A Tool That Supports the Psychologically Based Design of Health-Related Interventions

Anthony Jameson
anthonyjameson@chusable.com

Abstract

This paper offers a holistic and psychologically oriented perspective on health recommender systems and introduces a tool—CHUSAPEDIA—that is designed to support researchers and practitioners in putting this perspective into practice. One component of CHUSAPEDIA is a semantic wiki in which a wide range of knowledge is formalized about how people make choices and how these choices can be supported. The second component is a web application that accesses the knowledge in the semantic wiki to help designers to create choice support interventions of various types. In the paper, a starting point is a consideration of the strengths and limitations of the most advanced existing comparable resource, the Behavior Change Technique Taxonomy of Michie et al. An example of an analysis performed with CHUSAPEDIA then briefly illustrates the benefits offered by the tool, which will be demonstrated at the workshop and made available to all workshop participants.

CCS Concepts

•**Applied computing** →*Consumer health; Health care information systems;* •**Information systems** →*Wikis; Online analytical processing;*

Keywords

Choice, choice support, health recommender systems

ACM Reference format:
Anthony Jameson. 2017. A Tool That Supports the Psychologically Based Design of Health-Related Interventions. In *Proceedings of the Second International Workshop on Health Recommender Systems co-located with ACM RecSys 2017, Como, Italy, August 2017,* 4 pages.

1 Introduction

Encouraging and helping people to live healthier lives is an enterprise that involves a great deal besides recommender systems. The health-related behavior of the target person depends on a number of choices made by that person as well as others, such as family members and healthcare providers. The choices made by these people will almost inevitably be influenced not just by recommendation technology but also by other forms of advice and support offered either by interactive computing technology or via other channels.

Taking this complex context into account is challenging. It requires, among other things, (a) a systematic way of dealing with multiple choosers and choices and (b) an understanding of the many different phenomena that occur when people make choices and the many different ways in which these choice processes can be supported.

I have provided a foundation for the understanding described in the second point in the form of the ASPECT model of choice and the ARCADE model of choice support ([3, 4]). But work on providing computational support for the application of these models so that they can be used by designers of recommender systems and other choice supporting technology for the design of complex interventions began only recently; the present paper is the first publication on this work in progress. I start by discussing the most advanced existing approach that attempts to achieve similar goals, noting its strengths and limitations. I then introduce the CHUSAPEDIA system with reference, for concreteness, to an example of a recent health-related intervention program that includes both recommendation technology and other forms of choice support.

2 Related Work

The Behavior Change Technique Taxonomy (BCTT)

In this short paper, instead of attempting even a modestly comprehensive literature review, I will focus on a single well-known line of work which itself aims to integrate a great deal of previous work: the program of the group of Susan Michie, whose best-known result is the Behavior Change Technique Taxonomy (BCTT, [5, 6]). In this research program,[1] the authors synthesize insights from dozens of models of how people make behavioral choices ([7]) and how these choices can be influenced and supported. Some of these models can be seen as general models of human behavior, while others include concepts that are specific to the domain of healthcare, which is the application domain in the main focus of the authors' program. This knowledge about how people make health-related choices is synthesized in the COM-B model, which identifies six general factors influencing people's health-related behavior, several of which in turn comprise subfactors.

Likewise, the new system CHUSAPEDIA aims to achieve generality through the inclusion of high-level concepts whose value has been demonstrated in many different domains and also more domain-specific models such as those concerning the domain of health-related behavior.[2]

HealthRecSys'17, Como, Italy

[1] I summarize this approach using terms and concepts that are employed in the rest of the present paper as opposed to adopting the authors' original terminology. In particular, whereas Michie et al. speak of "changing people's behavior", I speak of "helping people make better choices", for the reason explained below.

[2] CHUSAPEDIA can accordingly be applied to arbitrary other choice domains when equipped with the necessary domain-specific models.

Michie et al. also take into account the fact that understanding how people make choices does not automatically enable you to help them make better choices. Drawing from many lines of previous research, they developed the Behavior Change Technique Taxonomy, which comprises 93 behavior change techniques ([5, 6]).

In addition to offering these compact syntheses, the authors offer a practical procedure for putting the synthesized knowledge into practice.

Strengths and Limitations of the BCTT Approach

The BCTT program has rendered a valuable service by enabling intervention designers to deal with compact and coherent taxonomies of choice-related variables and choice support techniques, respectively, instead of having to cope with dozens of largely overlapping models that use conflicting conceptual schemes and terminologies. Among other visible benefits, hundreds of published behavioral interventions have been described in terms of the BCTT,[3] making it possible to identify their "active ingredients" and to more rapidly accumulate knowledge about what interventions work in what contexts. But especially from the point of view of those who aim to apply recommender systems and related technologies in the health domain, there are several limitations that remain to be overcome:

1. The authors' focus on the healthcare domain makes it somewhat difficult to apply the concepts to situations that fall even partly outside of that domain. Consider, for example, the many applications that help encourage people to engage in sports activities. Although such activities can have a large impact on achievement of the goal of healthy living, sports is not entirely a matter of keeping healthy. It also involves goals such as having fun, competing with others, and maintaining social relationships. So it would be desirable to have a framework that (a) enables the exploitation of domain-specific insights but also (b) enables the intervention designer to decide which domains are relevant for his or her particular problem.

2. The COM-B model of behavioral choice ([7]) is what might be called a "variables-based" model: It identifies a number of variables that influence people's behavioral choices, such as "psychological capability" and "reflective motivation". Designing an intervention therefore is a matter of taking steps that will lead to more desirable values of some of these variables (e.g., improved skills or factual knowledge). One limitation of this type of model is that it is too coarse-grained to express many of the insights that have been developed in decades of research into how people make (behavioral) choices.

By contrast, CHUSAPEDIA (like some other approaches) employs a "process-based" model of how people make choices. The ASPECT model,[4] which forms part of the knowledge base of CHUSAPEDIA distinguishes six *choice patterns*, two of which in turn have subpatterns. For each choice pattern, there are several typical steps that can be taken to apply it. The choice patterns can be applied alternately or in parallel, and one choice pattern can invoke another one as a sort of subroutine.

3. Like many other authors in the domain of health and well-being, Michie et al. speak of "changing behavior" rather than of "helping people to make better choices". In addition to being more clearly relevant to the recommender systems field, the latter conception is more general than the former conception: Because of the mostly voluntary nature of human behavior, changing people's behavior in general involves inducing them to make particular choices (e.g., what to eat or how to exercise). The "choice support" perspective is more general than the "behavior change" perspective in that it includes not only inducing people to choose options that a particular behavior change agent considers desirable (e.g., following a Mediterranean diet) but also helping people to make satisfying choices where there is no predetermined correct option (e.g., finding out which particular foods within the Mediterranean diet the chooser most enjoys preparing or eating). In my keynote talk at Persuasive 2013 ([2]) and in my tutorial at Persuasive 2017,[5] I argued for the desirability of viewing these two types of support for choices—which I have called *persuasion* and *choice support*, respectively—as complementary approaches that should in general be combined (cf. also Section 1.2.2 of [3]).

4. One of the main uses of the BCTT to help integrate knowledge about existing interventions has been the practice of coding an intervention in terms of the BCTT techniques that it employs. But most interventions involve a number of different concrete "features" (e.g., the functions provided by a mobile recommendation app; regular consultations with a doctor), which can take very different forms. Moreover, a single feature can realize two or more BCTT techniques, and a single BCTT technique can be realized by two or more features. So it would be more helpful to know which particular BCTT techniques were realized by which particular features of the intervention. Accordingly, CHUSAPEDIA's concepts are applied not to an entire intervention but rather to specific features of an intervention.[6]

3 Brief Introduction to Chusapedia

CHUSAPEDIA is a web-based system designed to be used by anyone who wants to design a *choice support intervention*, which may be anything from a single recommender system application to a combination of applications and/or human activities (e.g., advice provided by health specialists). CHUSAPEDIA has two main components: The first is a semantic wiki (realized within the Semantic MediaWiki platform[7]) in which a wide range of knowledge about how people make choices and how these choices can be supported is collaboratively formalized. This knowledge is derived from the ASPECT and ARCADE models and from other models such as BCTT and more specific models such as those that BCTT has already taken into account. It will be continually expanded to include also knowledge that is specific to particular application domains or types of choice problem. The second component is a web application that is implemented outside of the semantic wiki but that accesses

[3] http://www.bct-taxonomy.com/interventions

[4] The ASPECT model and other concepts used in CHUSAPEDIA are presented briefly in the readily available handbook chapter [4] and in detail in the book-length monograph [3]. The CHUSAPEDIA user interface also includes explanations of the concepts. In the present paper, these concepts are explained only to the minimal extent required for readers to be able to understand the main features of CHUSAPEDIA and how it can be useful in the area of health recommender systems.

[5] http://www.dfki.de/~jameson/pt17-tutorial-jameson

[6] The concepts are also linked to particular choices made by particular "choosers", as is explained below.

[7] https://www.semantic-mediawiki.org/wiki/Semantic_MediaWiki

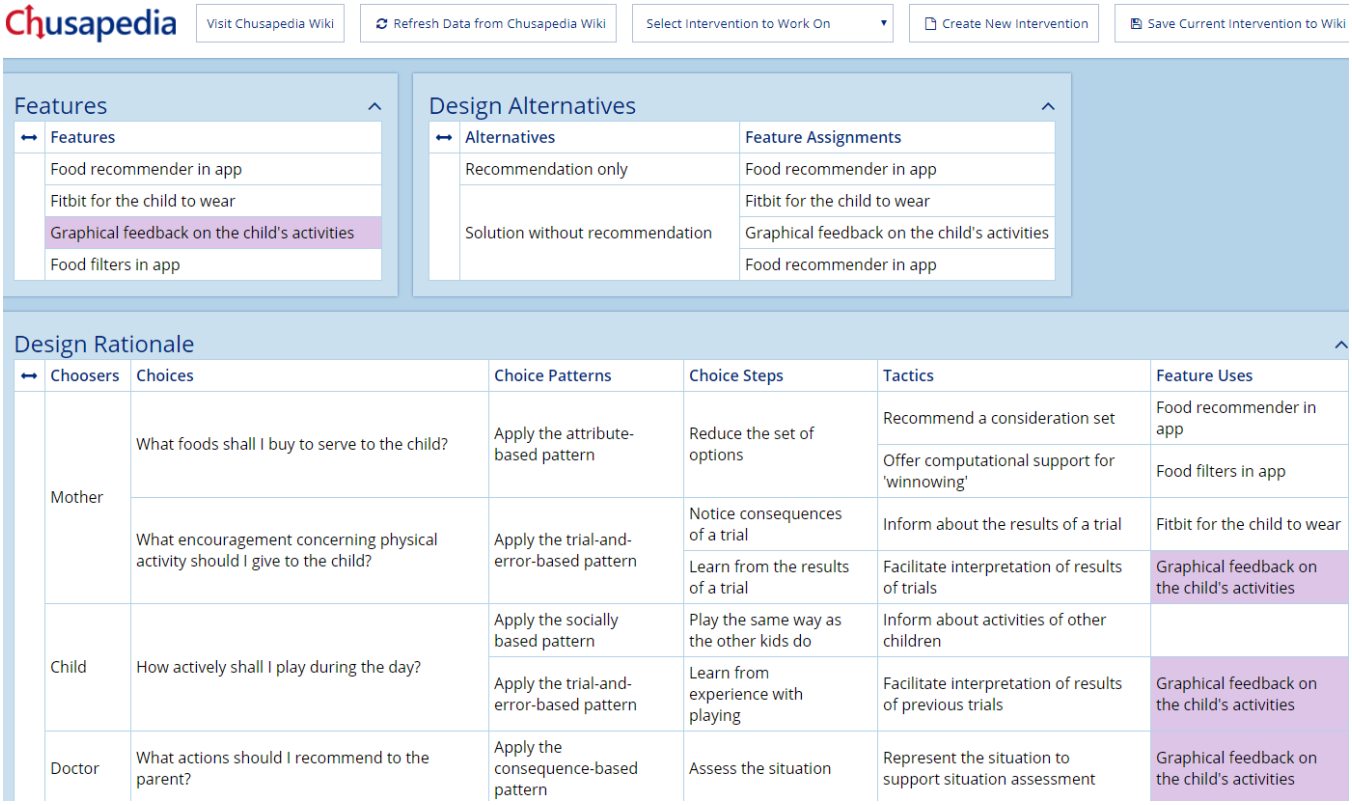

Figure 1: Screen shot of an early version of the Chusapedia web application showing a partial analysis of the TreC-LifeStyle intervention

the wiki's knowledge to enable designers to analyze and improve designs for specific choice support interventions.

Both components of CHUSAPEDIA will be demonstrated at the workshop and made available to participants.[8] Because of the space limitation for this paper, I explain CHUSAPEDIA here with reference to a concrete example of how it can be used to analyze and improve a specific intervention in the domain of health and well-being.

The intervention ([1]) is specifically aimed at families in Italy that include a child who is overweight because of some combination of inappropriate nutrition and inadequate physical activity. One aspect of the intervention is that the child is expected to wear a motion tracker throughout the day, whose data are transferred to the TREC-LIFESTYLE mobile application. This app has several types of functionality, including those that help the parent of the child to monitor the child's physical activity, to select appropriate food to serve the child, and to keep track of the child's food consumption. The actions of the child and the parent are monitored by a doctor, who gives advice about any necessary adaptations to the actions of these participants.

Figure 1 gives a selective overview of the information contained in CHUSAPEDIA after an intervention designer has used CHUSAPEDIA's web application to describe the current version of the TREC-LIFESTYLE intervention and its design rationale. In the left-hand column, we see that the designer has distinguished three types of *chooser* that are addressed by the intervention: the parent who is responsible for buying and preparing food for the child; the child who is supposed to be encouraged to eat and exercise in a healthier way; and the doctor who monitors progress and gives advice.

In the second column, we see that the designer has listed the choices made by each chooser that the intervention is intended to support.[9]

Together, these two columns illustrate the fact that a choice support intervention often needs to address several different choices made by different choosers.

In the third column, the designer has specified, for each choice, which of the six choice patterns (Section 2) distinguished by CHUSAPEDIA might be applied by the chooser in making that choice. The inclusion of these choice patterns in CHUSAPEDIA helps to remind the designer of the wide variety of ways in which people make choices, so that the designer does not make the mistake of basing the intervention's design on assumptions that may not be true.

[8] An unpublished document about the system's structure and design rationale is available on request.

[9] Starting with this column, the table shows only a subset of the relevant elements, because of the limited space available for the presentation and discussion of the table.

Each choice pattern is associated with some typical *choice steps*: mental operations that the chooser can engage in. In the fourth column, the designer has specified the likely choice steps for each choice under consideration.

For each choice step in each choice pattern, CHUSAPEDIA offers information about some *choice support tactics* that can be applied to support that choice step. Some of these tactics are quite generic and domain-independent; many of these were presented in the original exposition of the ARCADE model of choice support ([3]). Other tactics may be specific to particular application domains or problem types. The semantic wiki component of CHUSAPEDIA makes it possible for domain experts to contribute specific tactics of this sort, which the designer of an intervention can ask to have loaded into the web application when she begins her analysis. One of the goals of CHUSAPEDIA is that the library of such specific models should grow over time, making the system increasingly useful in a growing number of domains.

In the final column, the designer has specified which particular features (cf. Section 2) of the intervention realize each tactic. As the last four rows illustrate, a single feature can realize more than one tactic, and the designer can ask for all uses of a given feature to be highlighted.

4 Benefits of a Chusapedia Analysis

Even before considering how a designer can use CHUSAPEDIA to improve an intervention (or to design an intervention from scratch), let's consider how the designer can benefit by creating this sort of analysis of an existing intervention:

1. The analysis yields a *holistic* view of the intervention. Instead of seeing the intervention as a set of specific techniques that are being applied under the assumption that they will somehow be helpful, the designer sees the features of his intervention as fitting into a large picture comprising one or more choosers, the choices that they are making, the ways in which they go about making them, and the ways in which they can be supported by the intervention.

2. References to general and domain-specific models of choice and choice support, which in turn are based on large amounts of research and experience, enable the designer to tap systematically into a large body of knowledge that would otherwise be scattered over many different publications and other documents, using different terminology and conceptual schemes.

3. The analysis will in most cases not simply serve to satisfy the designer that she has already come up with an optimal intervention. On the contrary, it is more likely to bring to light the fact that the designer, when originally designing the intervention, did not take into account one or more choosers, choices, choice patterns, choice steps, and/or available tactics. This identification of gaps can help the the designer to proceed to improve the intervention.

Improvement of the intervention proceeds in much the same way as the analysis of the original version of the intervention: The designer specifies additional elements of the analysis, including possibly new features of the intervention that ought to be added—and possibly also the elimination of features which, according to the analysis, serve no clear function.

When it comes time to improve the intervention, the designer can take advantage of another source of knowledge within CHUSAPEDIA: the case base of interventions that have already been contributed by other designers. Since these interventions will have been similarly described in terms of CHUSAPEDIA's concepts, it will be fairly straightforward for the designer to retrieve previous interventions that involve similar application situations, types of choices, and choice processes. He can then copy and adapt parts of the previous analysis and intervention design, for example adding a feature from a previous intervention.

As another useful source of knowledge, *external models* such as the Behavior Change Technique Taxonomy are represented in the semantic wiki component of CHUSAPEDIA along with links to the "core ontology" that has been discussed so far. So if a designer who is already familiar with the BCTT gets the idea of applying technique 5.2, "Use methods specifically designed to emphasise the (health) consequences of performing the behavior with the aim of making them more memorable", she can specify this idea and CHUSAPEDIA will tell her which choice steps and tactics from the core ontology correspond to that particular technique. This incorporation of external models is intended to ensure that (a) the knowledge already incorporated in these models is also present in CHUSAPEDIA and (b) intervention designers who are already accustomed to using other models will find it easy to take advantage of the benefits that CHUSAPEDIA offers.

5 Acknowledgements

Thanks are due to Silvia Gabrielli, Mauro Dragoni, and Claudio Eccher of FBK in Trento for detailed information about the TREC-LIFESTYLE intervention and for extensive feedback on an early version of CHUSAPEDIA.

References

[1] Silvia Gabrielli, Lorena Filippi, Marco Dianti, Rosa Maimone, Marta Betta, Monica Ghezzi, and Stefano Forti. Design of a mobile app for nutrition education (TreC-LifeStyle) and formative evaluation with families of overweight children. *JMIR mHealth and uHealth*, 5(4), 2017.

[2] Anthony Jameson. How can persuasive technology help people choose for themselves? In Shlomo Berkovsky and Jill Freyne, editors, *Proceedings of Persuasive 2013*. Springer, Berlin, 2013. Abstract of a keynote address.

[3] Anthony Jameson, Bettina Berendt, Silvia Gabrielli, Cristina Gena, Federica Cena, Fabiana Vernero, and Katharina Reinecke. Choice architecture for human-computer interaction. *Foundations and Trends in Human-Computer Interaction*, 7(1–2):1–235, 2014.

[4] Anthony Jameson, Martijn Willemsen, Alexander Felfernig, Marco de Gemmis, Pasquale Lops, Giovanni Semeraro, and Li Chen. Human decision making and recommender systems. In Francesco Ricci, Lior Rokach, and Bracha Shapira, editors, *Recommender Systems Handbook*. Springer, Berlin, 2nd edition, 2015.

[5] S. Michie, M. Richardson, M. Johnston, C. Abraham, J. Francis, W. Hardeman, M. Eccles, J. Cane, and C. Wood. The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: Building an international consensus for the reporting of behavior change interventions. *Annals of Behavioral Medicine*, 46(1):81–95, 2013.

[6] Susan Michie, Lou Atkins, and Robert West. *The Behaviour Change Wheel: A Guide To Designing Interventions*. Silverback Publishing, UK, 2014.

[7] Susan Michie, Robert West, Rona Campbell, Jamie Brown, and Heather. Gainforth. *ABC of Behaviour Change Theories: An Essential Resource for Researchers, Policy Makers and Practitioners*. Silverback Publishing, UK, 2014.