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Understanding Effective Coaching on Healthy Lifestyle by Combining Theory- and Data-driven Approaches

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Abstract. New wearable technologies such as health watches and smartphones provide rich data and give the opportunity to learn about the user's preference, traits, states and context. Our research aim is to uncover principles of effective coaching and to deliver personalized e-coaching applications in the domain of healthy lifestyle, by using both psychological theory and data science techniques. We believe the synergy of both fields will result in a deeper understanding of effective coaching. Theory provides plausibility criteria and 'behavioral templates' which help to understand the meaning of data. On the other hand, data can fine tune theory, especially in terms of studying individual differences and tailoring. Our research plans include a review of literature, interviews with health coaches and studying real life coaching data to generate hypotheses. Next, we plan to use adaptive tools in user trials, where both data-driven and theory-driven approaches can be combined.

1 Background and Research Questions

There is a strong link between behavior and health [1]. Having a healthy lifestyle, e.g., regular physical activity and healthy eating, prevents many diseases. E-coaching can play a role in supporting people to achieve their health goals and changing or maintaining their healthy behavior.

New wearable technologies such as health watches and smartphones create new opportunities to learn more about a user's preference, psychological state, personality and environment [2]. Insights about variances on these aspects between and within users are easier to obtain now the trend is to have bigger and richer data created by following users on many aspects over time.

Our research aim is to uncover principles of effective coaching and to deliver personalized e-coaching applications in the domain of healthy lifestyle. We combine two worlds: psychological theories of coaching, persuasion and behavior (change) on the one hand, and data science and machine learning techniques on the other hand. We expect this synergy will result in more and deeper insights in effective coaching.

Many psychological theories are formulated on a high level of abstraction, which makes the transfer to application domains, e.g. behavior change interventions, not trivial. However, these theories do provide plausibility criteria and 'behavioral templates' which help to understand the meaning of data, or 'pointers' that tell us where

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to look for in the data. Theory can inform the relevant frameworks and constraints needed to formulate working hypotheses that may direct the data mining process and help separate relevant from irrelevant information. Tailoring to users also follows from understanding data, for example by recognizing behavioral patterns, habits and teachable moments.

This brings us to our research questions: (1) What are the critical parameters for effective (e-)coaching? And (2) what aspects are most important to tailor to, in order to improve the effectiveness of (e-)coaching?

In the current early phase of this research, we wish to understand coaching in a broad sense. It includes many aspects, e.g. persuasion, behavior change, personal contact and type of recommendations. We propose to differentiate between:

- *what* does the coach say or recommend,
- *how* and
- *when* does he do that.

What the coach recommends is sometimes left by psychologists as 'domain knowledge', but we argue it is potentially critical for effective coaching. Also, it can be important content for tailoring. In the field of recommender systems, much is known about procedures how to obtain proper recommendations [3]. *How* the coach is communicating / persuading / motivating / coaching includes many forms, e.g. 'tone of voice', communication styles, principles of persuasion (e.g. [4]) and behavior change techniques (e.g. [5]). *When* the coaching occurs is in literature often referred to as opportune, interruptible or teachable moments [2].

Within these fields, the effectiveness of coaching interventions is often extensively studied. For example, in a meta-analysis, the effectiveness of 26 behavior change techniques is studied in the domains of physical activity and healthy eating [6]. Meta-regression enables identification of effective components of behavior change interventions, for example the authors found that 'self-monitoring' is the most effective technique. However, there is criticism on the simplicity that is used in this study, for example [7] state that there is more nuance needed in why and how certain behavior change techniques do or do not work. On top of that, we would like to argue that we should take even one more step back, and investigate the way in which the *what*, *how* and *when* relate to each other and which of those components is most critical for effective coaching.

Tailored behavior change interventions are proven to be more effective than standard interventions [8,9,10]. It should be noted that tailoring can be manifested on many levels [11], ranging from calling the user by his name to using the tone of voice that suits the user's personality or current mood best. Although tailoring is shown to be effective, the mechanisms underlying this increased effectiveness are still ill-understood, and require further exploration.

In literature, several models are presented with determinants of behavior (e.g. awareness, social support, attitude, perceived barriers, self-efficacy) which are indicated as important aspects for tailoring. (e.g. [12,13]). The authors of the latter study even present a computational model, which is a good start to make it practically feasi-

ble as an e-coach application. Still, the quantification and validation of these models is limited. Having rich data sets, machine learning techniques can help to overcome this problem.

The ever growing presence of smartphones allows us to collect ecological valid data, since it brings the lab into our lives, as stated in Millers' [14] 'Smartphone Psychology Manifesto' and in IJsselsteijns' [15] 'Psychology 2.0'. Seizing this opportunity is inevitable to bring the psychology of coaching and behavior change to the next level.

To conclude, data can help to fine tune theory, a practical application provides a good test for the value of the theory. But, looking at data only can also burden us with spurious correlations or other flaws. For this, good theory can offer a solution. By combining both theory and data, we aim for understanding the critical parameters in coaching, including the important tailoring aspects. We hope to map the *what*, *how* and *when* of the coaching to the relevant user characteristics to make coaching appropriate for anyone anywhere at any moment.

2 Research Plans and Methodology

First, we explore the literature for the current state of the art. We interview health coaches and perform a thematic analysis on this data. To complete, real life coaching data from field trials from Philips Research[1] will be used for inspiration. By those means, hypotheses will be formulated about effective coaching.

Note that coaching principles obtained from the interviews with human health coaches cannot be generalized to e-coaches automatically. We need to take into account the differences – and the consequent advantages and challenges – between human and e-coaches.

After this exploration, we move forward to a more confirmatory phase. Field trials will be used to check the hypotheses on real life data. When using adaptive tools to influence behavior, both data-driven and theory-driven approaches can be combined.

Possible future research questions are:

- If certain user characteristics or context aspects happen to be important to tailor the coaching on, how can those be measured? Which sensors are needed? What kind of data processing (e.g. affective computing) is needed?
- What is the optimal balance (in terms of user experience) between asking questions to the user versus deducing information from the data? How can the uncertainty of predictions be used explicitly in machine learning techniques, to prompt questions at the right moment?

[1] This research is part of a collaboration between Philips Research Eindhoven and the Data Science Centre of the Eindhoven University of Technology.

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