Algorithmic Support for Health Behavior Change: A Scoping Review Protocol

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Abstract

A wide variety of algorithms has been developed to provide effective support in eHealth applications for behavior change. However, an overview of the types of algorithms is missing. We aim to provide such an overview by conducting a scoping review of papers published in the Scopus database. We are currently screening the 44 remaining papers based on their full texts and collecting information on the characteristics of the algorithms themselves, what the algorithms optimize in an intervention, and the domain in which the algorithms are employed. We also keep track of how the algorithms have been evaluated. Our review will provide insights into what types of algorithms are currently used and how they can be improved in the future.

Keywords

Behavior change support systems, Persuasion, Algorithmic support, Digital health, Scoping review

1. Introduction

Given that 18.5% of the disease burden in the Netherlands is caused by unhealthy behavior [1] and one in three people would need to work in healthcare by 2060 to meet the needs of the aging population [2], eHealth applications for behavior change have a large potential in supporting people in changing behaviors such as physical inactivity [3], smoking [4], and unhealthy eating [5]. However, these applications typically suffer from dropout and low levels of adherence [6, 7, 8], indicating a discrepancy between the support provided by the applications and the needs of users.

Various algorithms have been designed to address this discrepancy by adapting what these applications offer (e.g., different physical activity suggestions [9]), how (e.g., using different persuasive strategies such as commitment and authority [10]), when (e.g., optimizing the timing of physical activity notifications [11]), and with whom (e.g., deciding when to add human support [12]). The decisions these algorithms make can be based on theories such as the Transtheoretical Model (e.g., [13]), expert knowledge (e.g., [14]), as well as offline and online data (e.g., [10, 14]). Moreover, the algorithms can be forward- (e.g., [10]) or backward-directed (e.g., [15]), include a positive feedback loop (e.g., [14]) or a negative one (e.g., [16]), consider

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users' future states (e.g., [10]) or the effects of repetitions (e.g., [17]), and balance exploration and exploitation (e.g., [18]).

In light of this variety of algorithms, we seek to provide a review of algorithms for adaptive health behavior change support. The focus thereby lies on the characteristics of these algorithms as well as how their effectiveness has been evaluated (e.g., controlled experiments [10], simulations [11]). To this end, we are conducting a scoping review using journal and conference articles published in the Scopus database. The general goal of a scoping review is to "identify and map the available evidence" [19]. For example, scoping reviews can be used to examine how research is conducted in a field or to identify important characteristics related to a concept [19]. We expect that our scoping review will give us insights into the types of algorithms that are currently developed to support health behavior change and how they can be improved.

2. Approach

We formulated a search query consisting of four components. Specifically, we wanted to obtain papers about 1) digital interventions, 2) algorithms, 3) behavior change, and 4) health. The resulting query (Table 1) led to 993 results in Scopus in March 2024.

Table 1
Search query components.

Digital intervention	Algorithm	Behavior change	Health domain
digital health intervention	recommender system*	beavio* change	physical activity
mHealth	algorithm	intervention	obesity
eHealth	machine learning	health self management	smoking
digital intervention	deep learning	health promotion	sleep
mobile health	reinfocement learning		non-communicable disease
	artificial intelligence		mental health
			cessation
			health

Subsequently, we removed papers using the first three exclusion criteria presented in Table 2, leading to 678 remaining papers. Next, papers were excluded based on their titles and abstracts if they were review papers or did not mention a behavior change algorithm.

Table 2
Exclusion criteria.

1. Document type is not either an article or conference paper
2. Source type is not either a journal or conference proceeding
3. Language of the paper is not English
4. Not about a behavior change algorithm
5. No access to full text
6. Insufficient information about behavior change algorithm

The remaining 235 papers were screened based on their full texts. 29 of these papers were

excluded because we did not have access to the full texts, 76 because they did not describe a behavior change algorithm, and 86 because they did not provide enough information about a behavior change algorithm. Currently, we are examining the 44 remaining papers in more detail. The primary goal is to characterize the algorithms based on their characteristics (e.g., based on online data, expert-devised rules). Moreover, we will investigate what the algorithms are used for (e.g., reminder timing, intervention selection), the domain they are employed in (e.g., mental health, smoking cessation), and how they have been evaluated.

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