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Published in:

e-Coaching for Health and Wellbeing, 26-27 January 2017, Amsterdam, The Netherlands

Published: 26/01/2017

Document Version

Accepted manuscript including changes made at the peer-review stage

Please check the document version of this publication:

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- The final published version features the final layout of the paper including the volume, issue and page numbers.

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Citation for published version (APA):

Rutjes, H., Willemsen, M. C., Kersten - van Dijk, E. T., de Ruyter, B., & IJsselsteijn, W. A. (2017). Better together : opportunities for technology in health coaching from the coach's perspective. In e-Coaching for Health and Wellbeing, 26-27 January 2017, Amsterdam, The Netherlands (pp. 1-14)

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Better Together: Opportunities for Technology in Health Coaching from the Coach's Perspective

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Abstract. Health coaching is an interpersonal process, where communication and the relation between the coach and the client are central aspects. Still, new technologies offer a variety of interesting opportunities, in both measurement as well as intervention. To understand the coaching process and to explore the possible added value of technology, we conducted semi-structured interviews with health coaches and performed a thematic analysis on the data. Based on the daily practice and the needs of the coaches, we extracted opportunities and requirements for technology. We found that humans can easily express empathy and are sensitive to evolving goals and underlying motives, whereas technology can consistently measure behavioral data and can predict effectiveness of interventions by learning from large datasets. We conclude that the strengths of humans and technology are complementary and map to different aspects of the coaching process.

Keywords: health coaching, interpersonal process, e-coaching, behavior change support, assisting technology, human-technology interaction

1 Introduction

Good health is a key determinant of quality of life. Non-communicable diseases (e.g., cardiovascular diseases, cancers, diabetes, chronic respiratory diseases) are a major health risk in developing countries as well as in wealthy, industrialized countries [1]. Many of these diseases have been associated with exposure to common modifiable risk factors, such as unhealthy diets, physical inactivity, tobacco use, and harmful use of alcohol. These factors are modifiable in the sense that they are, at least in part, assumed to be a consequence of a series of behavioral or lifestyle choices [2]. It is known that behavior change is hard, as often established routines or habits have to be broken and deeply ingrained attitudes need to be changed. Health coaches may provide help in this difficult but beneficial process.

The process of health coaching itself is an interpersonal process, where communication and the relation between the coach and the client are central aspects. Wolever et al. [3] performed a systematic literature review on health and wellness coaching, in which they found that the majority of studies operationalized health coaching as a process which is patient-centered, includes patient-determined goals, incorporates self-discovery and an active learning processes (versus being instructed by the coach), encourages accountability for behaviors, and provides some type of education to patients along with the coaching processes. The most common training of the health coaches is on communication skills (e.g., express empathy, provide emotional support, various types of reflection, providing feedback), followed by training on behavior change, including health behavior models and behavior change techniques [3]. In psychotherapy, it is already known the quality of the therapy does not only rely on appropriate treatments and techniques, but also on the relationship between the counselor and the client [4].

In health coaching, like in many other fields, new technologies offer a variety of interesting opportunities, in both measurement as well as intervention. Commoditized technologies such as smartphones and health watches are equipped with a broad set of sensors, and advances in (big) data processing allow for increasingly personalized coaching. Many health apps are driven by user-determined goals and measurable behavior (either self-reported or automatically tracked). In general, health apps utilize sense-reason-act loops – with incoming sensor data being interpreted by an algorithm that subsequently decides on the appropriate course of action. Such actions may include visualizations of the behavior and performance of the user, aiming to generate actionable insights, or providing information, instruction and motivational messages. In a study on the most popular smartphone apps for weight loss, Chen et al. [5] assessed the behavior change techniques that were used in the apps. Using Michie et al.'s [6] taxonomy of behavior change techniques, the authors found that the most frequently used behavior change techniques were 'prompt self-monitoring of behavior', 'provide feedback on performance', and 'provide instruction'. Also, social support may be facilitated, for example by sharing performance with friends or participating in group challenges.

In addition to fully automated e-coaching solutions, some 'blended' forms of e-coaching exist, where human coaches are included in a setting of mixed control. For example, online coaching programs exist where health coaches are following the process online, giving additional advice by e-mail, phone or video calls, e.g. Vida and Fitmo [7,8]. Another example is the trend of health coaches using self-tracking data from daily life in their regular consultations. Such data may facilitate a better comprehension of the client's life and needs, and enable the coach to send motivational messages between consultations.

Given the opportunities provided by technology and the value of the interpersonal process, we would like to explore whether it is possible to combine the best of both worlds. With human coaches and e-coaches each having their unique strengths as well as limitations, how can we optimally pair the strengths of technology to the strengths of humans? Fully automated solutions might miss the essence of health coaching – the interpersonal and empathic skills required to facilitate a truly client-centered process, which is sensitive to explicit and implicit goals and the needs of the client. At the same time, human coaches too have their limitations. Like all humans, their judgments are

prone to cognitive heuristics and biases such as confirmation or availability biases [9]. They might also be better informed if they had access to the wealth of sensor data to which automated systems are privy. The question we pose here is: How can technology and data add value to the interpersonal coaching process, and, conversely, what can developers of e-coaching applications learn from the interpersonal coaching process?

To optimally pair the strengths of humans and technology in health coaching, we take the process of health coaching as a starting point. We believe that offers a fresh perspective on the opportunities and requirements for e-coaching technology, compared to the more common approach of starting from clients' goals and behaviors. We conduct semi-structured interviews with health coaches to investigate their reflections on the process of health coaching, including their definition of coaching success, common barriers and success factors, and the process of goal setting. Using thematic analysis [10] we explore emerging themes, in order to elucidate, from the perspective of the coach, the definition and determinants of a successful coaching process. Based on the resulting themes and the needs identified, we will draw implications for technology design, in order to potentially improve e-coaching applications and provide better support for health coaches and clients alike.

2 Method

2.1 Participants

Nine Dutch health coaches (seven women and two men, average age of 37 years, ranging from 25 to 56 years) were interviewed. Years of experience as a health coach was on average 10 years, ranging from 2 to 28 years. There were three dietitians, four personal trainers (three had their main focus on physical activity, one on nutrition), one coach providing coaching online (with a focus on physical activity) and one teacher/researcher in coaching, who is also a sports coach. All coaches volunteered to participate.

2.2 Procedure

Interviews were semi-structured, conducted by one researcher in a face-to-face setting. Duration varied between 30 and 60 minutes. As we aimed for a broad understanding of health coaching, we asked about many aspects of coaching (questions 1-5). With the sixth question, we hinted at opportunities for technology, without being overly explicit.

Interview Questions

1. Can you give examples of things you do and recommend as a coach, and how you motivate your clients? Does this change from person to person? If so, how?
2. When is coaching successful in your opinion? What contributes to that?
3. Who sets the goal? Can you explain this process?
4. How do you translate the (long term) goal into (short term) activities?
5. Which barriers do you see often with your clients?
6. If you could be a fly on the wall with your clients, what information would you focus on, and what would you do with this information?

2.3 Data Analysis

Saturation was used as a stopping criterion: when for three consecutive interviews no new major insights were collected, data collection was stopped. Two researchers agreed that the data was saturated after nine interviews. All recordings were transcribed verbatim. A thematic analysis was performed by four researchers, following established guidelines for thematic analysis [10]. The final coding of the data was executed by two researchers. The inter-rater reliability (IRR), expressed in percentage of agreement per interview per theme, was on average 98.8%, with a minimum of 88.0%. All disagreements were resolved by discussion.

3 Results

Five major themes emerged from the data, which we labeled as follows: (I) success is more than achieving goals, (II) the value of a personal (human) approach, (III) adapt the advice to situational characteristics, (IV) motivation is important and (V) appropriate short term goals are key. In this section, we will discuss these themes and subthemes in order (see Table 1), providing a description of each (sub)theme and illustrating them with relevant quotes from the interviews.

Table 1. Overview of themes and subthemes.

THEME I: SUCCESS IS MORE THAN ACHIEVING GOALS <ul style="list-style-type: none">a) It's about the experience instead of the numbersb) There is often a more profound issue underlying the goalc) Success is also about learning
THEME II: THE VALUE OF A PERSONAL (HUMAN) APPROACH <ul style="list-style-type: none">a) The importance of the relationship between coach and clientb) Social support as success factorc) Tailoring the advice and coaching style is important and implicit
THEME III: ADAPT THE ADVICE TO SITUATIONAL CHARACTERISTICS <ul style="list-style-type: none">a) Fit the advice in the daily life of the clientb) Consider stress and personal barriersc) Contextual information of the client is informative to the coachd) Not all information is shared
THEME IV: MOTIVATION IS IMPORTANT <ul style="list-style-type: none">a) Reasonable expectations are important, behavior change is hardb) Intrinsic motivation is key to success
THEME V: APPROPRIATE SHORT TERM GOALS ARE KEY <ul style="list-style-type: none">a) Suitable and specific short term goals help to motivate

3.1 Theme I: Success Is More Than Achieving Goals

Almost by definition, coaching is successful when goals are achieved. In the interviews, however, the coaches mentioned it is actually about a lot more than that. Many coaches said it is about the experience instead of the numbers. Coach #1 explained: “*Don’t look on a scale, look in the mirror. [...] It’s about how you feel.*” Success is not always predictable and objectively measurable according to the coaches. As an example, Coach #8 explained it happens that clients who are only halfway their initial weight loss goal are already satisfied, because they have more energy, sleep better and feel better. In spite of the original goal not being reached, Coach #8 considers this a success.

Also, coaches noted that there is often a more profound issue underlying the explicit goals and issues the client initially presents. For example, when a client wants to lose weight and has problems with emotional eating, bad self-esteem can be the underlying problem. As Coach #7 explained: “*The first impression is that someone wants to lose weight, but in my experience, it’s never about that. It’s really about somebody fighting something within themselves [...] So it is my role as a coach to understand which emotions are there, and to try to be sensitive.*” Some coaches even talked about referring their clients to mental health professionals or counselors to work on some of the psychological aspects first, when the problems clients appear to be coping with are beyond the professional abilities of the coach. As goals and problems often have a deeper subtext, the achievement of these goals is not always the (only) way to success.

Furthermore, the coaches indicated that success is, among other things, about learning; more specifically about awareness and making deliberate choices. Awareness of personal health and behavior is considered as a valuable benefit of coaching. Coach #5: “*In my opinion, if a client didn’t achieve the weight loss, it can still be successful, because something changed in their awareness. [...] That they realize: ‘This is really bad, I need to do something, and I know what can help me.’*” Not only awareness, but also knowledge about the impact of certain food and activities on health is considered important, to help clients make deliberate choices. This is most strongly stated by Coach #3, who said coaching can still be successful when clients are choosing the unhealthy option sometimes, as long as they are aware of it and their choice is deliberate.

When talking about success, some coaches made statements about the role of technology. Coach #1 expressed her concern about being obsessed with numbers, which is what technology naturally presents. She stated that long term perseverance is more likely when you enjoy what you’re doing, instead of focusing on, for example, speed or burned calories. On the other hand, some coaches indicate that quantitative measures can also positively influence the experience. Coach #7 gave an example: “*I have people who have such a bad self-esteem, or has lost touch with reality of their bodies, that unless I can show them on paper, ‘look, you’re making progress!’ they won’t believe me.*” Thus, there is a balance here that we need to consider, which we will discuss later.

Coaches also indicated that monitoring of behavior, either automatically by technology or by keeping manual diaries, helps in raising awareness, for example about sedentary time or food intake. Feedback on their behavior can also motivate clients to achieve their goals, as Coach #2 explained: “*Some people, when they see 8,000 steps on their activity tracker and know they have to reach 10,000, they will go for an extra*

walk to achieve their goal.” But the coach added this would only work for a specific group of clients. For others, especially clients with low self-esteem, this feedback can also be counterproductive.

The complexity of goals and measuring success already highlights the need for a personal, human approach. This is a theme also commonly noted by the coaches and is further discussed in the next section (Theme II).

3.2 Theme II: The Value of a Personal (Human) Approach

When talking about what contributes to successful coaching, all coaches emphasized the value of the relationship between the client and the coach. For example, Coach #3 said: *“It’s not only about the client and the coach, but also about the trust relationship between them. And that implies the skills a coach should have, standing by someone, being open, not judging, providing safety, guiding someone, listen, be empathic.”* Building a connection is often seen as a prerequisite to being able to work with a client. Many coaches reported that the first consultation is aimed purely at building a relationship with the client and only when this is established, they start working towards goals.

The role of social support of friends and family is also mentioned as a success factor. Coach #6 gave an example: *“Imagine you live in a student home where everyone is eating fast food all the time. Then it is very hard to cook your own meal week after week, even weighing your vegetables.”*

Another topic clearly emerging throughout all interviews is the fact that a tailored approach is important. All health coaches state that what they do depends on the client. For example, Coach #2 stated: *“I’m always looking for the things that a client needs. What motivates, helps, triggers him, or maybe just reassures him at this moment?”* It is notable that almost all coaches report they cannot explain how they tailor, it is based on a ‘gut feeling’. However, further probing did reveal certain specific parameters the coaches use to tailor their approach. Both personal and situational characteristics are reported. The personal characteristics that were reported include personal goals or problems, the need for empathy clients have (strict approach versus ‘hand holding’), how motivated clients are, their base level (*“With some of my clients, I’m already happy if they’d eat one piece of fruit a day”* (Coach #9)), potential physical injuries or limitations, gender, age, profession and their place of residence (rural or urban). Situational characteristics were even more commonly cited by the coaches as tailoring aspects and are discussed separately in the next section (Theme III).

3.3 Theme III: Adapt the Advice to Situational Characteristics

All coaches talked about the importance of adapting the advice to situational characteristics of the client. They try to make the advice very specific, and fit it into the daily life of the client. Practical constraints like working night shifts, truck drivers who are on the road, or different cultural backgrounds are important to address and are extensively discussed by clients and their coach to find feasible solutions. Even back up plans are made, Coach #5 gave an example: *“If a client plans to go for a run, but does not want to run in the rain, I suggest to install a weather-app and we discuss a back-up*

plan.” In summary, the health coaches reported the advice should be very specific and tailored to match the requirements of a client’s daily life.

Not only external, practical barriers but also internal, personal barriers play a role in coaching. The coaches reported they have to be sensitive to stress and other internal barriers. As Coach #2 explained: “*When there are big stressors like divorce or change of jobs, it is very hard to change behavior*”. A few coaches talk about ‘the right moment’ to make the change. Knowing the barriers against adherence to the coaching plan helps to understand and assist the client better. Examples include “*resistance because of earlier medical malpractice*” (Coach #3), “*low self-esteem*” (Coach #7), “*grief, stress*” (Coach #1), and “*depression or low energy because of disease*” (Coach #9).

Since tailoring to personal and situational characteristics is important according to the coaches, some coaches indicated the value of understanding the context of the client. For example, Coach #3 reported “*consultations when a partner or parent joins gives me much more information. [...] Also home visits are a very important source of information, seeing the kitchen and the fridge tells me a lot.*” Coach #9 asks the clients to make a food journal: “*It says it all. Some people forget it, then you know they’re not motivated, [...]. Some write very sloppy, others very tidy, including the times, others bring food to the consultation or make pictures. It’s not only the information itself, but also the way it is presented, which is very informative.*” Thus, examining the context of the client offers a rich source of information on the clients’ needs as well as motivation levels, and helps to make the advice more tailored.

Many coaches talk about how clients share information, whether it is withholding information (or lying) on purpose, or not sharing information simply because they don’t know it is relevant. The majority of the coaches said lying is a common practice in coaching, some even indicated they compensate for this in their coaching interventions by making them more ambitious than required.

3.4 Theme IV: Motivation Is Important

All coaches reported that in order to change on the long term, motivation is very important. First, reasonable expectations are important, it makes a difference if clients realize it’s hard and that they have to work for it. Expectations are monitored and managed when clients have unrealistic goals or think it will be easy. Coach #4 explained: “*Some clients start [an online coaching program] out of curiosity, some clients start out of real motivation, they say: ‘I know it’s hard and therefore I’m looking for your support’. That makes a big difference.*” Coach #8 and #9 reported that some clients think they are a magician and that just visiting them will initiate a change, not realizing that they have to make a change themselves. Thus, reasonable expectations, both towards the role and impact of the coach, as well as towards the effort required to implement a change in lifestyle, are important indicators for success.

Second, being intrinsically motivated is indicated as key for success by all coaches. Coach #8 sometimes wondered: “*Do you fully support this yourself? Otherwise, it is not going to work.*” She reports that clients who are not intrinsically motivated often do not take responsibility for their behavior, i.e., asking permission to the coach to eat certain food or drink wine. Also, clients make excuses, as Coach #2 illustrated: “*If I*

explain to a client that this healthy meal contains 430 calories, and he responds that he saw a bag of chips contains the same number of calories, yeah...". Some coaches indicate that clients with diabetes or other diseases are the hardest, because they visit a coach because their doctor told them to do so, instead of on their own initiative. To support intrinsic motivation, coaches are often looking for what makes clients tick, and pick sports activities that clients enjoy.

The use of technology and self-tracking by clients reveals something about their motivation, as indicated by Coach #9: *"When clients have an activity tracker, it gives a clue of who I'm dealing with: money enough to buy it, interested in their own data, [...] you just see they're engaged."*

3.5 Theme V: Appropriate Short Term Goals Are Key

The relevance of appropriate short term goals is clear from the response of all coaches. Although overall success is more than reaching explicit goals (see Theme I), setting specific, measurable short-term goals is essential in providing success experiences. Coach #7 gave an example comparing the short-term goal *"losing some body fat"* with *"losing 0.5% body fat"*. She described the power of making the goal very specific: *"[...] Next week, 0.5% done, high five, everybody happy, check off that goal. You see what I mean? [...] To the mental side, it makes a world of difference."* Not only measurable, also achievable goals are important, as Coach #5 explained: *"In the first week I set an achievable goal, so clients have a success experience [...] that will increase their self-efficacy"*. It is common practice for coaches to make step by step changes. For example, Coach #6 often recommends: *"eat like you normally do. And then every week, [...], I make an adjustment."* He does not believe in long lasting effects of a *"starvation diet or heavy training schedule"*.

It is very important to focus on successes, to keep clients motivated. Coach #2 explained that this is especially important when dealing with clients who have low self-esteem, for example those who are binge-eating: *"I focus on the things that they are able to do. [...] If those goals are achieved and they feel proud, then often you see that the binging decreases."* Coach #6 sometimes makes a progress report to make the success on the long term visible. He explains that it is hard for clients to see the progress because the steps are typically small.

4 Conclusion and Discussion

The results from our thematic analysis on the interviews show that health coaching goes beyond measurable goals and activities. Goals and corresponding successes are often related to the experience instead of numbers, and a good relation between client and coach is a prerequisite for successful coaching. The interviews also show the importance of fitting the advice to situational characteristics: The more specific and tailored the advice, the more likely clients are to adhere to it. Intrinsic motivation of the client is considered as main success factor, and specific and achievable short term goals help clients to stay motivated and increase self-efficacy. Many of our findings connect

to existing theories of behavior change and coaching, but also new insights are provided. Furthermore, our findings suggest (both explicitly and implicitly) requirements and opportunities for the use of technology in the health coaching process.

4.1 Connections to Theory on Behavior Change and Coaching

Overall, our results resonate well with the study of Wolever et al. [3], who showed that coaches are supporting and facilitating a patient-centered process, where interpersonal skills are key (relates to theme II), including patient-determined goals (relates to theme I) and incorporating self-discovery and active learning processes whilst encouraging accountability for behaviors (relates to theme IV).

The results from the interviews also link strongly to theories on behavior change. For example, many concepts that are discussed are known as determinants of behavior [11, 12], including awareness (in theme I), social support (in theme II), barriers (in theme III), motivation (in theme IV) and self-efficacy (in theme V). More specifically, the facts that health coaches indicate that creating awareness can be success in itself and that motivation is essential to persevere, fit effortlessly in the Transtheoretical Model [14]. Also, when coaches are talking about the importance of fitting the advice to the daily life of the clients, and defining small, specific, measurable goals, we can clearly recognize essential elements of the theory of implementation intention [14].

Most theories on behavior (change) focus on determinants of behavior that are relatively stable: what works for most people, most of the time. However, our interviews have revealed that the reality of coaching is more complicated, requiring an intimate understanding of the idiosyncrasies of each client's life to allow suitable, useful advice. Although taxonomies and frameworks for behavior change are useful, a successful intervention for an individual in practice requires a more personalized approach.

Also, in theories on behavior change, the focus is often on techniques, e.g., as presented in [6], instead of the boundary conditions before these techniques can be applied. Our interviews have shown that these conditions play a central role in effective coaching, e.g. expressing empathy and building a trusting relationship are a prerequisite before effectively working towards health goals.

4.2 Technology Implications

In this section, we derive technology implications from the themes that emerged from the interviews with health coaches. It is important to note that, although the role of technology was sometimes explicitly mentioned by the coaches, they are themselves not experts in technology design, nor did they generally involve technology in their coaching process (with the notable exception of the online coach). Rather, understanding the process and daily practice of health coaching, and the needs that emerge during that process, allows us to explicitly consider the role and potential added value of technology across the various themes.

Goals, Success, Feedback and Motivation

Current e-coaching applications are often driven by user-determined goals. Technology can compare the goal with known standards (e.g., for healthy weight loss), but it is challenging for technology to question the goal that is set and understand the underlying motives. The results of the interviews show that goals are often ‘fluid’, implicit, and transient. A client can be satisfied if she has more energy and is feeling better, even when her initial goal is not achieved. The level of the goal (e.g., losing 5 kilos), and the nature of the goal (e.g., weight loss instead of improving self-esteem), can be ambiguous. It is hard for technology to be sensitive to this, since it is difficult, if not impossible, for the client to make the underlying goals explicit. For a human coach, evolving goals and underlying motives naturally emerge in dialogue with the client. For an automated e-coach this is not easily accessible, and therefore it is a challenge for developers to deploy technology that is using the right indicators/data to work towards the real goal.

Since the interviews show that success is often more about the experience than the numbers, technology can benefit from this by emphasizing the meaning of the result (e.g., not being breathless after climbing the stairs) instead of the result itself (e.g., better heart health).

For automated systems, it is easy to provide feedback about the progress towards a goal. We learned from the interviews that this can work both in a positive and a negative way. It can create awareness and motivate clients to go the extra mile. Feedback on objective performance can be used in coaching to influence the experience, to convince the clients – especially those with low self-esteem – of the progress they are making. It can make slow progress visible, which would otherwise be hard to detect. On the other hand, explicit progress feedback can also demotivate clients when they do not see immediate results, or when they focus on failures instead of successes [15, 16, 17]. It may make clients obsessive about the numbers instead of focusing on their health and the fun of the activity [18]. The effect of feedback is not trivial, it depends on the state of the client and the context, which has also been studied by others [19, 20]. Human coaches appear to carefully weigh when and how they use ‘the numbers’, considering the fine line between motivating and demotivating. The design of e-coaching applications should be informed by these considerations, using personalization and feedback on performance effectively.

The interviews show that experiences of (small) success can be motivating, and that making them specific, measurable and achievable facilitates this success experience. The tendency for technology to work with specific and measurable goals is beneficial here. When clients are forced to make their (short term) goals specific, success experiences are experienced more often and have more impact. Also, since technology can coach 24/7, successes can be celebrated any time needed. This opportunity can be exploited even more when technology facilitates breaking down a long term goal into small achievable steps.

However, it is known that extrinsic rewards can be detrimental for intrinsic motivation and interest in the activity [19], although literature on this shows mixed results under different circumstances [21]. It is important to be aware of intrinsic motivation as a final goal when designing e-coaching applications, deliberately using extrinsic rewards.

Interpersonal Aspects

The interview results emphasized that a good relationship between the coach and the client has great value, and is even a prerequisite to being able to work together successfully. Expressing empathy is an important means to build this relationship.

Relationships are built upon communication. Communication between users and an e-coach is characterized by measurements in one direction (from the user to the e-coach) and feedback or messages in the other direction (from the e-coach to the user). The measurements can cover a wide range of behaviors and physical parameters (e.g., steps, sedentary time and heart rate) or prompted self-reports. This must fit in an *a priori* defined framework, leaving aside applications based on self-learning methods, e.g. neural networks. In a fixed framework, it is not possible for the user to tell her 'story' and the system is therefore not sensitive to subtle but important signals that are outside the scope of the predefined dialogue. For example, when a client has overslept and is in a rush to be in time for a meeting, the message 'Congratulations, you've reached your daily sleep goal!' may be correctly presented based on the available data, but is also very inappropriate, and demonstrates a lack of empathy and social intelligence. An e-coach that is not sensitive to key social signals in this situation, and which doesn't allow for a social response, is unlikely to succeed in building a good relationship. Although studies on social intelligence of interactive systems have shown some promising results, there are still considerable challenges for technology here [22].

On the other hand, there are also opportunities for technology to support and enhance the quality of interpersonal interactions. For example, tracking data may highlight potential discrepancies between a client's stated attitudes and goals, and his or her measured behaviour, thus sensitising the coach to potential barriers the client needs to overcome, and the kinds of contexts in which such barriers are likely to occur. This may provide conversation starters (e.g., "Since Tuesday you've been less active, what happened?") and it can strengthen the connection between the coach and the client. Through technology, coaches can also be enabled and prompted to initiate contact with their clients between consultations, and respond to real-time information. Considering the importance of social support from friends and family, technology can also facilitate the involvement of friends in many more ways than previously possible [23].

The health coaches stated in the interviews that tailoring the advice and approach to every single client is very important. Technology may play an important role in empowering both coaches and clients to tailor the coaching to the client's specific situation – both behavioural idiosyncrasies as well as contextual specifics. It may allow coaches to base coaching decisions on detailed behavioural data rather than sparse self-report and personal intuitions. Also, technology has the capability to collect and analyze information about many clients, which allows for matching clients with similar profiles and predict the effectiveness of interventions. This strength of technology can help human coaches overcome their predispositions and biases. It should be noted that appropriate tailoring highly depends on the right input, and that humans have different sources of information (e.g., dialog with client) than technology (potentially 24/7 behavior). Which sources are essential for effective coaching is still open for debate, but we note here that they can be complementary, and that a client-centered approach to e-coaching may benefit from both sources of information.

Situational Characteristics

Health coaches emphasize the importance of fitting their advice to situational characteristics of the client. Technology provides many opportunities to make behavior patterns in daily life visible and to identify the context of the client. This can be used by health coaches to better understand the client and to make the advice more specific and tailored. Also, automated e-coaches can seize every opportunity to help, being present 24/7 and send motivational messages whenever the client needs it most.

The interviews have shown the great value of contextual information to the health coaches, to better understand the client. The informative value of context is already known, e.g. by [24]. In health coaching, this means for example that not only the list of foods in the food diary, but also the presentation of the diary itself (e.g., sloppy writing, structured by meal, globally or written in detail) gives the coach a lot of information. Or, besides the content of the fridge of the client, also the appearance of the kitchen is important. Usually, technology tends to focus on content rather than context. Thus, technology can severely limit our contextual sensitivity, through imposing fixed frameworks and models, limiting the depth and breadth of contextual inputs, and de-contextualizing its information representation. At the same time, paradoxically, technology may also allow for a more detailed capturing and representation of context, and in-situ behaviors – above and beyond what clients would be aware of, or would be able to reproduce. Either way, context is an important source of information for human coaches, and we need technology that supports the capture and appropriate representation of context.

Health coaches collect information by asking the client about her daily schedule, sports activities and nutrition, sometimes supplemented with self-tracking data. Apart from the capabilities of people to share information systematically, people are not always fully transparent in reporting about their health-related behaviors or underlying motivations. The health coaches explained that sometimes clients don't share information, simply because they don't know it's relevant. Also, lying is a common practice, because of shame or denial. In the case of clients who don't share information because they don't know it's relevant, the opportunities for technology are evident. Technology can track behavior objectively and consistently. In the case of lying, technology can play the same role: by objective and consistent measurement, the behavior is accessible by the coach. Yet, in this case, we must be much more careful, since clients have a right to privacy and to keep things to themselves. An important requirement for technology here is that there should always be control and transparency over what is tracked and shared. A useful concept in this regard is social translucence [25], a concept introduced to help understand and design systems that make social information visible, allowing users to intuitively negotiate social visibility, mutual awareness, and accountability.

4.3 Humans and Technology in Health Coaching

Taking a step back from our data and the specific technology implications we identified, one overall conclusion we can draw is that there is a place for both humans and technology in health coaching. Some activities in the health coaching process are very natural for human coaches to execute and are hard to automate, e.g., being sensitive to

evolving goals and underlying motives, considering the mental state of the user when giving feedback that will optimally motivate someone, or the balanced two-way communication which is open to any type of information – including what is *not* being said, or what emerges from the context. Technology, on the other hand, has a natural role in health coaching by tracking behavior consistently and objectively, and by comparing the effectiveness of interventions among many clients, enabling appropriate tailoring.

This points to the value of both humans and technology as complementary, collaborative partners, especially in situations with high uncertainty and ambiguity [26], such as health coaching. Technology can inform human coaches by providing detailed behavioral and contextual data with high accuracy and temporal resolution, thus supporting and enriching clients' self-reports. This can empower the coach to better understand the client, and provide better tailored advice. Also, technology can aid the coach predicting the effectiveness of interventions, based on databases with coaching data of many clients, and provide the coach options with high probability of success. Conversely, developers of e-coaching technology can be inspired by, and use the strengths of, the interpersonal coaching process. E-coaching technologies can be improved by deploying sensors and methods that are open to evolving and ambiguous goals, and that carefully use progress feedback to optimally motivate clients. Also, e-coaching technologies can defer to human coaches in the coaching process at certain moments, e.g. when the signals are too ambiguous and an interpersonal dialog is needed.

Behavior change is difficult, and effectively supporting people in this process is a complicated and challenging task – one that benefits from significant interpersonal skills as well access to behavioral and contextual information. Technology and human coaches each have something to add to this process and in this paper, we have highlighted opportunities to optimize the collaboration between the two. Our conclusion is that a carefully orchestrated synergy between human coaches and technological solutions is needed to optimally support people on their journey to change.

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