How Much Exercise Do You Have to Do to Drink a Glass of Coke? A Health Action Process Approach in Virtual Reality

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Abstract. Obesity is the most widespread disease worldwide. There are numerous therapeutic approaches and possible solutions, but the problem has not diminished yet. By using digital technologies, we suggest to apply the concept of the Health Action Process Approach (HAPA) and Cognitive Absorption (CA) to a virtual reality (VR) context. The HAPA is used in physiology and psychology to examine phenomena with regard to nutrition and movements. In order to strengthen the motivational level of people with obesity, our idea is to achieve a better nutrition behavior through a higher level of immersion and physical activities in VR. To investigate this issue, we propose an integrated theoretical model and an experimental study with volunteers. The experimental study combines psychological elements (HAPA) with digital technologies (VR) in order to establish a temporally and spatially independent mobile solution for increased awareness and understanding of consuming unhealthy food and the associated need for exercising.

Keywords: Health Action Process Approach, Virtual Reality, Cognitive Absorption, Immersion, Experimental Study, Nutrition.

1 Introduction

The incidence of adiposity-related, non-communicable diseases such as diabetes mellitus type 2, cardiovascular diseases, and lipometabolic disorders is increasing worldwide. Organizations such as WHO or World Obesity Federation are collecting data around the world and show alarming trends over the last years. In Germany, such diseases cause not only individual suffering but also severe economic issues [1]. There is a basic scientific consensus that the development of non-communicable diseases is multi-causal and that excessive consumption of sugar, saturated fats, and salt can increase the risk of non-communicable diseases [2–4]. For instance, coke is one of the favorite sodas in the world, and the drink is reportedly recognized by 94 percent of the world's population [5, 6]. However, most people are not aware of how many calories one glass of coke contains and how much exercising they would have to do in order to compensate for that. Therefore, it is worthwhile to consider how new technologies and playful elements can be used to foster a healthy diet. The idea to

15th International Conference on Wirtschaftsinformatik,
March 08-11, 2020, Potsdam, Germany

https://doi.org/10.30844/wi_2020_f9-ressing

investigate the application of innovative technologies and particularly virtual reality (VR) within therapy is not new [7, 8]. To the best of our knowledge, studies that have examined existing theories from psychology and information systems concerning nutrition and movement approaches are scarce and focus on self-perception (e.g. [7]) or body awareness and image (e.g. [9]). In the field of VR, the concepts of Cognitive Absorption (CA) and its sub-dimension immersion play a decisive role [10]. Hence, we utilize immersion, movements (such as physical activities), and a psychological theory, i.e. Health Action Process Approach (HAPA), as potentially gainful for nutrition behavior and to antagonize obesity.

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2 Health Action Process Approach and Cognitive Absorption

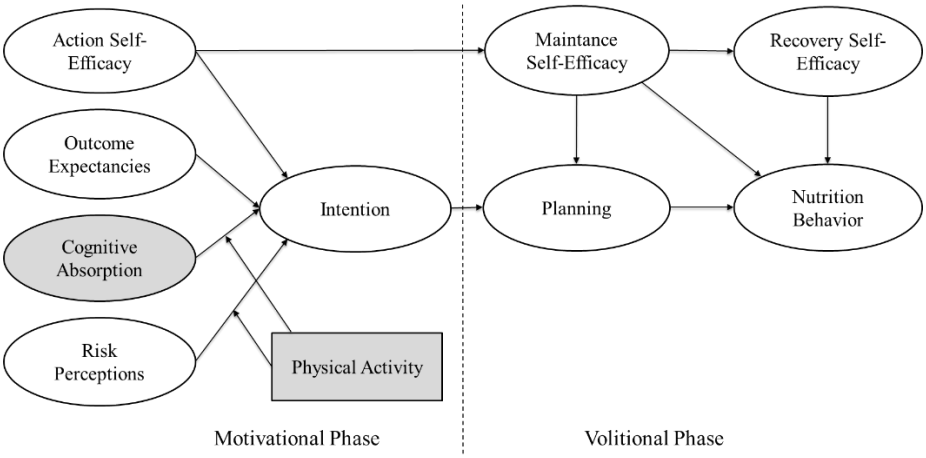
Physical activity and nutritional behavior are often difficult to develop, especially when unfavorable habits have been practiced for longer periods. It is usually not sufficient to know the "right" physical exercises and nutrition or to envision them as a goal. In motivational psychology, this is referred to as the intention-behavior gap [11]. The HAPA, which has already proven to be highly applicable in explaining health behavior, describes factors that facilitate the transformation of intentions into actions [12]. HAPA assumes two successive phases: (1) the pre-intentional phase, which includes motivational processes, and (2) the post-intentional phase, which includes volitional processes, i.e., real actions. In both phases, the promotion of health behavior can start because intentions from the motivation phase can be transferred to the volitional phase [13]. Particularly noteworthy are previously learned motivational self-regulation strategies whereof research has shown increases in treatment success [14].

VR technologies such as head-mounted displays (HMDs) are already part of recent research in healthcare. For instance, they are utilized in body-swapping or assessments and treatments of eating disorders and obesity, anxiety disorders, stress, or pain management [15]. With regard to eating disorders and obesities, VR has been used to analyze effects of modifying the enduring (allocentric) memory of the body [16–18]. Research has also shown that doing exercises in VR is more enjoying and fun than in reality [19]. We aim to integrate VR in existing treatments for eating and weight disorders (i.e., HAPA) by strengthening the sense of immersion (as part of CA) within the motivational phase in order to motivate people to choose for the right food and reduce food craving [20]. To do so, we argue that embodiment (i.e., interacting with the own body in a virtual setting [21] can have a positive effect on being immersed. Immersion is defined as the total engagement to a particular task or interaction while other attentional demands are ignored [10, 22]. In specific, we therefore investigate how the type of physical activity (reading nutrition facts and doing a calorie equivalent exercise vs. solely reading nutrition facts) in VR is able to enhance immersion and thus also knowledge acquisition to better shape the intention to behave healthier. We argue that just reading or recalling nutrition facts remain solely informative and is rather less engaging. However, by combining this with a VR

https://doi.org/10.30844/wi_2020_f9-ressing

exercise, we give this information a context and the user experiences what the information really means. Thus, the participant transforms the information into more capable knowledge about intake and consumption as well as the meaning for his/her health. Consequently, the participant is able, for example, to evaluate that his recent diet in comparison to his activity level will lead to higher obesity and is therefore more willed to change his behavior.

Figure 1 presents the integrated concept of HAPA, CA and physical activity.



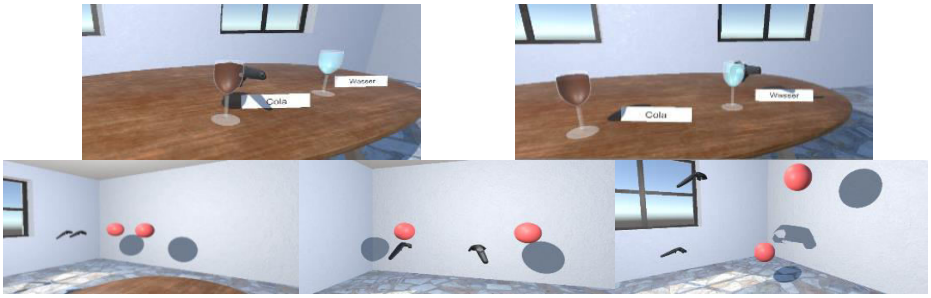
1. Figure 1: Extended HAPA concept by cognitive absorption and physical activity (adapted from [12]).

3 Research Method – An Experimental Approach

We suggest an experimental approach to create awareness for the reduction and avoidance of unhealthy food in the sense of health prevention and consumer information. We will use a HTC Vive with provided controllers and the lighthouse tracking system. In order to gain first insights, we aim to perform a pilot test (2x2 between-subject design). Sample size will be calculated with G*Power [23] . The experiment will take place in a lab. Each participant is randomly assigned to a group and is asked to participate in a virtual setting. In a time of eight weeks they have ten VR interventions (in the VR scenario participants get randomly presented three sodas like water, juice or coke etc. out of a wide assortment). We adapted the general procedure by Riva [7]. Additionally, each participant is asked to answer a questionnaire-based survey and two groups are asked to keep a diet diary for the time (here, we are adapting the longitudinal study method of Schwarzer et al. ([12, 24]). Within the physical activity treatment groups, participants additionally have to perform a workout exercise (a repetitive arm activity where each participant has to follow the movements of virtual balls; c.f. Figure 2 for the preliminary self-developed VR setting) to get a feeling for how many calories they would have consumed. For instance, water contains 0 calories per 100ml, while coke contains 360KJ/84 kcal per 100ml [5], which corresponds to a workout time of 20 minutes [25]. The VR system

https://doi.org/10.30844/wi_2020_f9-ressing

tracks the movements in order to perform the exercise correctly. To motivate over time, participants will receive performance feedback by use of gamifications elements such as levels. We have chosen arm movements as a physical activity within the VR setting to guarantee that no participant will harm oneself due to the fact that VR-HMD completely encloses the view.



2. *Figure 2: Self-developed virtual concept of the exercise by picking coke or water*

The measurement items for HAPA and CA will be adapted from literature. We will use Schwarzer's items [12] about nutrition behavior und Burton-Jones and Straubs' items [10] to measure CA (here, immersion, which is argued by Burton-Jones and Straub to be the only sub-dimension of CA that actually measures cognitive absorption). The actual nutrition behavior (within the volitional phase) will be measured by analyzing the diet diary in accordance with Schwarzer [24].

To analyze our data, we will use four-group longitudinal structural equation modeling with multiple indicator variables [26]. Moreover, we integrate manipulation checks to validate our experimental treatments of physical activities and analyze these by use of t-tests.

4 Preliminary Discussion and Concluding Remarks

Our experimental study aims at integrating a psychological approach with a VR scenario and its distinct characteristic immersion for better nutrition behavior. Here, we propose a theoretical model based on the HAPA with a motivational phase for intended behavior, extended by the theoretical construct CA, and a volitional phase with an actual nutrition behavior. Moreover, we will contribute to existing literature by suggesting not only positive effects on nutrition aspects but also for more physical activity by supporting people with, obesity in order to be more aware of their nutrition behavior. We argue that if people are aware of and understand how many exercise repetitions, i.e., being physically active over a longer period, are needed to compensate for high caloric food, they are more likely to choose healthier and low caloric food products. Within a longitudinal study with several measurement points, we check for an actual change of nutrition behavior over time.

https://doi.org/10.30844/wi_2020_f9-ressing

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https://doi.org/10.30844/wi_2020_f9-ressing