Training cognitive control

VALORISATION ADDENDUM

Creating value from science

Relevance

The rates of overweight and obesity have doubled since 1980, and continue to rise rapidly (Finucane et al., 2011). It is estimated that at the moment around 1.9 billion adults are overweight, and approximately 600 million adults are considered obese (WHO, 2016). Some experts even talk about an epidemic. Obesity is associated with adverse health consequences as it places individuals at risk of cardiovascular diseases, various forms of cancer, diabetes mellitus type II and musculoskeletal disorders (Lim et al., 2013). It is also associated with serious psychological consequences such as a reduced quality of life (Uzogara, 2017).

There is a wide variety of diets and diet products available, all promising quick and easy weight loss. The problem, however, seems to lie for a large part in adherence to a diet. We live in a so-called obesogenic environment, an environment that promotes gaining weight and one that is not conducive to weight loss (Swinburn, Egger, & Raza, 1999). Unhealthy, high-caloric foods are cheap and available in abundance, portion sizes have increased, and unhealthy products are aggressively marketed. Obviously, this makes it difficult to maintain a healthy lifestyle and to follow the rules of a particular diet or stick to diet products only. Traditionally, obesity has been considered as mainly a biomedical problem, though behavioral factors seem to play an important role in the etiology and maintenance of obesity (Jansen et al., 2009).

Current lifestyle treatment programs which focus on reduced intake and heightened physical activity do result in modest initial weight loss (around 8–10%; Butryn, Webb, & Wadden, 2011). However, only a small percentage of dieters (between 3% and 21%, depending on the definition of 'successful weight loss') manages to keep the weight off in the long-term (Ikeda et al., 2005). Thus, it is clear that we need more effective interventions to combat this epidemic. This thesis provides a first step in the development of new trainings targeting the cognitive profile of obesity. In part one, cognitive weaknesses associated with unhealthy eating behavior and weight loss success were identified, and in part two, causal associations between these cognitive elements and eating behavior and weight loss were tested in experimental designs. As experimental research aimed at the training of executive function in the field of eating behavior and weight loss is still sparse, this thesis focused on a question that was, and still is, a very prominent one.

Target groups

As the numbers of overweight and obese individuals are rising, the conducted studies were aimed at a large target group. We studied in this thesis a broad range of participants, with and without weight loss goals, within multiple age groups. The findings described in this thesis are relevant for individuals with overweight or obesity, individuals at risk, clinicians, researchers, research organizations and policy makers. The obesogenic epidemic places a high burden on health care providers, which leads to high costs for insurance companies and therefore for society. If we know more about the etiology of obesity, eventually treatment can be optimized and money can also be used more efficiently. The current manipulations developed for an obese, adult sample could also be adapted and studied in the treatment of other impulse-disorders (e.g. alcohol abuse, smoking) and in other age groups (e.g. children and elderly).

Activities and products

Results of the research in this thesis have been presented at scientific conferences, but also at more applied, clinical conferences, for instance, the Association of Cognitive Behavioral Therapy in Veldhoven, the Netherlands, and the Workshop Congress of Clinical Psychology and Psychotherapy in Chemnitz, Germany. These conferences are attended by both researchers and clinical therapists and therefore these events facilitate contact between science and clinical practice: therapists can learn about new scientific developments, and scientists can get direct feedback from the clinical practice.

It takes time before treatment can be applied into the clinic. The extensive collaboration of our eat-lab with clinical institutions makes it possible to discuss and implement results at an early stage of the development. Co-Eur Centre for Obesity and Eating Disorders, a multidisciplinary weight loss clinic, was involved in the execution of the research described in chapter 2, and the staff of Co-Eur as well as their clients will be informed about our outcomes.

It is not only important to inform clinicians, but also to the general population. Besides scientific publications, we also shared our knowledge with a more broad audience. A Dutch overview article was published in the online peer-reviewed journal The Inquisitive Mind, which is targeted at the scientifically interested lay person. This article is currently being translated for the German edition of the Inquisitive Mind. In the summer of 2016, a public event was organized, during which the research of the eat-lab was presented to the general public. Visitors could for instance get hands-on experience with and provide us with feedback about the gamified working memory training described in chapter 6.

Teaching to students of Maastricht University was also part of this project. Many students have gained experience in the set-up and execution of scientific research by

assisting with the research described in this dissertation. Lectures about this project and related topics have been provided to the (upcoming) students of Maastricht University and the University College Venlo. Also children from elementary schools and teens from secondary schools had a first acquaintance with science and our eating behavior research in initiatives from Maastricht University like KidzCollege and Class Days.

Innovation

Many studies show that individuals with obesity have less effective executive functions. The first innovative step is that we tried to train these functions and thereby demonstrate the causal connection, to eventually reduce obesity rates. In a number of ways this has been studied by other researchers in recent years (e.g. there is a large field of research which focused on inhibition training), but we looked for new ways to train and improve executive functioning by training of working memory, shifting and episodic future thinking.

A second innovation is in the way the training is being delivered. In chapter 6, we made use of elements of 'gamification'. This entails the use of game-elements in a non-game context (i.e., the classic cognitive training paradigm) to motivate the user to conduct the training and increase his or her user activity (Deterding, Dixon, Khaled, & Nacke, 2011). Earlier research shows that cognitive tasks can be successfully transformed into game format without losing their scientific value (Lumsden, Edwards, Lawrence, Coyle, & Munafò, 2016). Thus, by adding game-elements, the scientific value of the training is retained, though the execution becomes more fun (Boendermaker, Prins, & Wiers, 2015). We put a game shell around the classic online working memory training paradigm, and added external rewards. Unfortunately, current results provide mixed evidence for the effectiveness of our gamified working memory training in weight loss, and drop-out numbers of our gamified version were equal to previous research studying the classic training paradigm (Houben, Dassen, & Jansen, 2016). Thus, future research should continue to study working memory training in experimental designs, before its potential as a tool for clinical practice can be established.

Schedule and implementation

The cognitive tasks and trainings that were developed in the context of this thesis, in collaboration with the Maastricht University Instrumentation department, are still available and usable. A major advantage of having such tasks and modules available within the university is that future research projects do not have to develop a cognitive training from scratch or rely on and invest in commercially available alternatives. Our tasks and trainings are currently used for multiple studies. For instance, within the Eatwell collaboration, a study testing the classic working memory training paradigm

within COPD patients is currently being conducted by our colleagues of the Faculty of Health, Medicine and Life Sciences.

The current work has been part of the mission of the eat-lab to eventually develop more effective treatments for obesity. Current results will be used in follow-up research to continue to study the role and trainability of executive functioning in eating behavior and weight loss, as it is clear that considerable steps are needed before clinically relevant effects on behavior change can be achieved. Eventually, web-based training paradigms can become easily and cost-effectively tools to be used by obesity clinics in treatment, as participants can train at home or anywhere they want on their tablet or smartphone. It is also possible to make cognitive trainings available to the general public in the future via for instance the development of an app.