in preparing healthy meals.
Pointers for Dialogue Writing	Introduces random French words here and there. At every mention of cheese, points out that he loves cheese.
Coach Selection Blurb	As a nutrition coach, François can help you eat and drink healthier. He can help you set dietary goals, and help you stick to them. François lets you keep track of your weekly diet, and has a large collection of recipes that he will gladly help you choose from, should you need cooking inspiration.

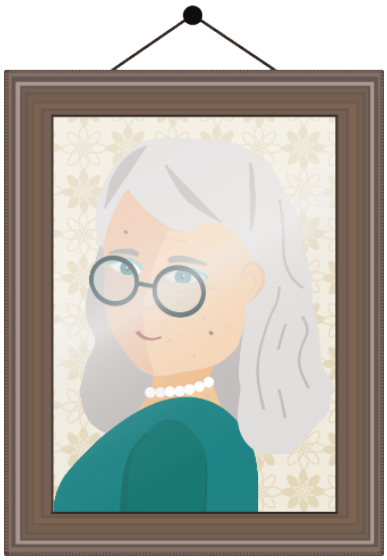
4.3 Social coach (Emma)

Name	**Emma Li**
Occupation	Social Coach
Gender	Female
Age	28
Height	1.68
Weight	55 kg
Place of Birth	Pennsylvania, USA
Likes	Yoga, Sushi, playing piano, collecting unique shoes
Dislikes	Watching scary movies

Backstory	Emma grew up as an only child in the state of Pennsylvania, USA. Her mother, born in China, was a first-generation immigrant. She moved to the USA when she was 18, where she met Emma's father, captain of the local Rugby team. At the age of five, Emma started playing piano. She has always enjoyed it very much. It helps her to relax. After her youth, she went to the University of New York. Emma received a scholarship by showing her musical skills in the University orchestra. Since her mother had had a difficult youth, her parents stimulated her to perform well at school. This is what she did: Emma was a great student. At the age of 24, she received her Master of Arts. Two years ago, Emma's father passed away after a heart attack. From this moment on, the bond with her mother became even tighter. Often, she takes the train from New York to Pittsburgh to accompany her mum. Although Emma has had several relationships during college, she is still single. However, she likes her freedom and often hangs out with friends. They like to go to cafés or shopping. Emma loves shoes: she's always looking for a strange new pair. In addition, she adores sushi! On other days, Emma appreciates spending time alone in her cosy apartment in the city. Often, she just stares out of the window having a cup of tea, and observing the crowd. Although her space is small, she managed to place a piano! In general, Emma is a calm and quiet person. She is a good listener. However, sometimes she can be a bit crazy and hysterical.
Role	Assisting the user in leading a socially active life. Helping the physical and 'nutrition coaches by providing a social angle to activity- and coaching advice.
Pointers for Dialogue Writing	Often uses rhetorical questions, for example by ending sentences with "…isn't it?", "…you know?" "…right?". Often refers to examples of her own life.
Coach Selection Blurb	Emma is a very social person that knows what it's like to be alone. Emma will find the social angle for every situation, and can help you with tips and advice on leading a socially active life.

4.4 Cognitive coach (Helen)

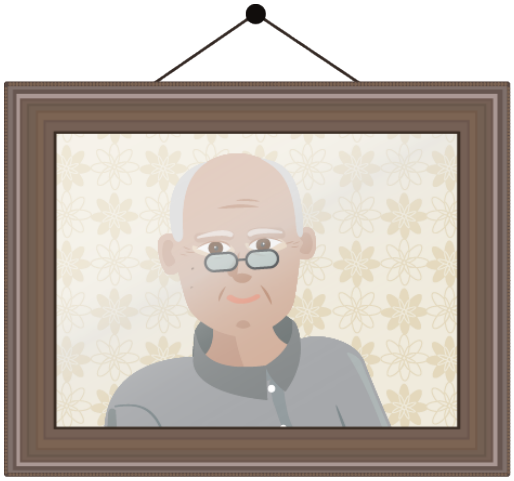
Name	**Helen Jones**
Occupation	Cognitive Coach
Gender	Female
Age	64
Height	1.80
Weight	75 kg
Place of Birth	London, England
Likes	Puzzles, walking in nature, gardening, knitting, yoga, cats
Dislikes	Big cities and noise



Backstory	She grew up in a fairly well-off home. She had an interest in others from a very young age, always wanting to know what drove people to do what they did. Her motivation to understand others led to go on a trip through Africa and Asia to get insight into other cultures. After developing her understanding of people with other cultures and from different social classes, she returned to England to study psychology, focusing on human cognition. Helen worked in London until her early 40s, but she was always in love with smaller and more rural towns and nature. This is why at 43 she decided to start her own practice in Brockenhurst and move there. This was an exciting and new endeavour for her. Since then she has worked with many (older) adults, and has helped many change their thoughts and behaviours. When Helen recently retired at the age of 63, she started missing helping others. That was when she decided to join the Council of Coaches as a Cognitive Coach. She always tried to live a healthy life, mostly by living "close to nature" in her later years. She makes up for her lack of expertise in the health domain by being quite knowledgeable about how to talk to people, figuring out what makes them tick and helping them reshape their cognitions. In her free time, Helen likes to be in nature. She often goes out for a walk, but also spent much time on gardening in her own backyard. She knows a lot about flowers and grows her own vegetables. In addition, at least twice a week she relaxes herself by doing a 30-minute yoga session. Furthermore, she enjoys doing puzzles, especially when accompanied by her cat.
Role	Informs the user about the importance of cognitive health and how it relates one's overall wellbeing. Helps the user by reflecting upon him or herself. Provides the user with information about and strategies for cognition.
Pointers for Dialogue Writing	Often asks the user to reflect upon him or herself ("How do you feel?", "What do you think?"). Likes to summarize points made by others to show her understanding. Is not judgmental and will always respect whatever someone thinks and feels.
Coach Selection Blurb	Helen is there to help you to keep your brain flexible and sharp. As a cognitive coach she provides advice and tips on how to stay cognitively fit in your everyday life through simple tasks and games.

4.5 Peer and support (Carlos)

Name	**Carlos Silva**
Occupation	Peer & Support
Gender	Male
Age	67
Height	1.73 m
Weight	85 kg
Place of Birth	Sines, Portugal
Likes	Benfica, playing cards, spending time with his grandchildren
Dislikes	Being told what to do



Backstory	Carlos lives together with his wife. They have three grown-up daughters and four grandchildren. Carlos is very proud of his family. Carlos has been working as an office worker in the local community for several years, but recently retired. Carlos never was a "career man"; he has not been that ambitious. Rather, he enjoyed the little things in life. His wife will retire in one year. They are looking forward to their joined retirement. Carlos likes spending time with his grandchildren. His grandchildren often call him "Silly granddad", but they adore their grandfather. Carlos has the tendency to spoil his grandchildren by often taking them on trips, to the beach or zoo, or by buying them too large ice creams. In addition, Carlos is a huge football fan. In his early years, Carlos played football at least four times a week. Nowadays, his football interest is expressed in him following his club Benfica closely. Therefore, the Silva's have a large TV, which almost 24/7 shows the latest football updates (mostly through the Benfica TV channel). Carlos' wife is not always happy with the TV and often tells Carlos to go out for a walk instead. Furthermore, Carlos and his friends, mostly all retired, regularly play cards and enjoy the weekly billiard evening in the local café. They like to have a drink together, while enjoying the sun. Carlos is a social person and often performs chitchat with others.
Role	Supporting the user in his/her journey with the Council of Coaches. Provide emotional support with the difficulties of behaviour change, and share experiences with the user.
Pointers for Dialogue Writing	Often talks about Benfica. Does not understand all suggestions of the other coaches immediately, regularly asks for more explanation.
Coach Selection Blurb	Carlos is not a coach. In fact, he is taking advice from the other coaches as well. He is struggling to change his lifestyle for the better, and he is here to share his experiences with you.

4.6 Chronic pain coach (Rasmus)

Name	**Rasmus Johansen**
Occupation	Chronic Pain Coach
Gender	Male
Age	33
Height	1.88 m
Weight	78 kg
Place of Birth	Roskilde, Denmark
Likes	Cycling, hiking, sailing, travelling
Dislikes	Sitting still

Backstory	Rasmus grew up in Roskilde, together with his parents and twin-brother. As a child, Rasmus was curious. Although he had a wonderful childhood in Roskilde, Rasmus always wanted to see more of the world. Therefore, during his medicine studies, he went a few times abroad. Rasmus studied in the United States for a year, and performed an internship in Tanzania in a childcare home. After his studies, he travelled a few months through Asia. He had a wonderful time. Currently, Rasmus is back in Denmark, working at a physical rehabilitation centre in Copenhagen. He lives on his own in a modern apartment in a suburb of Copenhagen. In his job, Rasmus regularly is in contact with chronic pain patients. Rasmus is very ambitious and always open for new experiences and cultures. He loves his work, but sometimes tends to be a workaholic. In his free time, Rasmus likes to cycle through the beautiful landscapes in Denmark. In addition, he likes to hike. Each year he, his twin-brother and friends travel to the Alps to hike for a week. Furthermore, Rasmus enjoys sailing. In Roskilde he grew up surrounded by water. Therefore, he learned to sail when he was a little boy. Nowadays, he has its own boat and often goes out onto the water.
Role	Go-to-person for all questions related to chronic pain. Making sure that all lifestyle advice is in line with the user's needs related to his/her chronic pain diagnosis.
Pointers for Dialogue Writing	Often uses metaphors to describe scenarios regarding chronic pain. Often provides examples on how they handle certain scenarios in other cultures
Coach Selection Blurb	If you have a diagnosis of Chronic Pain, Rasmus makes sure that the advice given to you by the other coaches will work for you as well. Rasmus knows the guidelines on Chronic Pain, and has your interests at heart.

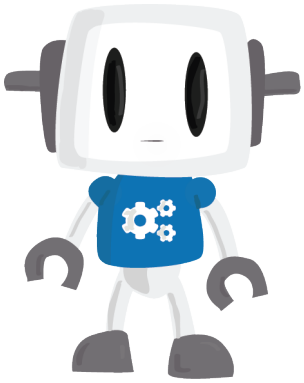
4.7 Diabetes coach (Katarzyna)

Name	**Katarzyna Kowalska**
Occupation	Diabetes Coach
Gender	Female
Age	45
Height	1.67 m
Weight	75 kg
Place of Birth	Lowicz, Poland
Likes	Baking, singing, family
Dislikes	Strawberries

Backstory	Katarzyna grew up in a small village close to Warshaw, Lowicz. She is the oldest of a large family, having three brothers and four sisters. At the age of twelve, her mother passed away. Since that moment on, Katarzyna supported her father and took over a large part of the care for her younger brothers and sisters. Nowadays, Katarzyna still lives in Lowicz, close to her parental home. She lives together with her husband, who works as a researcher at the University of Warsaw. They do not have children themselves, but spend a large part of their time with their nephews and nieces; they adore the Kowalski's. Katarzyna finished nursing school and works as a practice assistant at a general practitioner's practice in Warsaw for over ten years now. As a practice assistance, she is often in contact with Diabetes patients. Katarzyna performs annual checks and educates and advices Diabetes patients. She enjoys working with people and always seeks to provide her patients with the best help. Katarzyna gives up a lot for others and is always willing to help. She likes to spend her time with family. In her free time, Katarzyna likes to bake. She makes the loveliest pies. Her friends and family are always eager for an invitation to come over and try. In addition, Katarzyna sings in a choir. She rehearses at least once a week, and several times a year the choir gives a performance. Singing is Katarzyna's way to relax.
Role	Go-to-person for all questions related to diabetes. Making sure that all lifestyle advice is in line with the user's needs, related to his/her diabetes diagnosis.
Pointers for Dialogue Writing	Often talks about her adorable nephews and nieces. Sometimes sings, hums.
Coach Selection Blurb	If you are diagnosed with Diabetes Type 2, Katarzyna should be a part of your Council. Katarzyna knows the effects your Diabetes has on activity and nutrition, and will complement François and Olivia in their advice.

4.8 Council of Coaches assistant (Coda)

Name	**Coda**
Occupation	Council of Coaches Assistant
Gender	N/A
Age	Unknown
Height	1.12 m
Weight	110 kg
Place of Birth	Unknown



Likes	Solving incredibly complicated math problems in nanoseconds
Dislikes	Water, Low battery levels
Backstory	…
Role	As the Council's Dedicated Assistant, Coda helps the user in navigating their way through the Council of Coaches application. Coda performs tasks commonly done through cumbersome user interface fields in an intuitive, natural language way.
Pointers for Dialogue Writing	Coda is a robot, so makes robotic noises every now and then. He doesn't think, he calculates.
Coach Selection Blurb	N/A

5 Definition of coaching content and actions

In the following subsections, we will discuss the coaching advice and content incorporated in the system. For each coaching domain we will 1) describe the guidelines on which the content and advice are based 2) list relevant resources for the domain, 3) describe the coaching that the coach can provide for a user, and 4) elaborate on the actions (i.e. *topics to discuss*) that the coach has available.

The coaching described is focused on older adults (55+). When applicable, we will also describe deviations or additions that are relevant for adults above 55 with Age Related Impairments (ARI), Diabetes Type 2 (DT2), or Chronic Pain (CP).

To assist and to empower the user in their behaviour change process, each coach has a number of coaching actions available that they can perform. Each of these actions takes on the form of a dialogue (or set of dialogues) that discusses a specific topic. Which actions are performed when and with which frequency makes up the coaching strategy, and this process of selecting actions and their specific content, is tailored to the individual user based on the user's personal profile. E.g. which coaching approach was discussed with the user? What are their favourite activities? Do they have food allergies? Do they have diabetes type 2 or chronic pain?

To facilitate the dialogue writing process and to design for personalized topic selection, we have structured the topics that each coach can discuss. This structure of topics (which can be thought of as nodes) has a hierarchy to it and the topics at the end-points of this structure (which can be thought of as leaves) contain the topics for dialogues (or sets of dialogues) that the coach will have with a user.

5.1 Physical Activity

We start with a definition of physical activity. We follow the definition by the World Health Organization, which specifies *physical activity* for adults (18-64) (World Health Organization, 2011) and older adults (65+) (World Health Organization, 2011) as follows:

Physical activity:

"Leisure time physical activity, transportation (e.g. walking or cycling), occupational (i.e. work), household chores, play, games, sports or planned exercise, in the context of daily, family, and community activities."

Being physically active has generally been accepted as healthy behaviour. For people of 50+ being physically active leads to an increased life expectancy of 1-4 years. This is mainly due to a reduced risk of heart/vascular diseases. Regularly being active directly reduces this risk, but also indirectly due to lower blood pressure, lower cholesterol, and increase of HDL. Another benefit of being active is, for example, that it has a positive effect on depression and symptoms of depression (in general and for elderly) (Nederlands Huisartsen Genootschap, 2015).

People with diabetes type 2 can benefit from being active since it keeps the muscles strong, helps to lose weight, helps to keep up the blood flow/circulation, increases the use of blood glucose, and lowers blood glucose levels (van Bommel, de Bonth-van Lier, el Bouazzaoui, te Hennepe, & Oosterberg, p. 51).

People with pain complaints tend to be less active when it comes to activities of moderate- and vigorous-intensity (Koninklijk Nederlands Genootschap voor Fysiotherapie, 2014, p. 10), but do not necessarily move less. People with chronic low back pain, for example, tend to divide their activities differently over the day than those without pain; the difference is mainly in them being less active in the evenings. Older people in this group (65+) do tend to move less overall than people of a similar age without any pain.

5.1.1 Guidelines and recommendations

There are many recommendations for physical activity available. Most of these however, are based on the recommendations by the World Health Organisation (WHO). The WHO recommends that all adults (18-64 years) should do *at least* one of the following (World Health Organization, 2011):

1. 150 minutes of moderate-intensity aerobic physical activity throughout the week.
2. 75 minutes of vigorous-intensity aerobic physical activity throughout the week.
3. A combination of moderate- and vigorous-intensity activity equivalent to (1) or (2).

These goals are preferably reached through being active for 30 active minutes per day. In terms of steps per day, this means that adults (28-65) and older adults (65+) should do at least 7500 steps per day, while individuals living with disability or chronic illness should aim for 7000 steps (Tudor-Locke, et al., 2011). In addition, they specify that such activity should be performed in bouts of at least 10 minutes.

The WHO also specify that for additional benefits, the activity should be increased to one of the following:

1. 300 minutes of moderate-intensity aerobic physical activity throughout the week.
2. 150 minutes of vigorous intensity aerobic physical activity throughout the week.
3. An equivalent combination to (1) or (2) of moderate- and vigorous-intensity activity.

Finally, the WHO recommends performing muscle-strengthening activities, involving major muscle groups, 2 days a week.

For the specific group of adults above 65 years old the WHO's recommendations are the same as for adults in general (World Health Organization, 2011), but they list two additions that are relevant to the ARI, DT2 and CP groups:

1. Older adults with poor mobility should perform physical activity to enhance balance and prevent falls on 3 or more days per week.
2. If health conditions prevent doing the recommended amounts of physical activity, the older adult should be as physically active as their abilities and conditions allow.

The WHO also specifies that inactive people should start with small amounts of physical activity and gradually should increase duration, frequency and intensity over time.

The Dutch Association of General Practitioners provides recommendations, which are similar to those listed above (Nederlands Huisartsen Genootschap, 2015, pp. 30, 70). They give walking (3-4 km/hour) or cycling (10 km/hour) as examples of moderate intensity.

5.1.2 Information and resources

Resources and more information for the domain of physical activity can be found in the following overview of references.

For ARI:

- The Dutch Association for Physical Therapy provides information for various patient populations, e.g.:
  - Artrosis (Koninklijk Nederlands Genootschap voor Fysiotherapie, 2008)
  - Chronic obstructive lung diseases (Koninklijk Nederlands Genootschap voor Fysiotherapie, 2009)
  - Coronary heart diseases (Koninklijk Nederlands Genootschap voor Fysiotherapie, 2008)
  - Vulnerable older adults (Koninklijk Nederlands Genootschap voor Fysiotherapie, 2014)
  - Oncology (Koninklijk Nederlands Genootschap voor Fysiotherapie, 2011)
  - Osteoporosis (Koninklijk Nederlands Genootschap voor Fysiotherapie, 2008)

For diabetes type 2:

- The Dutch Association for Physical Therapy provides a guide for diabetes (Koninklijk Nederlands Genootschap voor Fysiotherapie, 2009)
- The Dutch Association for General Practitioners provides a guide that contains diabetes as a topic (Nederlands Huisartsen Genootschap, 2015, p. 31).
- Pharos (Dutch Centre of Expertise on Health Disparities) provides a guide for low literacy on Diabetes (van Bommel, de Bonth-van Lier, el Bouazzaoui, te Hennepe, & Oosterberg, p. 51)

For chronic pain:

- Chronic pain (Koninklijk Nederlands Genootschap voor Fysiotherapie, 2014)

5.1.3 Physical activity coaching in the Council of Coaches

Taking into account the guidelines and information described in the previous sections, the lessons learned from the behaviour change literature in D3.1 (Beinema, et al., 2018), and the abstract coaching model reported on in D3.3 (Beinema & op den Akker, 2018), we defined the coaching process between users and the physical activity coach in the Council of Coaches. For physical activity coaching this will involve the following:

A user will meet the physical activity coach. The coach will introduce themselves and their coaching domain. Between the serious coaching conversations that will follow, the coach will elaborate on their personal background story as a lighter topic of conversation. Sometimes these social conversations are about the coach's hobbies or where they grew up, other times, they could be about what they do as a coach.

Once the coach and the user have been introduced, the coaching process starts. The coach will provide the user with information on why they should be physically active, and why it is important to distribute activity equally over the day. They will ask the user questions on relevant topics, such as what activities they like, in what type of environment they live and if they have any disabilities that should be taken into account when recommending activities.

The coach will also ask the user to connect an activity tracker so that they might get insight into the user's current activity level. The coach will explain the tracker and its uses to the user, elaborate on what the data is used for and answer questions that the user might have.

After the coach has seen enough data to advise the user (i.e. a baseline measurement of a week), the user will set a long-term physical activity goal with the coach. This can be a goal in terms of number of steps, active minutes or calories burned; the user decides. The goal will be reached when a user reaches this number of steps/minutes/calories for a longer period of time.

In addition to the long-term goal, the coach will set daily goals with the user to work towards the long-term goal in small steps. Such a daily goal represents an achievable increase of their current activity. In addition, an agreement between the coach and the user can be made that the user tries to reach their goal for every day of the week. Indirectly this also makes the user balance their activity over the days of the week.

During the coaching sessions the coach will assist the user in achieving the set goals. They will continue to teach the user about being physically active, suggest methods and activities to reach their goals and to support the user in achieving a healthy lifestyle with respect to physical activity.

5.1.4 Coaching actions

For our physical activity coach, the topic structure starts with a 'Start' node that allows a choice between the 'Social' topic and the 'Coaching' topic (see Figure 3). The 'Social' topic has two subtopics. One is the 'Introduction' that represents the dialogue in which the coach and the user can introduce themselves. The other is 'Background story', which includes dialogues about the coach's background story – e.g. what are their hobbies, where did they grow up, etc.

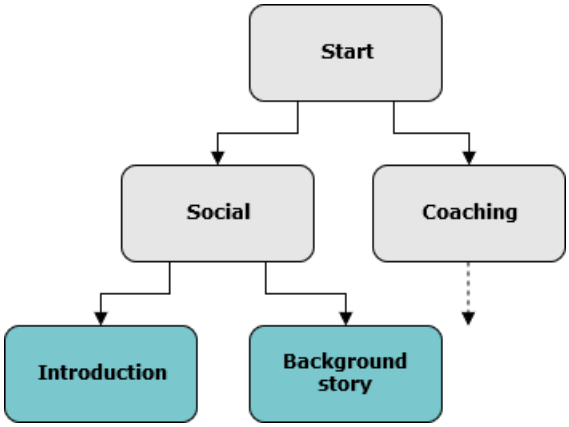


Figure 3: The start of the hierarchy of coaching topics and the two types of topics that are subtopics of the available 'Social' topic.

The 'Coaching' topic on the other hand has six subtopics, which include three topics that directly result in dialogues (see Figure 4) and three topics that have subtopics themselves (see Figure 5). We will begin by discussing the three topics that directly result in dialogues (again, see Figure 4). The first one is 'Gather information', which allows for dialogues in which the coach asks the user about their preferences. E.g. in what type of environment do they live (city or rural), what type of activities do they generally prefer (cycling, walking, something else?), do they like being physically active? The second one is 'Discuss coaching approach' in which the coach discusses with the user what style of coaching they would prefer. E.g. some users might really like to receive information, while others are already quite knowledgeable and prefer to receive more feedback. The third topic is 'Discuss sensors' which allows for dialogues about the sensors. E.g. Why would you wear a physical activity sensor as a user? What does the coach do with that data? How do you connect a sensor?

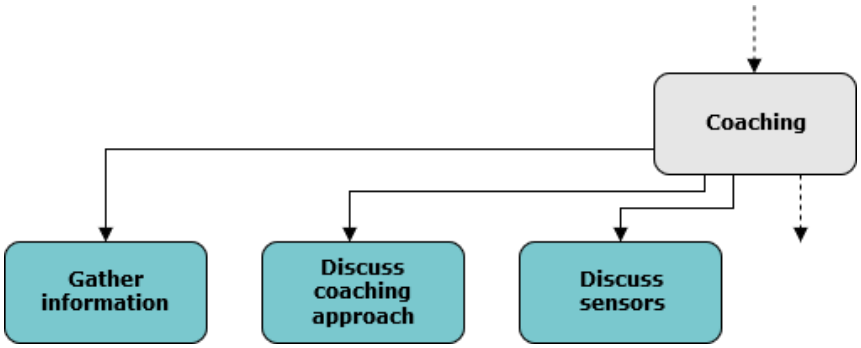


Figure 4: The first set of subtopics for the 'Coaching' topic.

Then, there are three other topics for 'Coaching' that have subtopics themselves (again, see Figure 5). These three are 'Goal-setting', 'Learning & skills', and 'Feedback & support'.

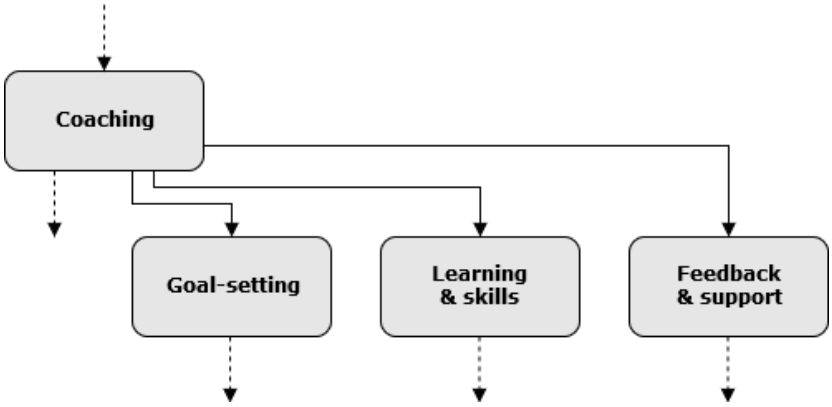


Figure 5: The second set of subtopics for the 'Coaching' topic.

The 'Goal-setting' topic has three subtopics (see Figure 6). The first is 'Set new goal', which relates to dialogues about setting a new goal. At first a long-term goal will be set. This can then be followed by also setting a new daily goal. The second topic 'Discuss existing goal' relates to dialogues in which the user discusses their current goal with the coach and possibly can indicate that the current goal is too easy or difficult (and possibly adjust e.g. the expected number of steps a little). The third topic 'Discuss actions to achieve goal' allows for a discussion between the coach and a user on what the user will do and when to e.g. reach more active minutes (e.g. take a walk before dinner). Previously gathered information such as the user's preferred activities can be used to suggest activities that fit the user.

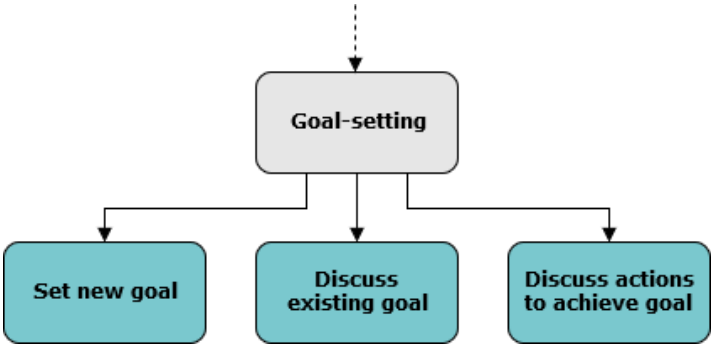


Figure 6: The subtopics for the 'Goal-setting' topic.

The 'Learning & skills' topic also has three subtopics (see Figure 7). The first is 'Inform', which has subtopics again (we will first explain the others). The second 'Advise on social support' relates to dialogues in which the user can discuss with the coach how they might ask their family and friends to perform activities with them. The third topic, 'Help recognise triggers', allows for a dialogue between the coach and the user in which the user reflects with the coach on what might cause them to be less active.

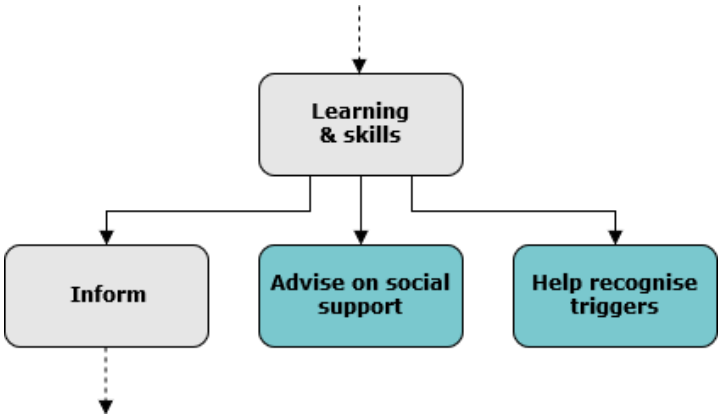


Figure 7: The subtopics for the 'Learning & skills' topic.

The inform topic has two subtopics (see Figure 8), 'Inform 'how'' and 'Inform 'why', which in turn have two subtopics. 'Give an example' provides an example of how the user can be physically active. E.g. by telling a story about a similar person who performed that activity. 'Explain' on the other hand explains to the user how they can be physically active. The dialogues for the 'Positive effects (of doing)' and the 'Negative effects (of not doing)' provide the user with information on why they should be physically active and why being physically inactive can be bad for their health.

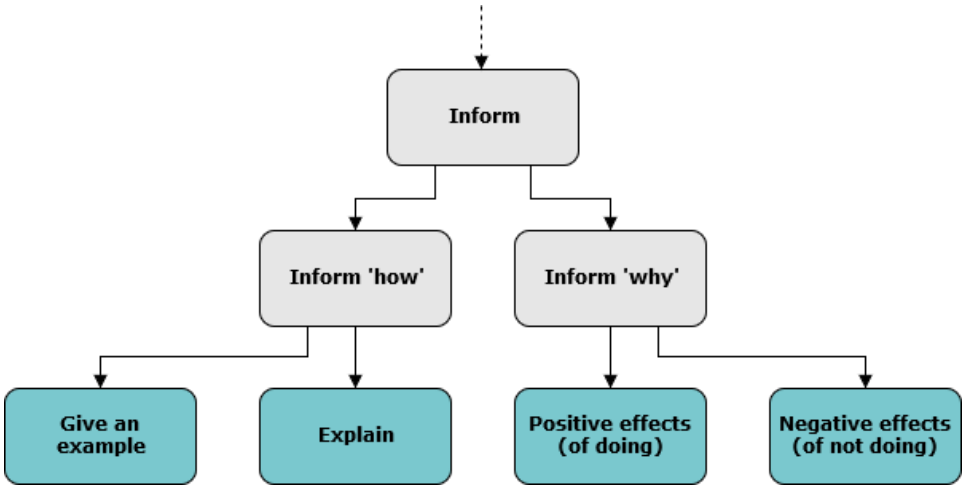


Figure 8: The subtopics for the 'Inform' topic.

Finally, the last topic, 'Feedback & support', has two subtopics (see Figure 9). The first is 'Discuss progress' in which the coach will discuss the user's progress. E.g. Are they doing well? How has their physical activity changed over the past month? The second subtopic is 'Discuss experience', which allows for a discussion between the coach and the user on how the user feels that it is going. E.g. is the process easy and are they getting used to their changes in activity? Or is it very difficult?

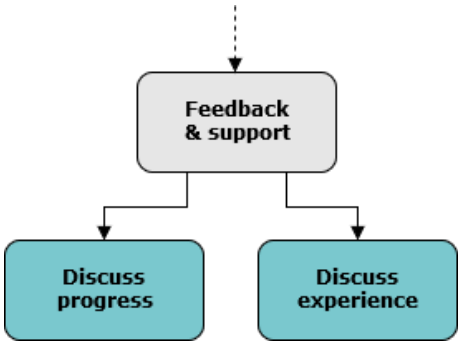


Figure 9: The subtopics for the 'Feedback & support' topic.

5.2 Nutrition

In 2015, the World Health Organization released the 'European Food and Nutrition Action Plan 2015-2020' (World Health Organization, 2014). The intention for this action plan is to reduce the burden of preventable diet-related noncommunicable diseases, obesity and all other forms of malnutrition still prevalent in the WHO European Region. The plan mentions excess body weight (body mass index > 25kg/m2), excessive consumption of energy, saturated fats, trans-fats, sugar and salt and low consumption of vegetables, fruits and whole grains as the leading risk factors and priority concerns. In addition, some countries are at the same time also challenged by nutrient deficiencies. (World Health Organization, 2014).

We define *nutrition* as:

Nutrition:

"The process of providing or obtaining the food necessary for health and growth."

5.2.1 Guidelines and recommendations

The WHO defines the types of food for which consumption should be limited to sustain a healthy diet (that is, energy-dense, micronutrient-poor foods and non-alcoholic beverages) as *food products high in energy, saturated fats, trans-fats, sugar or salt*. Three key aspects that the WHO lists to take action on (World Health Organization, 2018) are the following:

- *Energy intake (calories)* and energy expenditure should be balanced. Energy intake should not consist of more than 30% fat – of this percentage, a maximum of 1/3 can be saturated fats, and no more of 1% of total energy intake should be trans-fats. A shift from saturated fats and trans-fats to unsaturated fats is also recommended. Ultimately, the goal is to eliminate industrially-produced trans-fats.
- The intake of *free sugars* should be limited to less than 10% of total energy intake. For additional benefits it is suggested to reducing this to less than 5%.
- *Salt intake* should be no more than 5 grams per day (this equals 2 grams of sodium).

The details of what constitutes a healthy diet vary per person and these are heavily influenced by many factors, such as e.g. age, gender, but also cultural context, locally available foods and dietary customs (World Health Organization, 2018). With these notions in mind, we will discuss the nutritional challenges and guidelines for the Dutch, Danish and United Kingdom populations separately. Furthermore, we are aware of the guidelines for nutrition when people have diabetes type 2, but will discuss these when we elaborate on the diabetes coach.

5.2.1.1 Nutrition guidelines - Denmark

Dietary recommendations for the Danish follow the Danish food-based dietary guidelines (FBDG) (Danish Veterinary and Food Adminstration, 2018)[1], which in turn are based on the 2012 version of the Nordic Nutrition Recommendations (NNR) (Food and Argiculture Organization of the United Nations, 2013). These guidelines are:

- Eat a variety of foods, but not too much, and be physically active
- Eat fruits and many vegetables (600 grams per day, of which at least half vegetables)
- Eat more fish (350 grams a week of which 200 grams fatty fish)
- Choose whole grains (eat 75 grams per day).
- Choose lean meats and lean cold meats (500 grams per week, for 2-3 meals)
- Choose low fat dairy products (e.g. less than 0.7% fat for products such as yoghurt and 17% or 30+ for cheese)
- Eat less saturated fat
- Eat foods with less salt
- Eat less sugar (e.g. drink max 0.5 litres of soda per week)
- Drink water

[1] The original Danish guidelines can be found at: (Food and Argiculture Organization of the United Nations, 2013)

5.2.1.2 Nutrition guidelines - the Netherlands

Dutch guidelines for a healthy diet are similar to those for the Danish. The Health Council of the Netherlands published guidelines for healthy nutrition in 2015 (Gezondheidsraad, 2015). The short version of these guidelines is the following (translated from Dutch):

- Eat at least 200 grams of vegetables and 200 grams of fruit per day.
- Eat at least 90 grams of brown bread, whole grain bread or other whole grain products per day.
- Eat legumes at least weekly.
- Eat at least 15 grams of unsalted nuts per day.
- Eat several portions of dairy products per day; let these include milk or yoghurt.
- Eat fish once a week, preferably fatty fish.
- Drink three cups of tea per day.
- Replace refined grain products by whole grain products.
- Replace butter, hard margarine and baking fats by soft margarine, fluid baking fats or plant-based oils.
- Replace unfiltered coffee by filter coffee.
- Limit the consumption of red meat and especially processed meats.
- Drink as little sugary drinks as possible.
- Do not drink alcohol or at least not more than one glass per day.
- Limit salt consumption to a maximum of 6 grams per day.

5.2.1.3 Nutrition guidelines - United Kingdom (Scotland)

UK guidelines for a healthy diet are similar to those for the Danish and Dutch. The Eatwell Guide (Public Health England, 2019) lists the following:

- Eat at least 5 portions of a variety of fruit and vegetables every day
- Base meals on potatoes, bread, rice, pasta or other starchy carbohydrates; choosing wholegrain versions where possible
- Have some dairy or dairy alternatives (such as soya drinks); choosing lower fat and lower sugar options
- Eat some beans, pulses, fish, eggs, meat and other proteins (including 2 portions of fish every week, one of which should be oily)
- Choose unsaturated oils and spreads and eat in small amounts
- Drink 6-8 cups/glasses of fluid a day
- If consuming foods and drinks high in fat, salt or sugar have these less often and in small amounts.

5.2.1.4 Current diet - Comparison between countries

Figure 10, Figure 11, and Figure 12 show the consumption of food groups and components in 2016 for Denmark, The Netherlands and the United Kingdom, respectively. The TMREL values indicated define the safe minimum or maximum daily intake of a food group or nutrient.

Figure 10: Danish consumption of food groups and components in 2016. Images taken from (Development Initiatives Poverty Research Ltd., 2019).

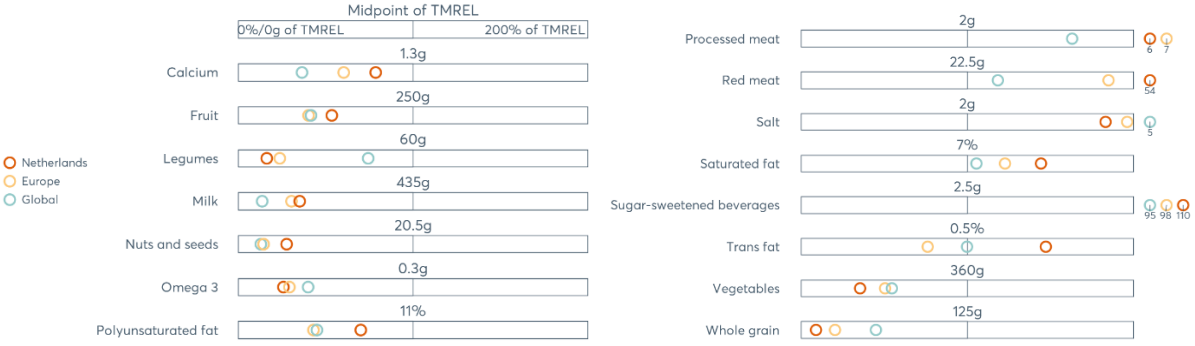


Figure 11: Dutch consumption of food groups and components in 2016. Images taken from (Development Intitiatives Poverty Research Ltd., 2019).

Figure 12: United Kingdom's consumption of food groups and components in 2016. Images taken from (Development Initiatives Poverty Research Ltd., 2019).

In Table 4 we provide an interpretation of these figures so that we can make a rough comparison between the three countries. Some observations:

- The Danish and Dutch consume more calcium and fruit than UK residents do, but all countries consume equal amounts of milk.
- Those from the UK eat less red meat and drink less sugar-sweetened beverages than those from the other two countries (it also happens to be the only country of the three with a tax on sugar-sweetened beverages).

- The Dutch consume more polyunsaturated fat than residents of the other two countries. They also consume somewhat more trans fats, although this difference is a lot smaller.
- In all three countries, salt consumption is lower than in Europe on average and globally. The same mostly holds for vegetable consumption as well.

Table 4: Estimated differences between the three countries of interest and Europe and the world on consumption of food groups and components in 2016.

Food group / component	Denmark		The Netherlands		United Kingdom	
	vs. Europe	*vs. global*	*vs. Europe*	*vs. global*	*vs. Europe*	*vs. global*
Calcium	+	++	+	++	0	+
Fruit	+	+	+	+	0	0
Legumes	-	---	-	---	0	---
Milk	+	++	+	++	+	++
Nuts and seeds	0	0	+	+	0	0
Omega 3	+	0	0	-	0	0
Polyunsaturated fat	0	0	++	++	0	0
Processed meat	+	+++	-	+++	+	+++
Red meat	+	+++	+	+++	--	+
Salt	-	--	-	--	--	---
Saturated fat	+	++	+	++	+	++
Sugar-sweetened beverages	+	+	+	+	-	-
Trans fat	+	-	+++	++	++	+
Vegetables	-	0	-	-	-	-
Whole grain	+	-	-	--	0	-

5.2.2 Information and resources

General:

- Voedingscentrum: https://www.voedingscentrum.nl/
- British Guidelines for Healthy Nutrition: (Public Health England, 2019)
- Danish Guidelines for Healthy Nutrition: (Danish Veterinary and Food Adminstration, 2018)
- Dutch Guidelines for Healthy Nutrition: (Gezondheidsraad, 2015)

Diabetes type 2 (more in the section on diabetes coaching):

- Diabetes Vereeniging Nederland (Dutch Diabetes Association): https://www.dvn.nl/leven-met-diabetes/voeding
- The British Diabetic Association: https://www.diabetes.org.uk/diabetes-the-basics/food-and-diabetes/i-have-type-2-diabetes

5.2.3 Nutrition coaching in the Council of Coaches

We defined the coaching process for nutrition coaching in a similar manner as the physical activity coaching. Taking into account the guidelines and information described in the previous sections, the lessons learned from the behaviour change literature in D3.1 (Beinema, et al., 2018), and the abstract coaching model reported on in D3.3 (Beinema & op den Akker, 2018), we defined the coaching process between users and the nutrition coach in the Council of Coaches. For nutrition coaching this will involve the following:

The first interactions will be similar to those with the physical activity coach. A user will meet the nutrition coach. The coach will introduce themselves and their coaching domain. The interactions between the nutrition coach and the user will also be a mix of serious coaching conversations and elaborations on the coach's background story (hobbies, origin, etc.) for a lighter topic of conversation.

Once the coach and user have been introduced, the coaching process starts. The nutrition coach will provide the user with information on what a healthy diet is. With diabetic users, the coach will take into account their diabetes and might provide additional information on e.g. the effects of eating carbohydrates (in cooperation with the diabetes coach). The coach will ask the user relevant questions, for example about their allergies and food preferences.

The nutrition coach in the Council of Coaches will ask the user to fill in a food diary, which helps them to become aware of their daily intake. The coach can also recommend recipes to the user, taking into account their (dietary) preferences and allergies. Together with the coach the user can set short term goals, which focus on making achievable changes to their diet and creating habits. For example, try to eat enough fruit every day for a week, drink enough water or add no extra salt to meals.

5.2.4 Coaching actions

For our nutrition coach, the topic structure again starts with a 'Start' node that allows a choice between the 'Social' topic and the 'Coaching' topic (see Figure 13). The general content for these topics is similar as for the physical activity (and other coaches). The 'Social' topic has two subtopics. One is the 'Introduction' that represents the dialogue in which the coach and the user can introduce themselves. The other is 'Background story', which includes dialogues about the coach's background story – e.g. what are their hobbies, where did they grow up, etc.

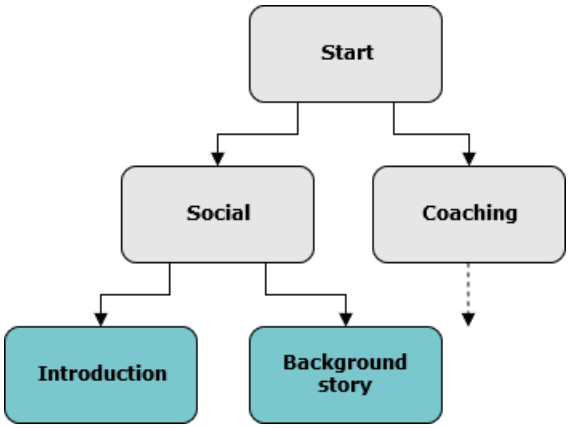


Figure 13: The start of the hierarchy of coaching topics and the two types of topics that are subtopics of the available 'Social' topic.

The 'Coaching' topic on the other hand has six subtopics, which include three topics that directly result in dialogues (see Figure 14) and three topics that have subtopics themselves (see Figure 15). We will begin by discussing the three topics that directly result in dialogues (again, see Figure 14). The first one is 'Gather information', which allows for dialogues in which the coach asks the user about their allergies and preferences. E.g. what allergies do they have, which types of food do they dislike, are they on a specific diet (vegetarian, vegan, low-carb, etc.)? What do they think of eating healthily? The second one is 'Discuss coaching approach' in which the coach discusses with the user what style of coaching they would prefer. E.g. some users might really like to receive information, while others are already quite knowledgeable and prefer to receive more feedback. The third topic is 'Discuss sensors' which allows for dialogues about the sensors. E.g. What is the food diary? What does the coach do with what you enter in the dairy?

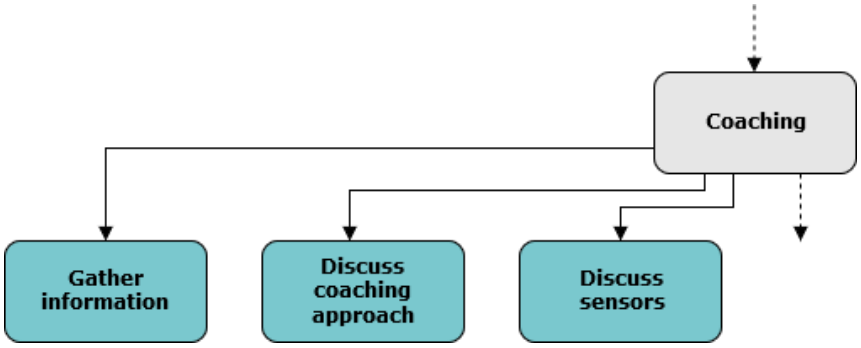


Figure 14: The first set of subtopics for the 'Coaching' topic.

Then, there are three other topics for 'Coaching' that have subtopics themselves (again, see Figure 15). These three are 'Goal-setting', 'Learning & skills', and 'Feedback & support'.

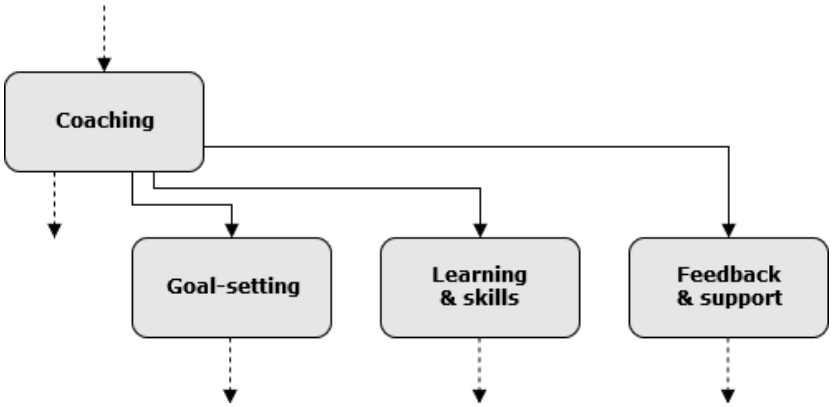


Figure 15: The second set of subtopics for the 'Coaching' topic.

The 'Goal-setting' topic for nutrition coaching has three subtopics (see Figure 16). The first is 'Set new goal', which relates to dialogues about setting a short-term goal (or weekly challenge). The second topic 'Discuss actions to achieve goal' allows for a discussion between the coach and a user on what the user will do and when to e.g. drink more water or eat more fruit. Previously gathered information such as the user's dietary preferences (and if they have diabetes) can be used to make suggestions that fit the user.

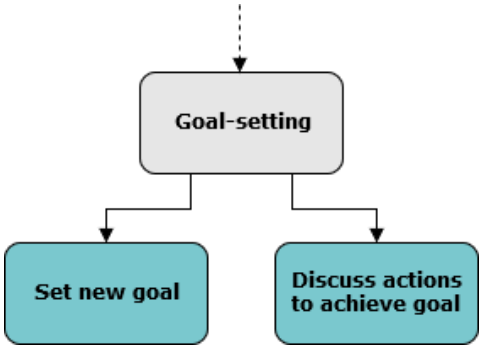


Figure 16: The subtopics for the 'Goal-setting' topic.

The 'Learning & skills' topic also has three subtopics (see Figure 17). The first is 'Inform', which has subtopics again (we will first explain the others). The second 'Advise on social support' relates to dialogues in which the user can discuss with the coach how they might ask their family and friends to change their diet with them or to help them adjust their environment. The third topic, 'Help recognise triggers', allows for a dialogue between the coach and the user in which the user reflects with the coach on what might cause them to have a less healthy diet.

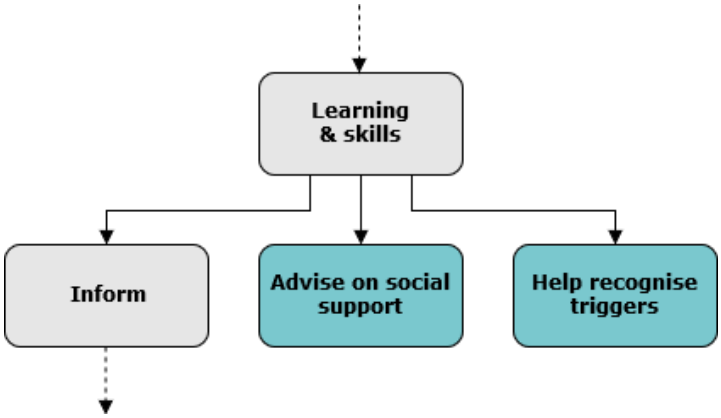


Figure 17: The subtopics for the 'Learning & skills' topic.

The inform topic has two subtopics (see Figure 18), 'Inform 'how'' and 'Inform 'why', which in turn have two subtopics. 'Give an example' provides an example of how the user might eat healthier. E.g. by telling a story about a similar person that did so. 'Explain' on the other hand explains to the user in a factual manner how they can eat healthier. The dialogues for the 'Positive effects (of doing)' and the 'Negative effects (of not doing)' provide the user with information on why they should eat healthy and why eating unhealthily might be bad for their health.

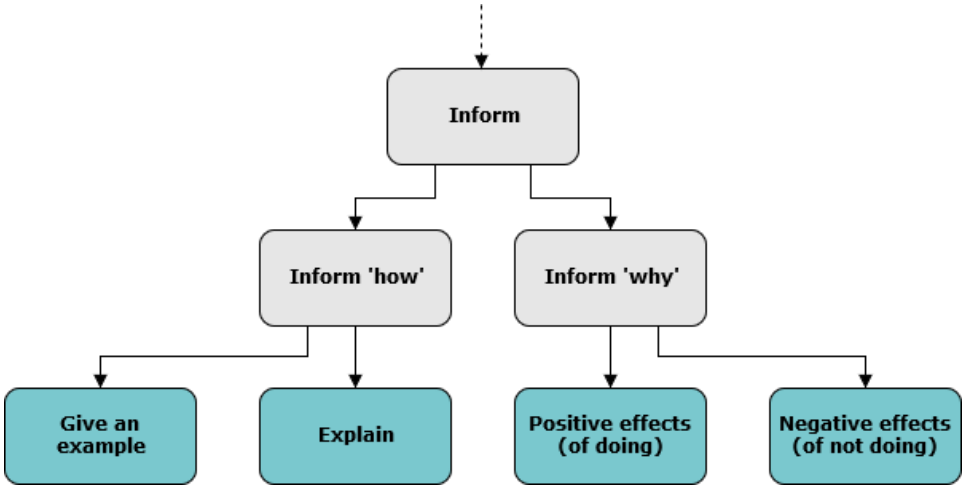


Figure 18: The subtopics for the 'Inform' topic.

Finally, the last topic, 'Feedback & support', has three subtopics (see Figure 19). The first is 'Discuss progress' in which the coach will discuss the user's progress on the short-term nutrition goal they have. E.g. Are they doing well? The second subtopic is 'Discuss experience', which allows for a discussion between the coach and the user on how the user feels that it is going. E.g. is the process easy and are they getting used to their dietary changes? Or is it very difficult? The third is 'Provide recipe' which allows for a dialogue in which the user can get a recipe recommendation from the coach.

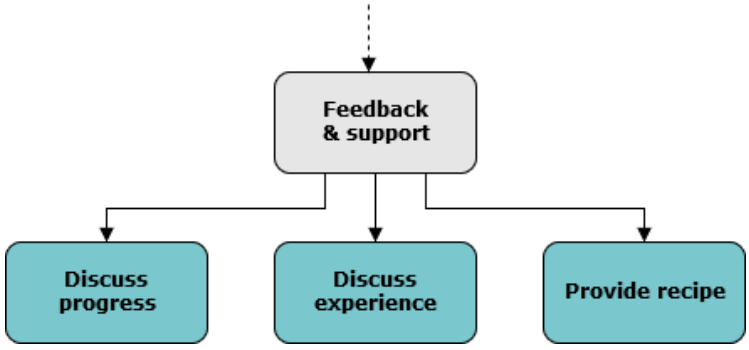


Figure 19: The subtopics for the 'Feedback & support' topic.

5.3 Social

The lack of social contacts and a social support network is related to loneliness and social isolation among (older) adults (Dahlberg, Andersson, McKee, & Lennartsson, 2015) (Dykstra, Van Tilburg, & Gierveld, 2005). It is important to draw the distinction between loneliness and social isolation. Loneliness can be defined as the subjective feeling of the absence of a social network or a companion (Peplau & Perlman, 1982) and social isolation can be defined as an objective lack of interactions with others or the wider community (de Jong-Gierveld, van Tilburg, & Dykstra, 2006).

In literature, both loneliness and social isolation are linked to numerous negative health outcomes (Leigh-Hunt, et al., 2017) comparable to the negative health outcomes of smoking, obesity, lack of exercise and high blood pressure. Providing coaching for the social domain however is difficult, since there is no one-size-fits-all solution to reduce loneliness and social isolation (Cotterell, Buffel, & Phillipson, 2018).

Nowadays, there is a shift from cure to prevention and current interventions have more and more focus on promoting the creation and maintenance of high quality social relationships (Cotterell, Buffel, & Phillipson, 2018) as social participation is considered to be the key to prevent loneliness and social isolation. Therefore, the social coach in the Council of Coaches will aim to maintain and enlarge the social network of the user.

We define *social activity* as:

Social activity:

"Social interaction with other people; sharing interests and joint activities."

5.3.1 Guidelines and recommendations

Despite the fact that the problems related to social isolation and loneliness are increasingly visible within our society there are no guidelines and recommendations to prevent social isolation and loneliness among populations. Therefore, our social coach will follow parts of the Dutch informal intervention "Natuurlijk, een netwerkcoach" (van de Lustgraaf, 2016). This intervention aims to enlarge the social network of the participant following the systematic TO GROW coaching model (Whitmore, 2009) (TO GROW being an acronym for: TOpic Goal Reality Options Wrap up).

The intervention focuses on adults in vulnerable situations or circumstances that have a weak social network (or supportive relationships). Examples of situations that are listed in the intervention as possible causes for these circumstances are chronic diseases or physical limitations, ageing and health complaints resulting from ageing, and being a caregiver for a family member.

The intervention takes nine months on average, during which the coach and the coachee see each other once or twice a week. In this process, the coach focuses on empowering the client. The intervention has three phases, with ten steps that people go through with their coach:

- *Phase 1. Orientation*. Mapping the social network of the client.
    - Step 1. Introduction. The coach meets the client and their environment.
    - Step 2. Create an overview of the social network.
    - Step 3. Investigate supportive value of network.
- *Phase 2. Deliberation*. Personal research to the possibilities to enlarge and strengthen the social network of the client.
- Step 4. The social traffic square.
- Step 5. A round of positivity.
- Step 6. Ask people to think along.
- *Phase 3. Action.* Creating and to carry out a personal plan to enlarge and strengthen the social network of the client.
    - Step 7. Top 3.

- Step 8. Personal plan of action.
- Step 9. Take action.
- Step 10. Learn from experiences.

Some of these steps are difficult to realize using our virtual coaches, since the subject of social interaction, and especially if there is a lack of interaction, can be a delicate one. Therefore, we will implement aspects of this approach that empower the user, focussing on informing and providing exercises.

5.3.2 Information and resources

General information about:

- The need of a social network.
- Loneliness
- Social isolation

Module: "Natuurlijk, een netwerkcoach!": *https://www.movisie.nl/sites/movisie.nl/files/2018-03/Methodebeschrijving-natuurlijk-een-netwerkcoach.pdf*

5.3.3 Social coaching in the Council of Coaches

We defined the coaching process for social coaching using a similar structure as for physical activity and nutrition coaching. Taking into account the intervention and information described in the previous sections, the lessons learned from the behaviour change literature in D3.1 (Beinema, et al., 2018), and the abstract coaching model reported on in D3.3 (Beinema & op den Akker, 2018), we defined the coaching process between users and the social coach in the Council of Coaches. For social coaching this will involve the following:

The first interactions will be similar to those for the other coaches. A user will be introduced to the coach. The coach will introduce themselves and their coaching domain. The interactions between the social coach and the user will also be a mix of serious coaching conversations and elaborations on the coach's background story (hobbies, origin, etc.) for a lighter topic of conversation.

Once the coach and user have been introduced, the coaching process starts. The social coach will ask the user about their social network. They will provide information on the need of a social network, loneliness and social isolation. They will also provide exercises that help the user become aware of their social network. That is, who are the people that they interact with? What could be opportunities to meet new people or increase contact with existing relations.

Since the domain of social relations can be a very sensitive subject and interpretation by the system is a sensitive process, the social coach will mostly limit themselves to the provision of information and exercises, as described above. The coach will provide these when the user indicates that they are welcome, in this manner focussing on empowerment of the user. To get a sense of a user's contacts with other people and into the user's social behaviour, the coach will regularly ask the user about their interactions with other people (following the coach-as-a-sensor paradigm).

5.3.4 Coaching actions

For our social coach, the topic structure again starts with a 'Start' node that allows a choice between the 'Social' topic and the 'Coaching' topic (see Figure 20). The general content for these topics is similar as for the physical activity (and other coaches). The 'Social' topic has two subtopics. One is the 'Introduction' that represents the dialogue in which the coach and the user can introduce themselves. The other is 'Background story', which includes dialogues about the coach's background story – e.g. what are their hobbies, where did they grow up, etc.

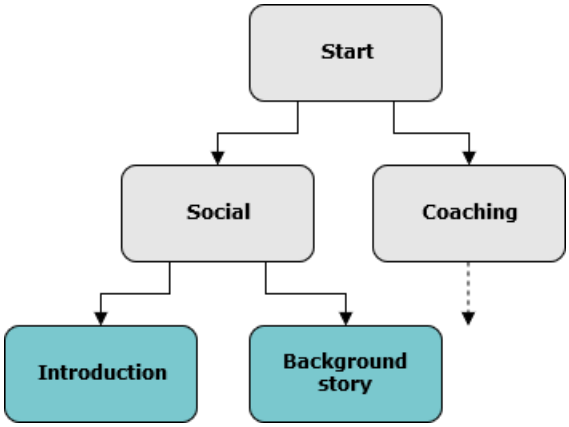


Figure 20: The start of the hierarchy of coaching topics and the two types of topics that are subtopics of the available 'Social' topic.

The 'Coaching' topic for the social coach has three subtopics, which include two topics that directly result in dialogues (see Figure 21) and one topic that has subtopics itself (see Figure 22). We will begin by discussing the two topics that directly result in dialogues (again, see Figure 21). The first one is 'Gather information', which allows for dialogues in which the coach asks the user about the social topics. E.g. How do they feel about discussing their social activity? Who are the people that they interact with often? The second topic is 'Discuss questions' which allows the coach to explain the questions that the user will be asked regularly about their social interactions and their purpose.

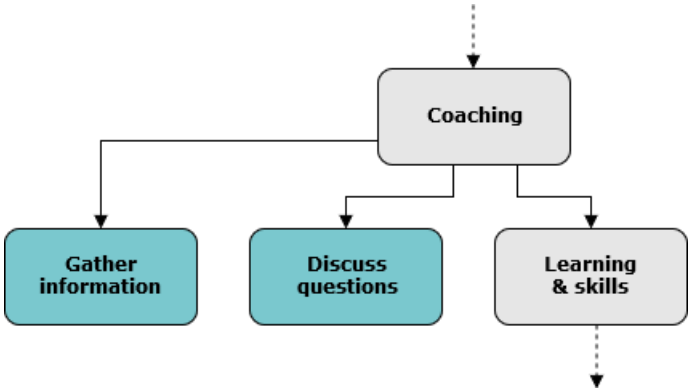


Figure 21: The subtopics for the 'Coaching' topic.

The 'Learning & skills' topic has two subtopics (see Figure 22). The first is 'Inform', which has subtopics again (we will first explain the other topic). The second topic is 'Provide exercise' and it relates to dialogues in which the coach explains an exercise to the user that helps them e.g. to learn more about their social network or could help them try a new interaction with other people.

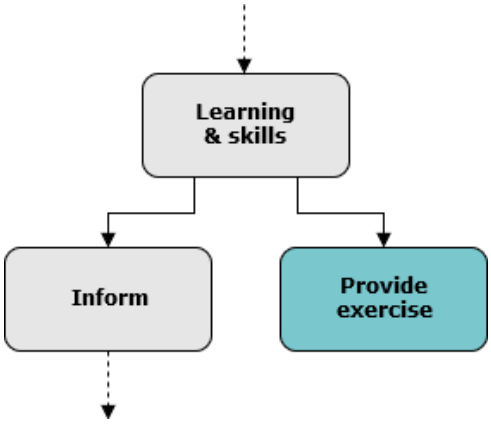


Figure 22: The subtopics for the 'Learning & skills' topic.

The inform topic has two subtopics (see Figure 23), 'Inform 'how'' and 'Inform 'why', which taken together have three subtopics. 'Give an example' provides an example of how the user could make a small change to their social life. E.g. by telling a story about a similar person that did so. The 'Explain' topic on the other hand provides some options of what the user could do. Finally, the dialogues for the 'Positive effects of doing' topic provides information on e.g. why a social network is important, etc. An explicit choice was made to not include the 'Negative effects (of not doing)' topic, since commenting on a user's social behaviour is a delicate process.

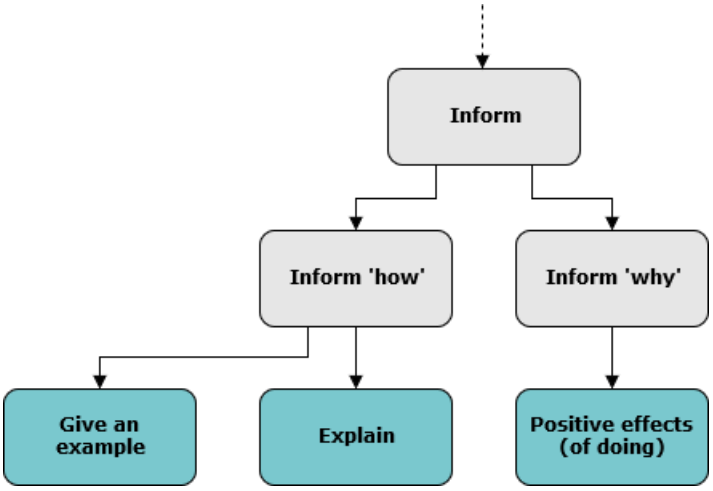


Figure 23: The subtopics for the 'Inform' topic.

5.4 Cognition

Recently, the WHO published the guidelines "Risk reduction of cognitive decline and dementia" (World Health Organization, 2019). These guidelines are composed to prevent cognitive decline and dementia by a public health approach and to implement key interventions to delay or slow cognitive decline or dementia. A public health approach is feasible because of the current knowledge on the existence of potentially modifiable risk factors as physical inactivity, tobacco use, an unhealthy diet, harmful use of alcohol, social isolation and cognitive inactivity.

In addition to the strong recommendation to increase physical activity among older adults, and to focus on a health and balanced diet, the WHO does the following conditional recommendation for the cognition domain: "Cognitive training may be offered to older adults with normal cognition and with mild cognitive impairment to reduce the risk of cognitive decline and/or dementia".

Following Stern et al., 2012 the cognitive reserve (the brain's ability to cope with or compensate for neuropathology or damage) is a protective factor that may reduce the risk of clinical onset of dementia and cognitive decline (Stern Y. , 2012). Studies show that increased cognitive activity may stimulate cognitive reserve and have a buffering effect against rapid cognitive decline (Stern & Munn, 2010) (Sattler, Toro, Schönknecht, & Schröder, 2012). Therefore, cognitive activity can be increased through cognitive stimulation therapy and/or cognitive training.

Considering the possibilities that the Council of Coaches application offers, the cognitive coach will focus on cognitive training. Cognitive training refers to "guided practice of specific standardized tasks designed to enhance particular cognitive functions" (Clare & Woods, 2004). In a recent review a meta-analysis was conducted which showed that cognitive training in health older adults has a moderate positive effect on overall cognitive functioning.

We use the following definition of *cognition*:

Cognition:

"The mental action or process of acquiring knowledge and understanding through thought, experience and the senses."

5.4.1 Guidelines and recommendations

Following the WMO guidelines "Risk reduction of cognitive decline and dementia", cognitive training may be offered to older adults with normal cognition and with mild cognitive impairment (MCI) to reduce the risk of cognitive decline and/or dementia. These guidelines list a number of interventions in other domains that influence cognition. To list those that are relevant for our set of target populations and domains:

- "Physical activity should be recommended to adults with normal cognition to reduce the risk of cognitive decline." (Moderate quality of evidence, strong recommendation.)
- "Physical activity may be recommended to adults with mild cognitive impairments to reduce the risk of cognitive decline." (Low quality of evidence, conditional recommendation.)
- "The Mediterranean-like diet may be recommended to adults with normal cognition and mild cognitive impairment to reduce the risk of cognitive decline and/or dementia." (Moderate quality of evidence, conditional recommendation.)
- "A healthy, balanced diet should be recommended to all adults based on WHO recommendations on healthy diet. (Low to high quality of evidence (for different dietary components), strong recommendation.)
- "Vitamins B and E, polyunsaturated fatty acids and multi-complex supplementation should not be recommended to reduce the risk of cognitive decline and/or dementia." (Moderate quality of evidence, strong recommendation.)
- "Cognitive training may be offered to older adults with normal cognition and with mild cognitive impairment to reduce the risk of cognitive decline and/or dementia." (Very low to low quality of evidence, conditional recommendation.)
- "There is insufficient evidence for social activity and reduction of risk of cognitive decline/dementia."
- "Social participation and social support are strongly connected to good health and well-being throughout life and social inclusion should be supported over the life-course."
- "Interventions for mid-life overweight and/or obesity may be offered to reduce the risk of cognitive decline and/or dementia." (Low to moderate quality of evidence, conditional recommendation.)
- "The management of diabetes in the form of medication and/or lifestyle interventions should be offered to adults with diabetes according to existing WHO guidelines." (Very low to moderate (for different interventions) quality of evidence, strong recommendation.)
- "The management of diabetes may be offered to adults with diabetes to reduce the risk of cognitive decline and/or dementia." (Very low quality of evidence, conditional recommendation.)

As can be seen from the list above, cognition can be affected by behaviour in a number of other domains. While cognitive training can help, the quality of evidence for cognitive training to be effective is very low to low, and therefore we believe that even though our cognition coach with provide elements from cognitive training, the coaching provided by the other coaches on the other domains will also be beneficial for the user.

5.4.2 Information and resources

As there is only limited information on effective cognitive training programs, we contacted a local Dutch welfare organisation "Wijkracht" (the name being a combination of the Dutch words for *us* or *we* 'wij' and *strength* 'kracht', in addition the word *neighbourhood* in Dutch happens to be 'wijk'). This organisation works within various municipalities and focusses on the wellbeing of older adults. They offer physical and nutritionals courses, but also provide a course on memory activation. The mentor of

this course shared with us her experiences and her handouts will be the main resources building the content for the cognitive coach. The handouts describe a course of eight meetings. During these meetings the following themes are addressed:

- The normal memory.
- The difference between age-related forgetfulness and dementia.
- Self-confidence.
- Frequently asked questions.
- External memory strategies.
- Internal memory strategies.

5.4.3 Cognition coaching in the Council of Coaches

We defined the coaching process for cognition coaching using a similar approach as for social coaching. We used the handouts and guidelines described in the previous sections, the lessons learned from the behaviour change literature in D3.1 (Beinema, et al., 2018), and the abstract coaching model reported on in D3.3 (Beinema & op den Akker, 2018) to define the coaching process between users and the cognition coach in the Council of Coaches. For cognition coaching the coaching will involve the following:

The first interactions will once again be similar to those for the other coaches. A user will be introduced to the coach. The coach will introduce themselves and their coaching domain. The interactions between the cognition coach and the user will, just as with the other coaches, be a mix of serious coaching conversations and elaborations on the coach's background story (hobbies, origin, etc.) for a lighter topic of conversation.

Once the coach and user have been introduced, the coaching process starts. The cognition coach will ask the user questions about their cognitive state. They will inform on the importance of cognitive training, and when asked, will provide additional information on this subject. They will also teach the user about known external and internal memory strategies.

As with the domain of social relations, the domain of cognition can be a very sensitive subject – especially for adults over 55. Therefore, the cognitive coach will, similar to the social coach, mostly limit themselves to the provision of information and teaching of strategies, as described above. The coach will provide these when the user indicates that they are welcome, in this manner focussing on empowerment of the user. To get a sense of a user's activities that relate to cognition (such as reading a book, etc.), the coach will regularly ask the user about their interactions with other people (following the coach-as-a-sensor paradigm).

5.4.4 Coaching actions

The coaching actions for our cognition coach are very similar to those of the social coach. The topic structure again starts with a 'Start' node that allows a choice between the 'Social' topic and the 'Coaching' topic (see Figure 24). The general content for these topics is similar as for the all the other coaches. The 'Social' topic has two subtopics. One is the 'Introduction' that represents the dialogue in which the coach and the user can introduce themselves. The other is 'Background story', which includes dialogues about the coach's background story – e.g. what are their hobbies, where did they grow up, etc.

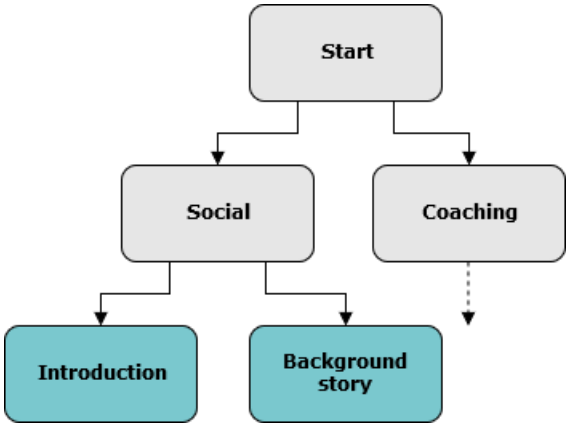


Figure 24: The start of the hierarchy of coaching topics and the two types of topics that are subtopics of the available 'Social' topic.

The 'Coaching' topic for the cognition coach has three subtopics, which include two topics that directly result in dialogues (see Figure 25) and one topic that has subtopics itself (see Figure 26). We will begin by discussing the two topics that directly result in dialogues (again, see Figure 25). The first one is 'Gather information', which allows for dialogues in which the coach asks the user about their cognition. E.g. what do they know about the topic? Which cognition training activities do they prefer? The second topic is 'Discuss questions' which allows the coach to explain the questions that the user will be asked regularly about their cognitive activities and their purpose.

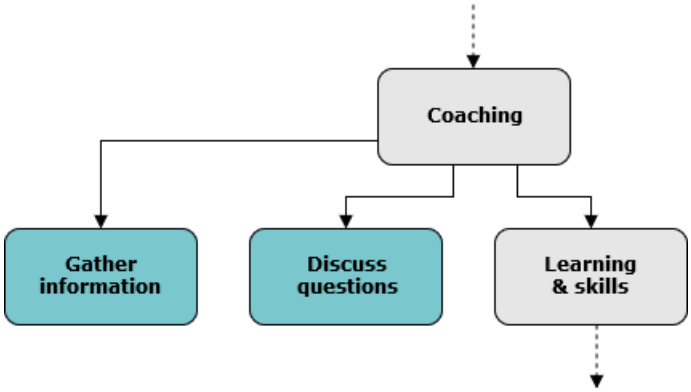


Figure 25: The subtopics for the 'Coaching' topic.

The 'Learning & skills' topic has two subtopics (see Figure 26). The first is 'Inform', which has subtopics again (we will first explain the other topic). The second topic is 'Provide exercise' and it relates to dialogues in which the coach provides the user with an exercise that trains their cognitive skills.

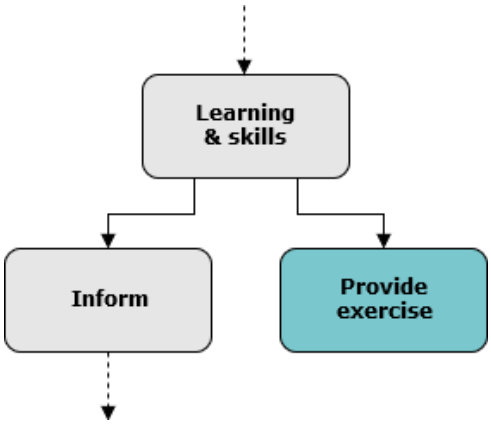


Figure 26: The subtopics for the 'Learning & skills' topic.

The inform topic has two subtopics (see Figure 27), 'Inform 'how'' and 'Inform 'why', which taken together have three subtopics. 'Give an example' provides an example of how the user could train their cognition. E.g. by telling a story about a similar person that did so. The 'Explain' topic on the other hand provides some options of what the user could do to train their cognition or how the internal and external memory strategies work. Finally, the dialogues for the 'Positive effects of doing' topic provides information on e.g. why it is important to keep training your cognitive capacity, etc. An explicit choice was made to not include the 'Negative effects (of not doing)' topic, since commenting on the negative effects of not training your cognition might involve comments about e.g. dementia or other illnesses that are often frightening for people and not always avoidable.

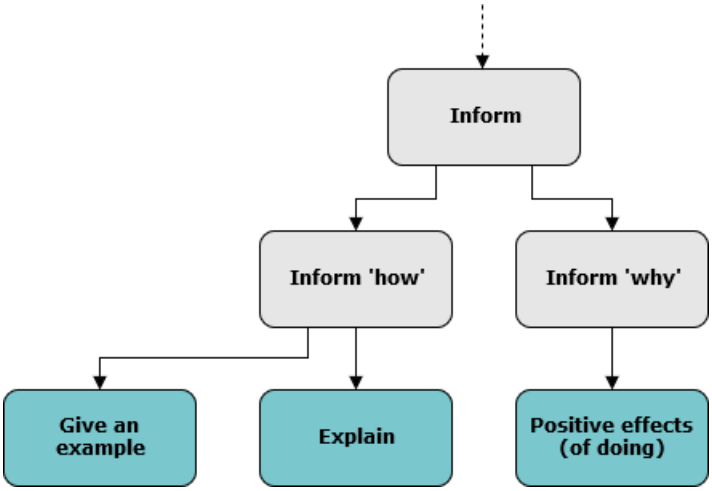


Figure 27: The subtopics for the 'Inform' topic.

5.5 Peer coaching

The peer coach in the Council of Coaches or "Carlos", will help the users by asking questions and adding to what the other coaches say. He will make comments that allow the user to ask for more information or that clarify what other coaches are saying. E.g. when the physical activity coach is explaining activity trackers, he can join in that he has a tracker as well, and offer to help the user from a "peer user" perspective.

In addition to his contributions in the conversations the other coaches have with the user, the peer coach will be able to introduce himself to the user, and he can discuss his background with the user to provide the user with a friendly intermezzo during the coaching sessions.

He can also ask the user about their experience with the Council of Coaches and will regularly inform on the user's most prevalent emotions throughout the day (following the coach-as-a-sensor paradigm), to get a sense of their mood.

5.6 Chronic pain

We define chronic pain in accordance with the definition of Turk & Okifuji (2009):

Chronic pain:

"Pain lasting longer than 3 months or beyond the expected period of healing of tissue pathology."

Chronic pain is a condition that often occurs as a comorbidity with other chronic conditions. Examples include cardiovascular disease, cancer, chronic pulmonary disease, and chronic renal disease (Kurita, Sjøgren, Juel, Højsted, & Ekholm, 2012). It can also affect people living with, e.g., diabetes, arthritis, fibromyalgia, irritable bowel and back pain (NHS, 2019).

Since chronic pain affects 20% of people worldwide, CP has quite a societal impact. In May 2019 the World Health Organization adopted the new edition of the International Classification of Diseases (ICD-11), in which chronic pain is included for the first time with code MG30 (World Health Organization, 2019). They define the following possible subcategories: chronic primary pain, chronic cancer related pain, chronic postsurgical or post traumatic pain, chronic secondary musculoskeletal pain, chronic secondary visceral pain, chronic neuropathic pain, chronic secondary headache or orofacial pain, other specified chronic pain, and chronic pain that is unspecified.

5.6.1 Guidelines and recommendations

One of the approaches used to help people with chronic pain is Acceptance and Commitment Therapy (ACT). This form of therapy was designed with Relational Frame Theory as a starting point. The Dutch book 'Leven met Pijn' ('living with pain') (Veehof, Schreurs, Hulsbergen, & Bohlmeijer, 2017) provides methods and exercises for a chronic pain patient to learn to accept and live with their pain. Since this approach can focus on many aspects, we decided to visit the Roessingh Rehabilitation centre and discuss with health care professionals working with chronic pain to see what type of content would be beneficial for chronic pain patients. The conclusion of this process was that chronic pain patients could mainly benefit from receiving information on how to explain their chronic pain to other people.

The brochure that resulted from the consultations with the rehabilitation centre addresses the following subjects:

- What is pain? (What is pain, when does it become chronic?)
- What does the treatment involve? (What is ACT and which health care professionals are part of a team to treat chronic pain?)
- Explaining chronic pain (And why is it important to explain?), with a focus on different groups of people:
    - The patient's partner, who usually directly sees the effects of chronic pain.
    - The patient's children, who might experience that the patient is less able to participate in activities.
    - The patient's friends and family, who do not see the main effects, but can experience that the patient has a lower energy level.
    - The patient's colleagues, who might notice that the patient structures their task differently or is able to do less.
    - The patient's acquaintances, who the patient might speak to less often, but might ask why the patient works less or was not present at a social activity.

The NHS lists a few options that can help patients manage their pain, which include: planning the day, pacing themselves, learning to relax, taking regular enjoyable exercise, taking painkillers, talking to others and enjoyment of activities (NHS, 2019).

5.6.2 Information and resources

- The book 'Leven met Pijn' (Veehof, Schreurs, Hulsbergen, & Bohlmeijer, 2017)
- The website of the Roessingh rehabilitation centre provides informative videos that explain what chronic pain is: https://www.roessingh.nl/pijnvoorlichting
- The Pain Alliantie in Nederland (PA!N) (the pain alliance in the Netherlands) website: https://pijnalliantieinnederland.nl
- The website 'Thuisarts.nl' by the Dutch Association of General Practitioners: https://www.thuisarts.nl/chronische-pijn
- The NHS inform website on 'Chronic Pain': https://www.nhsinform.scot/illnesses-and-conditions/brain-nerves-and-spinal-cord/chronic-pain

5.6.3 Chronic pain coaching in the Council of Coaches

We defined the coaching process for chronic pain coaching in the Council of Coaches using a similar approach as for the other coaches. We used the sources and information described in the previous sections, the lessons learned from the behaviour change literature in D3.1 (Beinema, et al., 2018), and the abstract coaching model reported on in D3.3 (Beinema & op den Akker, 2018) to define the coaching

process between users and the diabetes type 2 coach in the Council of Coaches. For chronic pain the coaching will involve the following:

The first interactions will once again be similar to those for the other coaches. A user will be introduced to the coach. The coach will introduce themselves and their coaching domain. The interactions between the chronic pain coach and the user will, just as with the other coaches, be a mix of serious coaching conversations and elaborations on the coach's background story (hobbies, origin, etc.) for a lighter topic of conversation.

Once the coach and user have been introduced, the coaching process starts. The chronic pain coach will focus on empowering the user with a focus on explaining their pain to others. To do so, they will ask the user questions about their type of pain, and on the people in their environment (e.g. do they have children, a partner, etc.). The coach will inform the user on the risks of overextending themselves, or being too sedentary, and the need of balancing their activity over the day and week. Furthermore, the coach will take care that the other coaches take the user's chronic pain into account when giving advice by joining in these conversations and emphasizing important elements for chronic pain.

5.6.4 Coaching actions

For our chronic pain coach, the topic structure again starts with a 'Start' node that allows a choice between the 'Social' topic and the 'Coaching' topic (see Figure 28). The general content for these topics is similar as for the physical activity (and other coaches). The 'Social' topic has two subtopics. One is the 'Introduction' that represents the dialogue in which the coach and the user can introduce themselves. The other is 'Background story', which includes dialogues about the coach's background story – e.g. what are their hobbies, where did they grow up, etc.

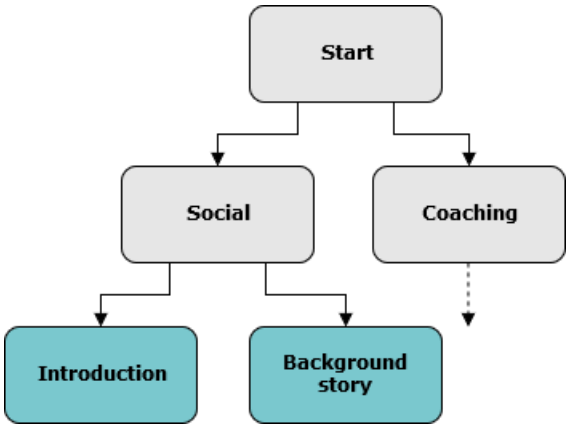


Figure 28: The start of the hierarchy of coaching topics and the two types of topics that are subtopics of the available 'Social' topic.

The 'Coaching' topic for chronic pain coach has two subtopics, which include a topic that directly results in dialogues (see Figure 29) and one topic that has a subtopic itself (see Figure 30). We will begin by discussing the topic that directly results in dialogues (again, see Figure 29). This topic is 'Gather information', which allows for dialogues in which the coach asks the user about their chronic pain. E.g. How long have they had chronic pain? Do they have children or a partner?

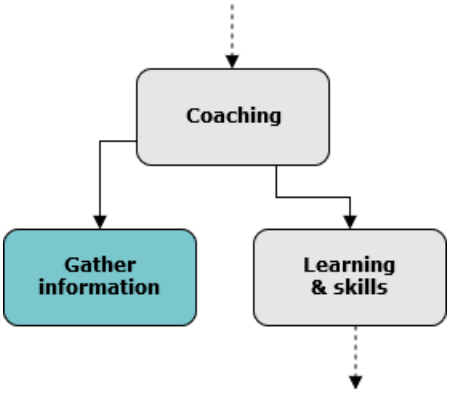


Figure 29: The subtopics for the 'Coaching' topic.

The 'Learning & skills' topic has one subtopic (see Figure 30). This topic is 'Inform', which has subtopics again.

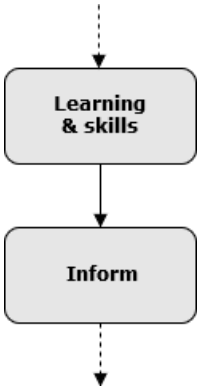


Figure 30: The subtopics for the 'Learning & skills' topic.

The inform topic has two subtopics (see Figure 31), 'Inform 'how'' and 'Inform 'why', which taken together have three subtopics. 'Give an example' provides an example of how the user could explain their chronic pain to other people. E.g. by telling a story about a similar person that did so. The 'Explain' topic on the other hand provides some concrete suggestions for balancing their activity over the day. Finally, the dialogues for the 'Positive effects (of doing)' topic provides information on e.g. why explaining their pain to others might be beneficial, or why balancing their activity over the day is a good idea.

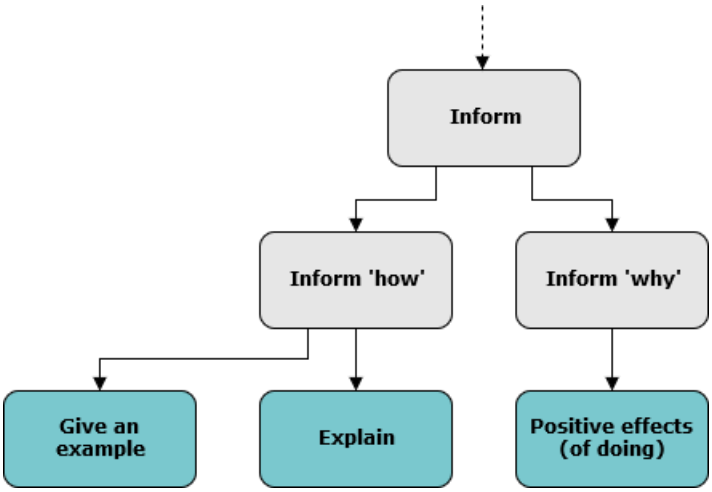


Figure 31: The subtopics for the 'Inform' topic.

5.7 Diabetes type 2

The WHO fact sheet on diabetes (World Health Organization, 2018) states that diabetes type 2 'results from the body's ineffective use of insulin', as opposed to type 1 (characterized by deficient insulin production). Most people who have been diagnosed with diabetes have type 2, which is in many cases the result of being overweight or an unhealthy lifestyle, while type 1, on the other hand, cannot be prevented and is present from a young age.

Diabetes type 2:

"Diabetes that is characterized by the body's ineffective use of insulin (or insulin resistance)."

In the 'Global report on diabetes' (World Health Organization, 2016), the introduction mentions that member states have set a target for 2030 to reduce premature mortality from NCDs (which includes diabetes) by one third. They also aim to achieve universal health coverage and make sure people have access to affordable essential medicines. While, these are changes that can be achieved by governments, there are interventions that can reduce the health effects for people with diabetes (for all types) (World Health Organization, 2016). These include blood glucose control, control of blood pressure and lipids, and regular screening for damage. Blood glucose control often involves adjustment of diet, physical activity, and medication - when needed. Control of blood pressure and lipids reduces cardiovascular risk and complications. Regular screening of eyes, kidneys and feet does not prevent all damage, but allows provision of treatment in an early stage, thus preventing further damage.

5.7.1 Guidelines and recommendations

The WHO's 'Global report on diabetes' (World Health Organization, 2016) provides six guidelines and recommendations, of which most are directed at governments. One of these guidelines however is:

"Prioritize actions to prevent people becoming overweight and obese, beginning before birth and in early childhood. Implement policies and programmes to promote breastfeeding and the consumption of healthy foods and to discourage the consumption of unhealthy foods, such as sugary sodas. Create supportive built and social environments for physical activity. A combination of fiscal policies, legislation, changes to the environment and raising awareness of health risks works best for promoting healthier diets and physical activity at the necessary scale."

This indicates that dietary adjustments and enough physical activity over the day are important elements in coaching for diabetes. The Nutritional Guidelines for Diabetes (Nederlandse Diabetes Federatie, 2015)) name a few dietary elements that are important in prevention of diabetes type 2:

Eating too much saturated fat can lead to higher amounts of fat in the liver, and visceral fat (around organs), which in turn have a relation with diabetes type 2. Reducing the consumption of sugar sweetened beverages might help against weight gain and prevent cardiovascular complaints. Consumption of coffee on the other hand seems to reduce the risk of diabetes type 2, as does a high enough vitamin D intake.

For people with diabetes type 2, the Nutritional Guidelines for Diabetes (Nederlandse Diabetes Federatie, 2015) provide the following practical advice:

- Eat a Mediterranean diet or a carbohydrate-limiting diet.
- When including sources of carbohydrates, prefer:
  - Whole grain products
  - Legumes
  - Vegetables
  - Fruit
- Limit refined carbohydrate products:
  - White bread and bread products from white flour
  - Cake, pastries and cookies

    - Cereals that are low in fibre
    - White rice and pasta
- Reduce consumption of sugary drinks and replace these with water, thee or coffee (without sugar).

The document containing the guidelines also elaborates on the glycaemic index (GI), and provides specific advice for all kinds of nutrients, ranging from carbohydrates to artificial sweeteners, the effects of alcohol and what to eat when drinking alcohol, and various types of vitamins. Participating in sports and exercise is mentioned as a situation that requires extra attention, since those activities have an effect on the blood glucose levels.

5.7.2 Information and resources

- The website of the Dutch Diabetes Foundation: https://www.diabetesfonds.nl/
- The website of the Dutch Diabetes Association: https://www.dvn.nl/
- The website of the Dutch Diabetes Federation: http://www.zorgstandaarddiabetes.nl
- Kiesbeter – Diabetes type 2 (a website by the Dutch government that provides information to help people make medical choices): https://www.kiesbeter.nl/onderwerpen/diabetes-type-2
- Thuisarts.nl (an informative website from the Dutch Association of General Practioners): https://www.thuisarts.nl/diabetes-mellitus-type-2
- Voedingscentrum (on nutrition for diabetes type 2): https://www.voedingscentrum.nl/encyclopedie/diabetes-type-2.aspx
- Foundation DIEP (Diabetes Interactief Educatie Programma): http://www.diep.info/
- The 'I have diabetes. What can I do?'-book by the Pharaos foundation that focuses on education for people with low literacy, migrants, elderly and those with a lower education: https://www.pharos.nl/kennisbank/ik-heb-diabetes-wat-kan-ik-doen/
- The American Diabetes Association: https://www.diabetes.org/diabetes/type-2
- Diabetes.org.uk (by the British Diabetic Association): https://www.diabetes.org.uk/

These sources provide all kinds of information, ranging from subjects such as nutrition and physical activity to explanations on the importance of self-checks for feet/eyes/skin/mouth to 'what is HbA1c?'.

5.7.3 Diabetes coaching in the Council of Coaches

We defined the coaching process for diabetes type 2 coaching in the Council of Coaches using a similar approach as for the other coaches. We used the sources and information described in the previous sections, the lessons learned from the behaviour change literature in D3.1 (Beinema, et al., 2018), and the abstract coaching model reported on in D3.3 (Beinema & op den Akker, 2018) to define the coaching process between users and the diabetes type 2 coach in the Council of Coaches. For diabetes type 2 the coaching will involve the following:

The first interactions will once again be similar to those for the other coaches. A user will be introduced to the coach. The coach will introduce themselves and their coaching domain. The interactions between the diabetes type 2 coach and the user will, just as with the other coaches, be a mix of serious coaching conversations and elaborations on the coach's background story (hobbies, origin, etc.) for a lighter topic of conversation.

Once the coach and user have been introduced, the coaching process starts. The diabetes type 2 coach will ask the user questions about their diabetes. E.g. how long have they been diagnosed? How much would they still like to learn about diabetes type 2? The coach will also inform on the importance of physical activity and a diabetes friendly diet (of course emphasizing to carefully balance their diet, insulin and exercise). She will also inform on the importance of regularly performing self-checks, and subjects such as blood glucose. Furthermore, the coach will take care that the other coaches take the user's diabetes into account when giving advice by joining in these conversations and emphasizing important elements for diabetes.

The diabetes coach will not provide advice that has to do with the user's insulin intake, nor will they advise lifestyle changes that go against doctors' orders. The user is under treatment of their general

practitioner and/or a hospital and the system will not make suggestions that can have an adverse effect on the user's health.

5.7.4 Coaching actions

For our diabetes type 2 coach, the topic structure again starts with a 'Start' node that allows a choice between the 'Social' topic and the 'Coaching' topic (see Figure 32). The general content for these topics is similar as for the physical activity (and other coaches). The 'Social' topic has two subtopics. One is the 'Introduction' that represents the dialogue in which the coach and the user can introduce themselves. The other is 'Background story', which includes dialogues about the coach's background story – e.g. what are their hobbies, where did they grow up, etc.

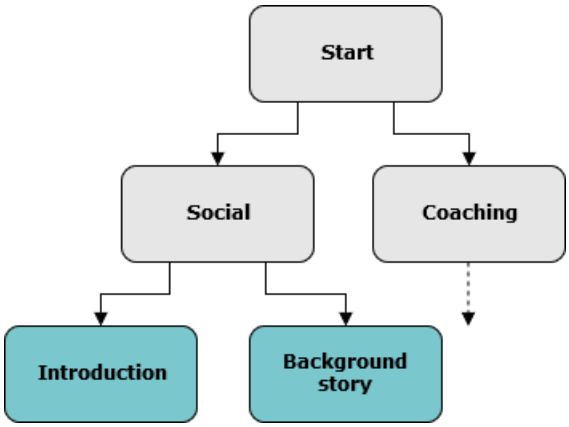


Figure 32: The start of the hierarchy of coaching topics and the two types of topics that are subtopics of the available 'Social' topic.

The 'Coaching' topic for the diabetes type 2 coach has two subtopics, which include a topic that directly results in dialogues (see Figure 33) and one topic that has a subtopic itself (see Figure 34). We will begin by discussing the topic that directly results in dialogues (again, see Figure 33). This topic is 'Gather information', which allows for dialogues in which the coach asks the user about their diabetes. E.g. How long have they had diabetes? Would they appreciate information on certain topics or not?

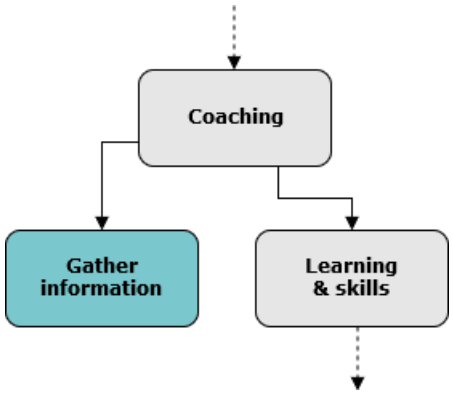


Figure 33: The subtopics for the 'Coaching' topic.

The 'Learning & skills' topic has one subtopic (see Figure 34). This topic is 'Inform', which has subtopics again.

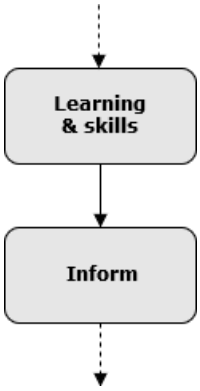


Figure 34: The subtopics for the 'Learning & skills' topic.

The inform topic has two subtopics (see Figure 35), 'Inform 'how'' and 'Inform 'why', which taken together have four subtopics. 'Give an example' provides an example of how the user could deal with eating healthier as a diabetic. E.g. by telling a story about a similar person that did so. The 'Explain' topic on the other hand provides some options of what the user could do to make lifestyle changes that are beneficial for their diabetes. Finally, the dialogues for the 'Positive effects (of doing)' and the 'Negative effects (of not doing)' topics provides information on e.g. why a certain diet and exercise pattern is beneficial for diabetics, and what the risks are for unhealthy behaviour.

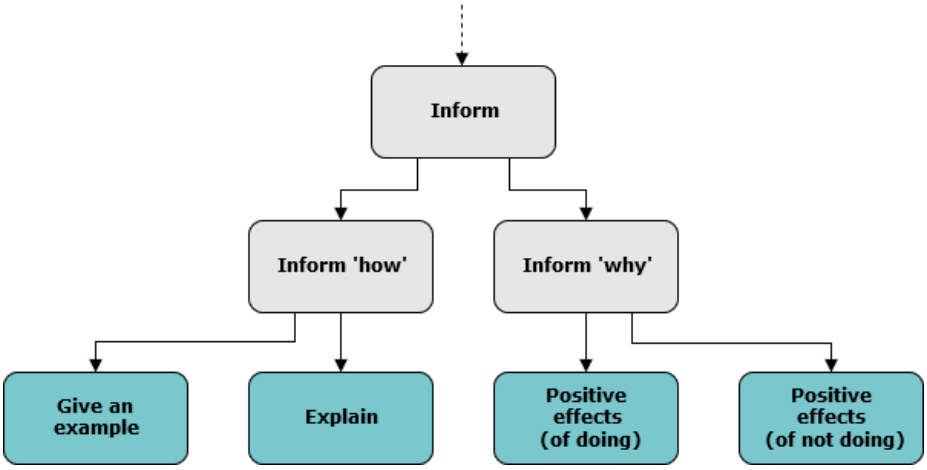


Figure 35: The subtopics for the 'Inform' topic.

5.8 Assistant

The assistant of the Council of Coaches or "Coda", will guide the users through the application. He will perform tasks that in a conventional application without agents could be represented by information pages, forms or menu-options. Coda is always visible to the user and there for them to talk to.

The first time the user meets Coda, he will help them create an account. Once the user has done so, he will ask the user some questions and then let them select a council by themselves. If the user prefers to get help with choosing a council, Coda will ask some additional questions and a suggestion of coaches is done that the user can agree with or adapt.

When the user enters the Council's living room for the first time, Coda will explain to them that they can click on the coaches and he will chair an introduction round with the coaches. This provides the user with an idea of the interaction mechanisms and sets up the more elaborate introductions and discussions between the coaches and the user by refreshing the user's memory of which coach is who.

After the initial contact between the user and the coaches, Coda will be able to repeat the explanation of the living room, and he will be able to log the user out of the system if they request so.

Part B: The WOOL dialogue framework

1. Design and description of the developed dialogue language and tools

6 The WOOL dialogue framework

Dialogue authoring for embodied conversational agents (ECAs) can be a time-intensive process. Writing *good* dialogues requires domain knowledge, knowledge about the dialogue specification language, knowledge about variables that are available in the system, and – not to be underestimated – creativity. This process can be difficult for writers who are not experts on the technical aspects, even though they might be domain experts; and vice versa.

During the development of the first functional demonstrator for the Council of Coaches project, the need for an easy to use dialogue language and authoring tools became apparent. After some background research – mainly in the domain of scripting languages for games (examples e.g. include Twine, and Ink) - a scripting language called Yarn became our starting point. Over the course of the project, we have created a dialogue definition that serves our needs and tools for dialogue parsing, execution, editing and testing.

The resulting WOOL dialogue framework is open-source under a MIT-license and fills the need for simplifying the dialogue writing process that we experienced in those initial sessions nearly two years ago. The dialogue specification itself has the power to express complicated conditionals and variables, but can also be used to define simple statements and replies. The web-based editing tool that is developed allows a novice user to edit the dialogues - after just a short explanation - and has built in error checking and a test-function, which allows the dialogue to be tested as an interaction with an agent.

The WOOL dialogue framework can be found at this GitHub repository:

The WOOL dialogue framework GitHub-repository:

https://github.com/RoessinghResearch/wool/

The repository contains a description of the dialogue specification language (also see section 6.3), the parsers (see section 6.4 for a short description), the editor (see section 6.5 for a short description and impression of the GUI) and the license under which it is available (the MIT License; also see section 6.6). The repository also includes a set of test dialogues that can be used by developers when starting out with WOOL.

In the following subsections we will begin with a short overview of existing tools for dialogue authoring – both from the scientific community and the commercial community. This is followed by the needs and objectives that we defined for our framework. After that, we will discuss the dialogue specification language and tools that make up the WOOL dialogue framework. We end this section of the deliverable with the license and a short conclusion.

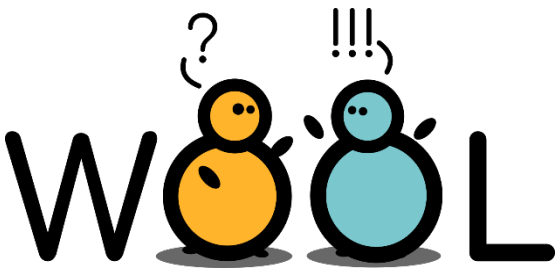


Figure 36: The WOOL dialogue framework logo.

6.1 Review of existing tools

We started a search for an existing tool that provided the functionality that we needed. Our initial needs were the following:

- The user must be able to easily learn and use the tool, especially when it comes to non-experts in agent-systems.
- The tool must not require the user to learn a specific language in order to author the dialogues.
- The tool must facilitate scripted dialogues with a statement-reply type structure.
- The tool must provide files for which the format is easy to read into our system.

A search for suitable academic and commercial tools led to a large set of potentially interesting tools from the domains of educational agents, chat bots or assistive agents, narrative games, interactive stories, serious games, soft skill educational simulations, and the gaming industry in general. While some of these we found to be no longer available or outdated. The availability was a common problem with tools found in scientific literature; e.g. the tools described in (Fitzmaurice, Armstrong, Carroll, Dagger, & Gill, 2007), (Iurgel, 2006) or (Jordan, Rosé, & VanLehn, 2001), while another problem was that the tools focussed on agents with a different type of dialogue specification (e.g. commercial tools such as Lex (Amazon, 2019), Wit.ai (Facebook, 2019), DialogueFlow (Google, 2019), Watson Assistant (IBM, 2019), or LUIS (Microsoft, 2019). Other types of tools were too elaborate or expensive (e.g. (Stefnisson & Thue, 2018) or Articy (Articy Software GmbH & Co.KG, 2019)) or had dialogue editing interfaces that were text based instead of more graphical (Nelson, 2019).

In the end, four toolkits/frameworks from the interactive storytelling community seemed to fit the two requirements listed above the best, namely:

- Novella, a scientific tool (Green, Hargood, & Charles, 2018b)
- Squiffy, an open-source 'commercial' tool (The Text Adventures Community, 2019)
- Twine, an open-source 'commercial' tool (Interactive Fiction Technology Foundation, 2019)
- Yarn, an open-source 'commercial' tool (The Yarn Community, 2019)

Of these tools, Yarn came closest to what we had in mind, and thus it became a starting point for our dialogue framework.

6.2 Objectives for the framework

In their review of authoring tools for narrative games Green et al. present the following feature set by which the tools that came out of their specific search could be defined or grouped (Green, Hargood, & Charles, 2018a):

1. Error Handling*: Linting, at build time, or at runtime
2. Highlight Syntax/autocomplete*: Highlight functions or autocomplete
3. Launcher/Dashboard: Internal project/story management
4. Node View: Graph based story editing
5. Can Duplicate Content: Easy duplication/copy and paste
6. Structural Shortcuts: Shortcuts to creating particular story structures
7. Autolayout: Automatic tidying/structuring of content
8. Link Parking: Functionality for temporarily connecting content
9. Source Editor: Text based editing through scripting or mark up
10. Content Browser: Easy browsing of story content such as a film strip
11. Searchable/Filterable: String based content searching
12. Relationships Method*: Visual, event based, or internal relationships
13. Statistics: Story stats for analytics
14. Editing Method*: Main content editing method - either modal popups, inline fields, or sidebar inspectors
15. Can Preview: Internal story previewing
16. Simple Debugging: Variables/consoles for runtime debugging
17. Modify During Debug: Modifiable variables during runtime debugging
18. Platform: Standalone, web, mobile, or integrated into 3rd party app
19. Documentation/Examples*: Availability of documentation/examples

20. File Format*: JSON, XML, GBLORB, HTML, or Custom Format
21. Able to Export: Author can export to a desired format
22. Exports to Runtime: Exports for use in other applications

(* feature has multiple possible implementations/versions instead of just a definition behind its name.)

While Green et al. use these features to cluster the tools they found, they also provide a good start in further defining the needs and envisioned capabilities for our agent dialogue framework. Therefore, we took them into account when defining the objectives for our framework.

Furthermore, Gaffney, Dagger & Wade (2008), working in the related domain of soft skill simulation authoring tools, list key requirements for those type of tools that are also relevant for dialogue authoring for agents. These are:

1. Dialogue visualisation.
2. Authoring process
3. Pedagogical framework.
4. Visual description of the framework.
5. Scalability.
6. Navigation.

In their elaboration of these requirements they suggest or name features that correspond to elements we added to our dialogue framework. For the first requirement they emphasize the 'need of an interface that is user friendly and intuitive' to enable the author to describe the dialogue components and their connections. For the second requirement they state that 'an author is unlikely to create an affective online soft skill simulation in their first attempt. They must review and edit the different aspects of their simulation, constantly making adjustments until the simulation meets their needs', which our editor meets by providing a test functionality. The third and fourth requirements are somewhat less relevant for our tools, but we explain to our authors the framework in which their dialogues should function, and authors can provide input for the presentation of dialogues in the interface. For the fifth and sixth requirement they state 'Scalability is also closely connected with the dialogue visualization. Without a visually accessible dialogue, creating a large complex simulation is very difficult due to the cognitive overload suffered by the author.' They also emphasize the need for easy navigation. The possibility to refer to other dialogues when defining a reply option allows the writer to make multiple dialogue files that can be linked together, instead of one huge dialogue file. The display of dialogues in our editor by means of boxes and arrows and the presence of zoom, search and scroll functions also helps the writer with overseeing the dialogue's structure.

6.3 The dialogue specification language

A WOOL dialogue definition is essentially a definition of a series of dialogue steps (that we refer to as *nodes*) linked together through user replies.

We define the following terms:

Node:	A dialogue step that contains one *Statement* and a one or more *Replies*.
Statement:	Something an agent says.
Reply:	A possible reply that a user of the system can give.
Agent:	A virtual speaker within a dialogue.

In the following subsections we will elaborate on the possibilities and options for

6.3.1 Nodes

A Node consists of two parts, a *header*, and a *body*.

6.3.1.1 Header

The header contains the following elements:

- **title** - a String that uniquely identifies this Node within this WoolDialogue.

- **speaker** - a String that defines the name of the Agent speaking in this Node.
- **optionalTags** - a set of <String,String> pairs that define optional, additional tags for this node.

An example of how this will be defined in a .wool file is as follows:

```
title: Start
speaker: Robin
position: -416,112
color: cyan
```

6.3.1.2 Body

The body of a Node contains at least one Statement and zero or more Replies. A very basic example is given here:

```
Hello, my name is Robin!

[[Nice to meet you Robin!|NodeRobin2]]
[[Goodbye.|NodeEnd]]
```

This Node defines a Statement "*Hello, my name is Robin!*", uttered by the Agent "*Robin*" and two possible Reply options. When a user selects "*Nice to meet you Robin!*" he will be forwarded to a Node labelled "NodeRobin2", and when he selects "*Goodbye.*" he will be forwarded to the Node labelled "NodeEnd".

6.3.1.3 File format

A .wool files consists of a list of concatenated Nodes separated by === markers. The header and body of the node are separated by the --- line. For example:

```
title: Start
speaker: Robin
position: -416,112
color: cyan
---
Hello, my name is Robin!

[[Nice to meet you Robin!|NodeRobin2]]
[[Goodbye.|NodeEnd]]
===
title: NodeRobin2
speaker: Robin
position: -216,112
color: red
---
Nice to meet you too, how are you doing?

[[I am fine and you?|NodeRobin3]]
[[Goodbye.|NodeEnd]]
===
...
```

6.3.1.4 WOOL Dialogues

A series of WOOL Nodes is called a WOOL Dialogue. The following rules apply to WOOL Dialogues:

- All Node titles must be unique within a WOOL Dialogue.

- There must be one Node with the title "Start" (this is the default starting point of the dialogue).
- WOOL Dialogue files may contain letters, numbers, dashes and underscores, and end with .wool
- Valid Examples:
  - mydialogue.wool
  - my-dialogue.wool
  - my_dialogue-1.wool
  - 123dialogue_for-Robin.wool

6.3.1.5 Ending a dialogue

A WOOL dialogue can end in two ways:

- The user does not have any Reply options in the Node (the Agent has the last say).
- The user chooses a Reply option that leads to a Node with title "End" (user has the last say).

Example 1:

```
It was nice talking to you, bye!
```

Example 2:

```
Do you have any other questions?

[[I have nothing left to say.|End]]
```

6.3.2 Comments

WOOL Supports line-comments, everything after a double-slash // is considered a comment:

```
Robin: Thank you very much. // Note: thank the user for the
gift.

// If it was a nice gift...
<<if $giftNice >>
    ...
```

6.3.3 Statements

6.3.3.1 Basic

In the end, all Nodes should output something like this:

"Hello, how are you?"

6.3.3.2 Including variables

You can use variables within your statements. Variables start with a $ sign, followed by one of A-Z a-z and then any number of a-z A-Z 0-9 or _. In short: start with a letter, then use letters, numbers or underscores, for example:

- $variableName

- $variable_name
- $var123

These variables can be used within statements to inject their values into a sentence, like so:

```
Hello $userFirstName, how are you?
```

6.3.3.3 Setting variables

WOOL allows you to set variables through a specific type of statement:

```
<<set $userFirstName = "Bob">>

<<set $greetingText = "Good morning U.S.A!">>
```

Notice that in both cases, the value should be surrounded by quotes (").

6.3.3.4 Special characters

What if you actually want to include a $ character in your text. If it is not followed by A-Z a-z, you can just type $. Otherwise, you can escape it with a backslash: \$. And to include a backslash? Just escape it with another backslash: \\. In fact, you can escape any character with \ and it will not be treated as a special character. Some more examples: \<< \>> \[[\]]

6.3.3.5 Including markup

WOOL does not care about your markup, if you want to add HTML tags around text, please go ahead. The parser will ignore it.

```
 Hello <b>$userFirstName</b>, how are you?
```

6.3.3.6 Conditionals

WOOL supports if-then-else statements. The simple example:

```
<<if $dayPart == "Morning" >>
   Good morning ladies and gentlemen!
<<elseif $dayPart == "Afternoon" >>
   Good afternoon peoples!
<<else>>
   Good evening everyone!
<<endif>>
 userFirstName</b>, how are you?
```

WOOL also supports nesting these if-statements, if you really have to:

```
<<if $dayPart == "Morning" >>
    <<if $userFriendly == true>>
        Good morning, sir! How are you today.
    <<else>>
        Mornin'.
    <<endif>>
<<elseif $dayPart == "Afternoon" >>
   ...
```

Note that in the case of boolean variables ('$userFriendly'), you can leave out the " == true" part. E.g., the following is valid and will work as expected if '$userFriendly' is an actual boolean value:

```
 <<if $userFriendly>>
```

However, if '$userFriendly' is actually a String with value "No, he is not friendly.", this expression will still evaluate to true.

6.3.3.7 User Interface Actions

Sometimes you might want to couple some event or action to a statement uttered by a speaker. WOOL supports specifically images, video or generic actions.

The image example:

```
And here you can see a picture of a dog.

<<action type="image" value="dog.png">>
```

The video example:

```
I would like to show you this cool video I found.

<<action type="video"
value="https://www.youtube.com/watch?v=dQw4w9WgXcQ">>
```

The "generic action" example:

```
Let me show you something in this book I found.

<<action type="generic" value="OPEN_RECIPE_BOOK">>
```

An example with specified *delay*:

```
Okay, I'll take you to the puzzle game, just a second...

<<action type="generic" value="LAUNCH_PUZZLE_GAME" delay="10">>
```

In this example, the *delay* parameter defines that the action should be executed with some delay (whether you interpret this as 10 seconds, 10 milliseconds or 10 days is up to your UI developer).

Finally, you may want to add some other parameters, so as long as you don't call them *type*, *value* or *delay* you should be fine:

```
Okay, I'll take you to the puzzle game, just a second...

<<action type="generic" value="LAUNCH_PUZZLE_GAME" delay="10"
difficulty="medium" background-color="#0000FF",
num_players="2">>
```

In this last example, the contents of the `value` parameter are completely up to you, and up to the user interface developer to interpret. Optionally you can pass parameters along with the action, using the *parameters* tag.

6.3.4 Replies

Every Node can define zero or more (indefinite, but please consult your UI designer) Reply options, the different types are defined below.

6.3.5 Basic

The standard Reply option defines a "Statement" and "Node Pointer":

```
[[Are you sure, Robin?|NodeConfirm]]
```

The user should be forwarded to the Node labeled 'NodeConfirm' when selecting the "*Are you sure, Robin?*" option.

6.3.6 Auto-forward Replies

You can leave out the statement, but you can only have one of these:

```
[[NodeConfirm]]
```

This should allow your user to go to the 'NodeConfirm' node when selecting e.g. a default "Continue" button, or automatically after some time (up to you UI design). As said, and as obvious, you cannot have two of these options in the same `Node`, but you can mix them with Basic replies, as so:

```
Would you like me to sign you up?

[[Yes, please do so!|Confirm]]
[[No, let's not.|Cancel]]
[[UserInDoubt]]
```

6.3.7 Input Replies

You can ask a user to input some text alongside a chosen reply using this syntax:

```
What is your first name?

[[None of your business Robin.|RobinInsulted]]
[[My name is <<input type="text" value="$userFirstName" min="5"
max="30">>, why do you ask?|RobinInputGiven]]
```

The general format of this statement is: (optional) beforeText, InputStatement, (optional) afterText.

Also supported is numeric input:

```
[[I am <<input type="numeric" value="$userAge" min="0"
max="120">> years old.|RobinInputGiven]]
```

In both cases, the ‘min’ and ‘max’ parameters are optional (you can have none, either, or both).

6.3.8 Setting variables in replies

Yes, that is something you can do as well, as such:

```
Do you prefer meat or fish?

[[Meat please.|NodeMeat|<<set $likesMeat = true>>]]
[[Fish for me.|NodeFish|<<set $likesFish = true>>]]
```

6.3.9 Adding actions to replies

Just as you are able to link a *set*-statement to a reply, you can also add *action*-statements to replies, like so:

```
[[Please show me the recipes.|RecipesStart|<<action
type="generic" value="OPEN_RECIPE_BOOK">>]]
```

6.3.10 Linking to other dialogues

There's only so much you want to put into one WOOL dialogue definition before you start losing track (and/or sanity), so WOOL allows you to link between different dialogue definitions, like so:

```
What should we talk about now?

[[Know anything about cars?|CarsDialogue.Start]]
[[What about fishing?|FishingDialogue.Start]]
```

In this example, the first reply option would take the user to the Node labelled 'Start' of the Dialogue labelled 'CarsDialogue'. Therefore, in this case, your application should be aware of a file named 'CarsDialogue.wool'.

6.4 Parser

We build a parser to process the dialogue specification. The parser is written in Java and with the development of the editor, a JavaScript version was also built. This allows us to read in WOOL-definitions from text files (which have the *.wool* extension) and build an internal representation of the dialogue that can be executed.

6.5 Editor

An understandable, quick to learn and easy to use language specification was step one, and a well working parser and internal processing of the dialogue representation was step two, but to make the dialogue writing process easy for most types of writer, the editor was also an important component. Just like our language specification started with the Yarn dialogue language and evolved from there, so did the origins of our editor lie with the Yarn editor.

While the interface of the main editor window (see Figure 37) does not seem to show many changes, there are many differences under the hood. To start, the editor has a build in JavaScript implementation of our parser to check the dialogue in the editor. This means that, for example, any errors in *set* or *if* statements, or when defining *input* fields in replies, will be marked so that the user can change them. This limits the amount of errors that need to be solved by the technical staff when including the defined dialogues in the Council of Coaches system. The edit-screen for a single dialogue step (or node) (see Figure 38) has changed to have the speaker in the header and it can indicate which lines have errors.

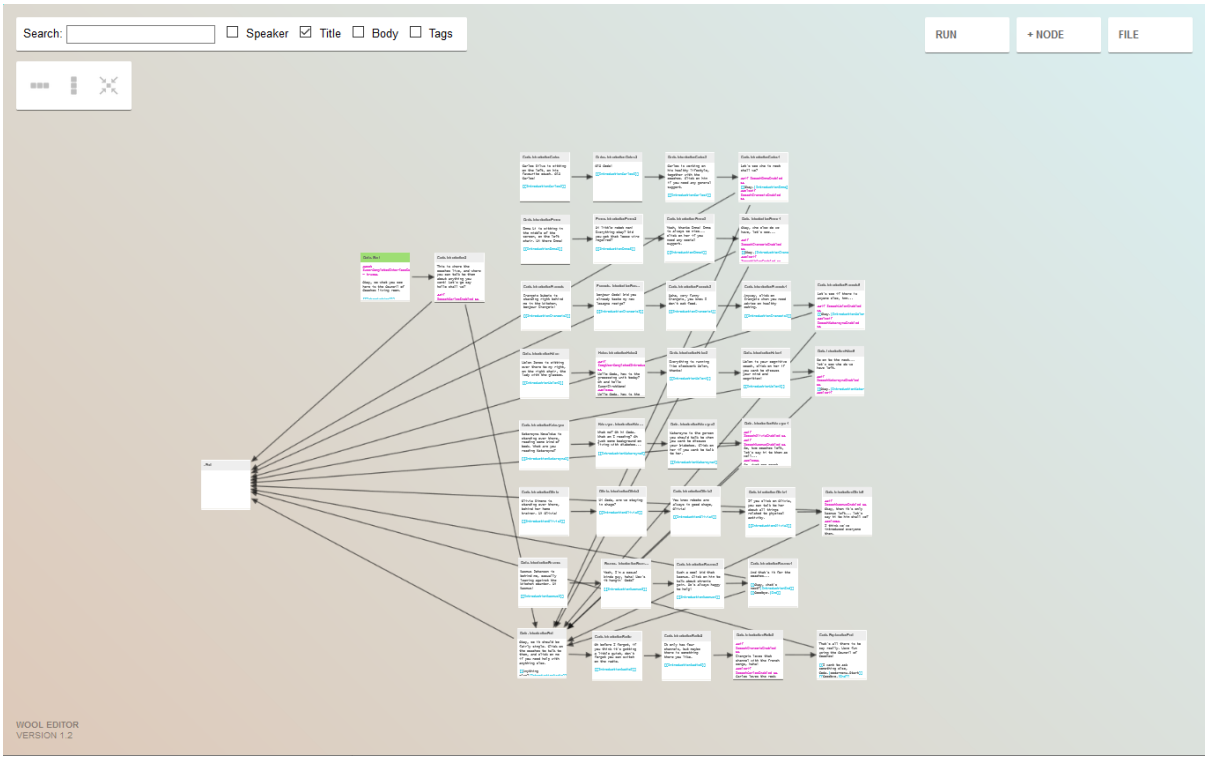


Figure 37: The interface of the main editor window for the WOOL editor – each node represents a dialogue step, while arrows show possible pathways through the dialogue structure.

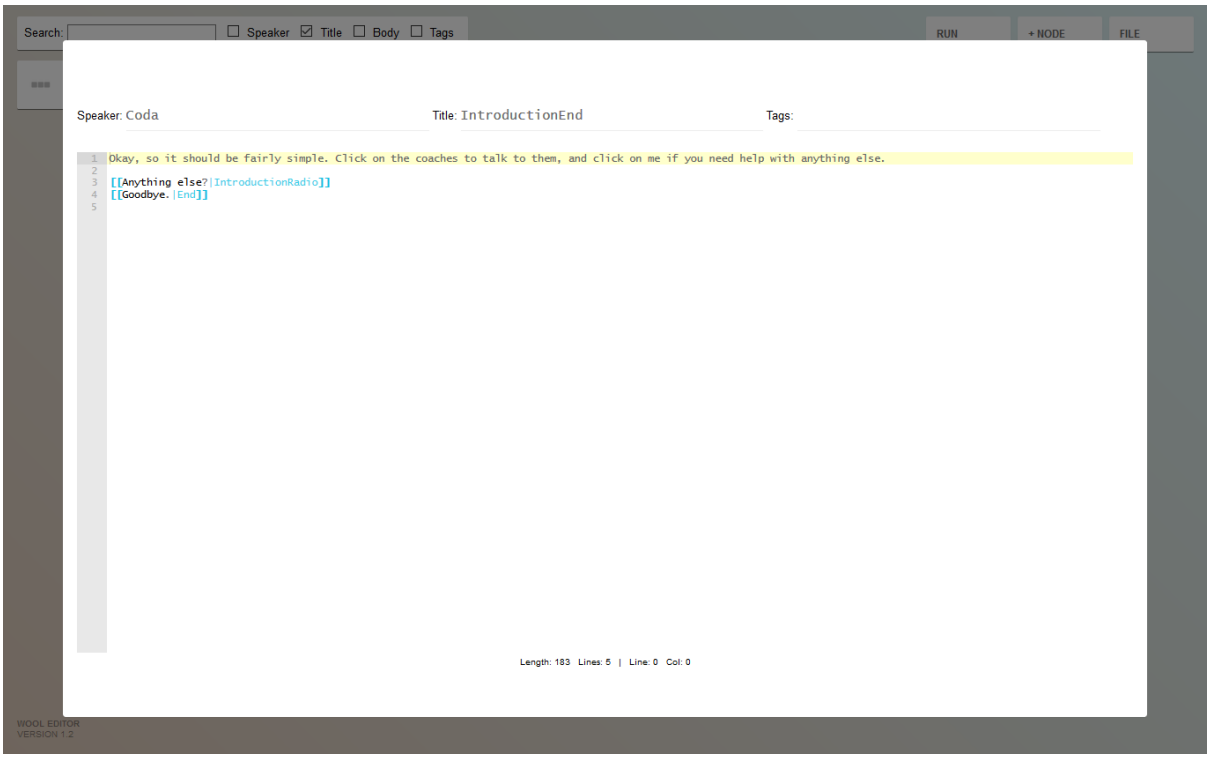


Figure 38: The interface when editing a specific dialogue step (or node).

The inclusion of a JavaScript version of our parser in the editor also has a second advantage. We added a 'Run' functionality to the editor, which allows users to test their dialogues while they are writing them. They are able to switch back to a specific node in the editor to make a change and then continue the testing of the dialogue where they left, but they are also able to restart a dialogue or to return to the

editor in general. This makes it easier for writers to test the flow of their new dialogue and helps test the dialogues before they need to be put in the main application.

Furthermore, the editor will show a different character for every speaker that is in the dialogue (with a feature that allows the user to change this character using a random character generator). It also provides the user with the option to select a different background. These features might seem trivial, but can help writers develop the look and feel of their newly written dialogue in a context that is similar to the context in the final system.

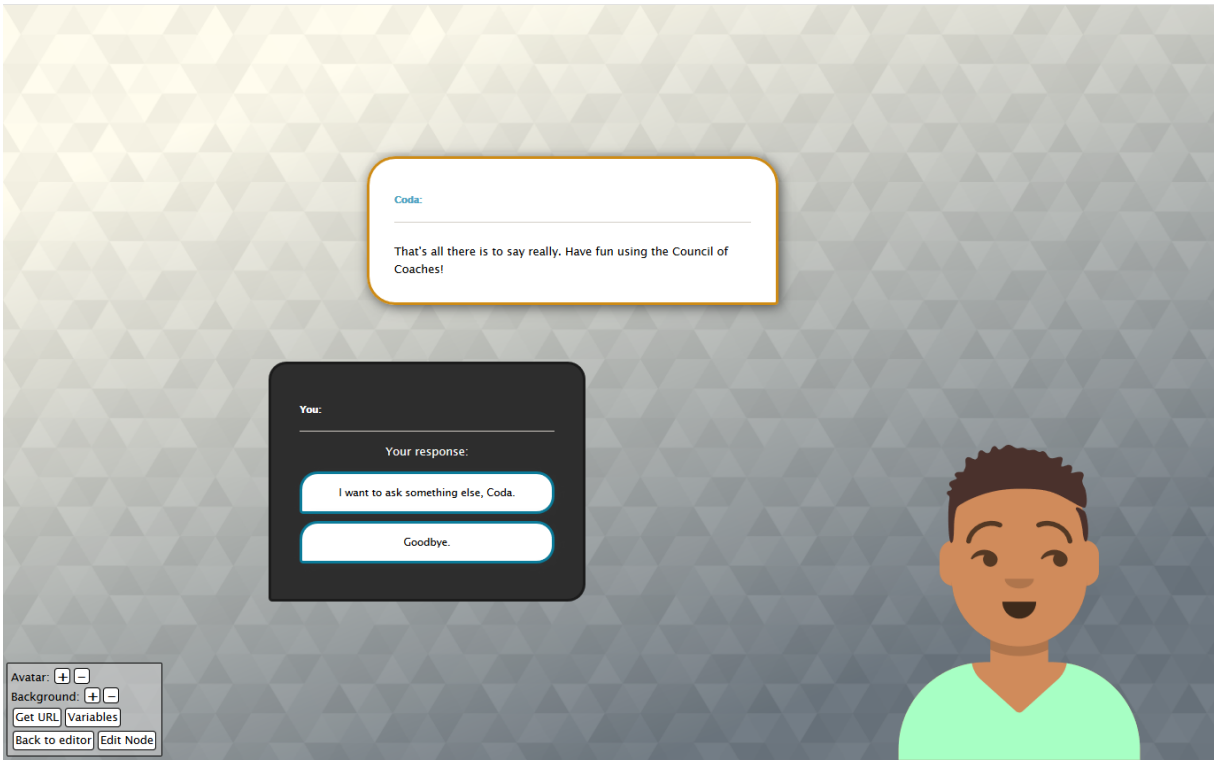


Figure 39: The test interface for the WOOL editor.

6.6 License

WOOL is available under the following MIT License:

6.7 Conclusion

All in all, the WOOL framework has proved its worth in the project. The editor has allowed domain experts who had never seen it before to be able to write and test dialogues within five minutes. The online version of the editor has also been helpful in collaborative dialogue writing at a distance. For example, one writer could write a dialogue and send it to the other, who was then able to review and test it without having to install the entire Council of Coaches system, in this manner paving the way for the iterative approach that is needed in dialogue authoring.

Part C: Review of requirements

1. A review of the requirements that were elicited from users throughout the project

7 Review of requirements on coaching actions and content

In this section, we provide an overview of all the various requirements that have been collected in the project that relate to "Coaching Actions and Content" (i.e. those requirements that can reasonably be addressed through the definition of coaching actions and content in this deliverable).

We will review these requirements per deliverable in which they were originally reported:

- Section 7.1 for requirements from D2.3
- Section 7.2 for requirements from D2.4
- Section 7.3 for requirements from D2.5
- Section 7.4 for requirements from D2.6

Within these sections for each deliverable, the requirements are divided into four tables representing each of the FICS components (which is identical to the original division):

- **F**unctions and Events
- **I**nteraction and Usability
- **C**ontent and Structure
- **S**tyle and Aesthetics

The prioritization (**P**) of the requirements are done using the MoSCoW scale:

- **M** – Must Have
- **S** – Should Have
- **C** – Could Have
- **W** – Won't Have

7.1 Requirements from D2.3

In the following subsections, we review the requirements as originally reported in D2.3 (Broekhuis, et al., 2018).

7.1.1 Functions & events

Table 5 provides an overview of requirements from D2.3 in the category 'Functions and Events'.

Table 5: Overview of requirements from D2.3 regarding functions and events.

ID	Requirement	P	Inclusion	✓
D2.3-F1	The systems must provide a 'buddy' or 'peer counsellor' as one of the coaches.	M	Included. The set of coaches includes a peer coach (Carlos).	✓
D2.3-F2	The coaches must be able to explain the sources they base their information on.	M	In progress, at relevant points in the dialogue we will allow the user to ask about information sources.	
D2.3-F3	The system must provide coaches that reflect the different aspects of health, as defined by Huber (physical health, mental health, social health, spiritual health, quality of life, daily functioning).	M	Included. The definition process for the domains of the coaches started with these aspects and the three target groups.	✓

D2.3-F4	The system could adapt itself with respect to tone of voice (positive, negative, humorous) by learning from compliance with given advice.	C	Not included. The system does adapt its feedback based on whether e.g. goals are achieved, but does not take compliance with advice into account in this process.	
D2.3-F5	The system should allow a medical professional to activate a health education module on a specific topic or disease (e.g., diabetes T2, losing weight) for an individual end-user.	S	Not included, a “back-end” control system is out of scope for the project.	
D2.3-F6	The system should provide triage on whether to visit a general practitioner or physical therapist, or none at all, on all types of complaints (possibly linked to F7).	S	Not included. In extreme cases, coaches might back out of giving advice and refer the user to professional health, but so far this is not in scope of the coaching content.	
D2.3-F7	The system should incorporate all information in the end-user’s medical record when providing personal advice.	S	A connection to a medical record is out of scope.	
D2.3-F8	The system should provide the option for the end-user to provide consent of using all his/her personal health information, right after registration, rather than asking for permission to use selected snippets of information during use (e.g., demographics, data related to medication use, data related to allergies).	S	To be considered in the product exploitation phase.	
D2.3-F9	The coaches could provide information about local health-related events that are of interest for an individual end-user.	C	Out of scope. Double work for two proof of concept study evaluation sites.	
D2.3-F10	The coaches should remind the end-user that he or she has forgotten to take his or her medication.	S	Not included. Keeping track of medication by the system can cause serious adverse effects if mistakes are made.	
D2.3-F11	The coaches could explain the interpretation of common medical tests (e.g., CRP blood test) and interpret the end-user’s values with respect to reference values.	C	Not included. We leave this up to the user’s general practitioner or physician.	
D2.3-F12	The system could display instruction videos of exercises that were prescribed by a physical therapist.	C	Still under consideration if development time permits.	
D2.3-F13	The system must offer monitoring assistance for patients with a chronic disease to detect exacerbations.	M	Not included.	

D2.3-F14	The system could monitor physical and mental workload, and must intervene when the workload becomes too much for an individual end-user.	C	Not included.	
D2.3-F15	The coaches should be up-to-date about the advice their fellow coaches have given and should take this into account into their own conversation and/or advice.	S	Included. Important information from advice given by coach A can be used in the conversation with coach B.	✓
D2.3-F16	The coaches should monitor the occurrence of life events that happen to an end-user (e.g., divorce, losing a job), and should take this into account in their coaching strategy.	S	Not included.	
D2.3-F17	The system must offer monitoring assistance for decline due to old age to detect instances where professional is necessary.	M	Not included.	
D2.3-F18	The coaches in the system must collaborate to work on overarching individual health goals for the end-user.	M	Included. Different coaches collaborate to achieve coaching goals.	✓
D2.3-F19	The system should provide end-users the opportunity to give permission to share snippets of personal health information (e.g., activity data, medical history) with caregivers whenever the needs arises or a caregiver requests them.	S	Not included. Connections to health care professionals are out of scope.	
D2.3-F20	The system could allow an end-user to include their real-life caregivers as virtual coaches in their council of coaches.	W	Not included. It was classified as a 'won't have'.	
D2.3-F21	The system should to send a notification to a (informal) caregiver of the end-user when one of the following health issues occur: not taking medication, being physically inactive, a situation of mental overload.	S	Not included. We are not tracking a user's medication intake or mental overload. Physical inactivity is not necessarily cause for alarm.	
D2.3-F22	The system should use the 6 dimensions of Huber's model of health to create a profile of end-user's health.	S	Included as part of the proof of concept study.	✓
D2.3-F23	The virtual coaches should incorporate vicarious persuasion strategies.	S	Included. Coaches ask each other questions, explain to each other and discuss among each other in order to persuade the user.	✓

7.1.2 Interaction and usability

Table 6 provides an overview of requirements from D2.3 in the category 'Interaction and Usability'.

Table 6: Overview of requirements from D2.3 regarding interaction and usability.

ID	Requirement	P	Inclusion	✓
D2.3-I1	The system should allow the end-user to choose one coach that leads the discussion with the end-user.	S	Included. The user can indicate the coach whose domain they want to discuss.	✓
D2.3-I2	End-users should interact with the interface via clicks on buttons only (no use of sliders, swipe mechanisms, etc.).	S	Included. The user can interact by clicking on coaches, buttons and occasionally filling in a value.	✓
D2.3-I3	End-users must interact with multiple coaches instead of a single coach.	M	Included. The main subject of a dialogue is chosen by the coach that was selected, but other coaches join in to present their point of view on the subject.	✓

7.1.3 Content and structure

Table 7 provides an overview of requirements from D2.3 in the category 'Content and Structure'.

Table 7: Overview of requirements from D2.3 regarding content and structure.

ID	Requirement	P	Inclusion	✓
D2.3-C1	The system content must be written with B1 (or equivalent in other countries) proficiency in mind.	M	Included. When presenting concepts that might be new or unknown an explanation is added, as well as allowing for clarifying questions to be asked.	✓
D2.3-C2	The system should provide the most common symptoms of each medication that an end-user is using.	S	Not included. No coaching concerning medication is provided.	
D2.3-C3	The coaches in the council should have an empathic tone of voice.	S	Included. The coaches are designed to be fair and understanding.	✓
D2.3-C4	The system must facilitate ACT treatment.	M	Not included. After discussion with professionals who work with chronic pain patients, we decided to include information on explaining chronic pain to others instead.	
D2.3-C5	The health information that the coaches provide must be based on credible sources (e.g., scientific papers, medical protocols, official health information websites, like "*voedingscentrum*", "*thuisarts*", municipal health services, centers for disease control).	M	Included. All health information that is provided is constructed based on credible sources.	✓

D2.3-C6	The coaches could support end-users before and after an operation (in terms of diet, physical activity).	C	Not included. This is not the application's main focus, even though it does offer physical activity and nutrition coaching.	
D2.3-C7	The coaches should be able to explain the treatment protocol for a disease.	S	Not included. We believe a health care professional should be consulted for such sensitive information.	
D2.3-C8	The coaches could support a discussion with patients with chronic pain about whether or not they are still capable of working, and if so, how they should adapt themselves or their workspace.	C	Not included. We belief this to be a sensitive and delicate subject for which a health care professional is required.	
D2.3-C9	The coaches could provide older adults coaching on maintaining an independent life (e.g. reminding them on daily routines, birthday reminders, reminders on (social) events they planned, etc.).	C	Not included. The emphasis is on behaviour change and healthy behaviour as opposed to reminders and calendar-type features.	

7.1.4 Style and aesthetics

Table 8 provides an overview of requirements from D2.3 in the category 'Style and Aesthetics'.

Table 8: Overview of requirements from D2.3 regarding style and aesthetics.

ID	Requirement	P	Inclusion	✓
D2.3-S1	The appearance of the coaches should be in line with their role (e.g., the physical coach should be physically fit).	S	Included. The coaches' appearance matches their expertise.	✓
D2.3-S2	The virtual coaches should be more than just a 'talking head'. Virtual coaches should be designed as interesting "characters".	S	Included. Characters have been designed with background stories.	✓
D2.3-S3	The appearance of the virtual coaches could be competent/authoritative when providing important information.	C	Included in the technical demonstrator where coaches automatically gesture based on the content provided.	✓

7.2 Requirements from D2.4

In the following subsections, we review the requirements as originally reported in D2.4 (Beinema, et al., 2018).

7.2.1 Functions & events

Table 9 provides an overview of requirements from D2.4 in the category 'Functions and Events'.

Table 9: Overview of requirements from D2.4 regarding functions and events.

ID	Requirement	P	Included	✓
D2.4-F1	There should be an option to add your own recipes or “tips”.	C	Not included. We decided to prioritize providing recipes and information over allowing users to add their own.	
D2.4-F2	The definition of the “cognition” coach should be made clear.	S	Included. Additional explanation was added and users are able to ask clarifying questions.	✓
D2.4-F3	There should be an option to talk to one or two coaches directly.	S	Included. Participants can indicate which coach they want to talk to.	✓
D2.4-F4	There could be an option of showing exercise examples, for example through a video.	C	Still under consideration.	
D2.4-F5	The diet coach could have links to recipes that are healthy for the user.	S	Included. The diet coach can suggest a recipe base on their knowledge of the user.	✓
D2.4-F6	System could include a “points” or reward system to increase engagement.	C/W	Under consideration for the product exploitation phase after the project.	

7.2.2 Interaction and usability

Table 10 provides an overview of requirements from D2.4 in the category ‘Interaction and Usability’.

Table 10: Overview of requirements from D2.4 regarding interaction and usability.

ID	Requirement	P	Inclusion	✓
D2.4-I1	The system should have a way of “returning to the previous option”. After a reply is given, it should be possible to revert this and go back to the previous step.	C	Not included. Reverting a dialogue step has serious technical and principal issues in a dialogue system. Other solutions to the problem identified could be showing a dialogue history, which is currently under consideration.	
D2.4-I2	It should always be possible to “escape” from conversational loops (e.g. “I started with fish and he keeps talking about fish”).	S	Included. Made the (existing) escape option in the fish loop more obvious.	✓
D2.4-I3	Spoken text should be clearly “subtitled”.	S	Not included. The text to speech engine was changed however, so that the voices were better to understand.	

7.2.3 Content and structure

Table 11 provides an overview of requirements from D2.4 in the category 'Content and Structure'.

Table 11: Overview of requirements from D2.4 regarding content and structure.

ID	Requirement	P	Included?	✓
D2.4-C1	Content of the conversations should have a clear direction and should contain useful information.	S	Included. Conversations were adjusted to address a clear subject.	✓
D2.4-C2	Conversations should be "to the point", and shouldn't go too much "off topic".	S	Included. We adjusted the conversational structure after this demonstrator.	✓
D2.4-C3	Conversations should be "predictable" in terms of their content.	S	Included. We adjusted the replies participants could give to be more predictable as to what the coach could respond when choosing that reply.	✓
D2.4-C4	The underlying goal of the conversations should always be clear.	S	Included. We adjusted the conversation structure and worked to adjust 'opening statements' for sub-dialogues to be clear about the dialogues aim.	✓
D2.4-C5	Conversational content could be optional between "hard" and "soft", where "soft" includes more background and social talk, as opposed to "hard" conversations that are strictly on topic and to the point.	C	Included. Users have the possibility of stopping conversations and can decide for themselves if they want to click on an elaborating reply.	✓
D2.4-C6	There should be "more" reply options in the dialogues.	S	Included. We worked on adding more reply options.	✓
D2.4-C7	Language use should be simple in all conversations.	S	Included. When presenting concepts that might be new or unknown an explanation is added, as well as allowing for clarifying questions to be asked.	✓

7.2.4 Style and aesthetics

Table 12 provides an overview of requirements from D2.4 in the category 'Style and Aesthetics'.

Table 12: Overview of requirements from D2.4 regarding style and aesthetics.

ID	Requirement	P	Inclusion	✓
D2.4-S1	The coaches should be able to express different facial expressions or emotions.	S	Included. Nonverbal behaviour is a key feature for the technical demonstrator.	✓

D2.4-S2	The overall appearance of the system should be less “childish”.	S	Included. Coaches are made to be more human-like and a less childish graphic style was chosen in the functional demonstrator. The technical demonstrator stayed the same since it already had a realistic graphic style.	✓
D2.4-S3	The coaches should be facing the user when talking (i.e. don’t look away within the scene).	S	Included. Coaches are now facing the user in both technical and functional demonstrator.	✓
D2.4-S4	When multiple coaches are involved in the conversation it should always be clear who is talking.	S	Included. This was already clear for the technical demonstrator. Updates were made to the speech bubbles of the functional demonstrator to make this clearer.	✓
D2.4-S5	The connection between the speech bubble and the coach should be clear.	S	Included. This was already clear for the technical demonstrator. Updates were made to the speech bubbles of the functional demonstrator to make this clearer.	✓
D2.4-S6	Speech should be properly synchronized with the coaches’ facial expressions.	S	Expression and gesture synchronization remain a difficult aspect but is receiving ample attention in WP6.	✓
D2.4-S7	Facial expressions should have sufficient “contrast” in order to be recognizable.	S	Ongoing work.	

7.3 Requirements from D2.5

In the following subsections, we review the requirements as originally reported in D2.5 (Beinema, et al., 2019).

7.3.1 Functions & events

Table 13 provides an overview of requirements from D2.5 in the category ‘Functions and Events’.

Table 13: Overview of requirements from D2.5 regarding functions and events.

ID	Requirement	P	Inclusion	✓
D2.5-F1	The system could provide an option for the user to save information on coaching and coaching strategies the virtual coaches share during the conversations.	C	Not included. This requires to add an additional feature to the system and other elements were given more priority.	

D2.5-F2	The system should include an option 'go back', during the conversation with the virtual coach(es).	S	Not included (discussed at D2.4-I1).	
D2.5-F3	The system must provide the option for the user to choose a coaching strategy if the user dislikes the coaching strategies that are offered by the virtual coaches.	M	Included. The user can always indicate that they find a topic less interesting or not relevant. Options to discuss coaching strategy on a global level are ongoing.	✓

7.3.2 Interaction and usability

Table 14 provides an overview of requirements from D2.5 in the category 'Interaction and Usability'.

Table 14: Overview of requirements from D2.5 regarding interaction and usability.

ID	Requirement	P	Inclusion	✓
D2.5-I1	The design of the GUI must be scalable, depending on the screen size of the device (laptop and tablet)	M	Included. Interface is fully scalable.	✓
D2.5-I2	The appendix of the speech balloons in the GUI should clearly indicate who of the virtual coaches is talking.	S	Included. An icon of the speaker was added to the balloon as well.	✓
D2.5-I3	During the interactions with the virtual coach(es), the user should frequently have the option to continue with the coaching conversation and stop the background story talk (I6)	S	Included. We added more options. The speech balloon can also be closed.	✓
D2.5-I4	The system should indicate what type of information (numerical or textual) is required in the open text fields (I7)	S	Partly. Error checking has been enabled, but this could be further clarified.	

7.3.3 Content and structure

Table 15 provides an overview of requirements from D2.5 in the category 'Content and Structure'.

Table 15: Overview of requirements from D2.5 regarding content and structure.

ID	Requirement	P	Inclusion	✓
D2.5-C1	When introduced to the system, information should be provided to the user on how to interact with the system: that the user can converse with the virtual coach(es) by clicking on the response buttons below.	S	Included. Coda (the assistant) explains the interface to the user and arrows with hints are present during the creation of an account.	✓

D2.5-C2	The system could explain to the user how to exit the Fish-loop with Francois and continue with the conversation.	C	Included. Reply option clarified.	✓
D2.5-C3	During the dialogues with the virtual coach(es), users should have the option to ask for clarification on non-native words.	S	Included. We added explanations and reply options with clarifying questions for non-native words and possibly unknown concepts such as 'cognition', 'activity tracker' etc.	✓
D2.5-C4	The system should provide the user additional information such as a longer explanation on the suggested coaching strategies.	S	Included. We added explanations and reply options with clarifying questions for topics that might raise questions for the user.	✓
D2.5-C5	The system should provide information on the expertise and skills of the virtual coaches during the introduction of the coaches	S	Included. The coach selection screen includes descriptions. Furthermore, the coaches introduce themselves and elaborate on what they can do.	✓
D2.5-C6	The font size in the GUI should be adjustable	S	Not included. This influences the display of all the elements in the GUI. We have chosen for a static design taking into account readability by default.	
D2.5-C7	The virtual coach(es) should explain to the user the purpose of the questionnaires the user has to fill out.	S	Partly, the coaches explain that information is used for personalization, but not in great detail.	
D2.5-C8	While filling out the questionnaires in the system, the user should have the option to ask for clarification on statements and questions.	S	Included. Clarifying questions are added to statements for which it seems relevant.	✓
D2.5-C9	The system could explain to the user how they decided upon a strategy based on his or her input.	C	Included. We provide this information as an explanation of why we need the information. We can also elaborate on this if the user has questions when the coach makes suggestions. (In this specific evaluation, the reasoning was part of the experimental setup, and thus was not explained.)	✓

7.3.4 Style and aesthetics

Table 16 provides an overview of requirements from D2.5 in the category 'Style and Aesthetics'.

Table 16: Overview of requirements from D2.5 regarding style and aesthetics.

ID	Requirement	P	Inclusion	✓
D2.5-S1	The system should emphasize in the GUI during group conversations to whom the virtual coaches are communicating.	S	Not included. We have not made additions to the GUI. We have clarified the dialogues.	
D2.5-S2	The virtual coaches in the system should be multi-cultural and represent various ethnic backgrounds	S	Included. Coaches were redesigned to be multi-cultural.	✓

7.4 Requirements from D2.6

In the following subsections, we review the requirements as originally reported in D2.6 (van der Kamp, et al., 2019). Since D2.6 was recently finished, we report the planned inclusion for these requirements.

7.4.1 Functions & events

Table 17 provides an overview of requirements from D2.6 in the category 'Functions and Events'.

Table 17: Overview of requirements from D2.6 regarding functions and events.

ID	Requirement	P	Planned inclusion	✓
D2.6-F1	The system should provide the option for an extensive or short introduction of the coaches.	C	Will be considered to create additional "escape paths" in the coach introductions.	
D2.6-F2	The Fitbit connection system coding should be checked, to prevent failing connections and redirections to the home-page.	M	To include. We will check the Fitbit connection process. Technical issue that will receive attention.	
D2.6-F3	Effort could be taken to optimize system performance, to prevent slow system responses and enable proper system use all tablets/iPads.	C	System performance was impacted by screen recording software, so the recommendation is somewhat coloured. There are ongoing efforts to minimize the graphics fidelity without impacting the visual appearance.	
D2.6-F4	Personalize the amount of small talk, funny interactions and fun facts.	S	To include, although personalization of serious content has priority.	
D2.6-F5	Enable the option to select both the diabetes and chronic pain coach.	S	Will not be included within the scope of the project, as it constitutes complications that need to be solved for a very small user segment.	

7.4.2 Interaction and usability

Table 18 provides an overview of requirements from D2.6 in the category 'Interaction and Usability'.

Table 18: Overview of requirements from D2.6 regarding interaction and usability.

ID	Requirement	P	Planned inclusion	✓
D2.6-I1	Add an indication in the coach selection screen that the coach choice can be altered.	S	This will be clarified more clearly in the pre-explanation.	
D2.6-I2	When introduced to the coaches in the living room, information should be provided clearer to the user on how to interact with the system.	C	To include. The explanation will be clarified.	
D2.6-I3	The system should provide the user with information on how to proceed after the introduction of coaches if there is no interaction for a while or when random clicking in the living room is recognised	S	To be considered – an automated interaction after some time of inactivity.	
D2.6-I4	The system should make it clearer to the user to interact with Olivia if they have to connect an activity tracker.	M	To include; although this was also an effect of the type of task participants were given.	
D2.6-I5	Both the dialogue-path "my progress" as "my activity tracker" should lead towards the activity data.	S	To include. We can add a dialogue branch that leads to the data.	
D2.6-I6	The diabetes coach (Katarzyna) should have an option to refer to the nutrition coach Francois for food related questions and recipes.	C	To include. Part of Katarzyna's task would be to refer to Francois and Olivia as the experts on the nutrition and physical activity domain.	
D2.6-I7	The recipe dialogue of Francois must end with the actual recipe	M	Under development.	
D2.6-I8	The system could include an option 'go back', during the conversation with the virtual coaches.	C	Not to include as discussed before. It is a technically complicated feature and not intuitive in dialogue-based interactions. Workaround solutions are under consideration.	

7.4.3 Content and structure

Table 19 provides an overview of requirements from D2.6 in the category 'Content and Structure'.

Table 19: Overview of requirements from D2.6 regarding content and structure.

ID	Requirement	P	Planned inclusion	✓
D2.6-C1	Change the dialogue content after selecting to choose your own coaches to a less direct way of saying "are you sure you want to select your coaches yourself?	S	To include. We will adjust this statement.	
D2.6-C2	Include screening questions in Olivia's dialogue for specific (medical) limitations and risks concerning physical activity.	M	To be discussed.	
D2.6-C3	Include visual support during the explanation of the connection of the Fitbit.	S	Under development.	
D2.6-C4	Provide more (optional) detailed information within the activity book (i.e. types of activities, history of activity by swiping through book).	C	High on the wish list, but time consuming.	
D2.6-C5	Expand the number of recipes so that a better match to the food preferences of the users can be found.	S	Database of recipes will be included.	

7.4.4 Style and aesthetics

Table 20 provides an overview of requirements from D2.6 in the category 'Style and Aesthetics'.

Table 20: Overview of requirements from D2.6 regarding style and aesthetics.

ID	Requirement	P	Planned inclusion	✓
D2.6-S1	Make the "create account" button stand out for the first time the COUCH system is used.	C	To include. We will review the design and make the necessary adjustments.	
D2.6-S2	Better highlight the next button next to the text entry fields	S	To include. We will review the design and make the necessary adjustments.	
D2.6-S3	Include a visual label of each coach's expertise.	C	To be discussed with graphics designers.	
D2.6-S4	Prevent that coaches that are talked about are not visible due to the speech bubble of another	S	Not possible from a fundamental design point of view.	

8 Conclusion

This deliverable reported on the coaching actions and content and related design and development processes. The deliverable was structured to consist of three parts. The first part described the design and theory behind the coaching areas, coaches, content and coaching actions. While this design process presents a set of clearly defined areas, coaches and content for the application, the authoring of the dialogues is still in progress, therefore, changes to the final content and actions might still occur.

The second part described the dialogue framework that we developed during the course of the project. This dialogue framework is a core foundation for the generation of content. The dialogue definition needed to be flexible enough to support multi-coach interactions and high level of personalisation, while the overall structure should be easy to use for non-technical dialogue writers. The third part presented a review of requirements, showing how the valuable input collected through the various end-user studies has impacted the later design phases of the project, especially from a content perspective. While we included the requirements from D2.6 in this review, we did so from a planned implementation perspective.

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