Valorisation addendum
Relevance of the studies

Less than 50 years ago, underweight was one of the main problems society had to face. We have since transitioned to a world that is characterized by dramatic numbers of overweight and obesity, in some western countries reaching prevalences of up to 70% and 50%, respectively. Although a considerable amount of overweight and obese individuals engage in weight loss attempts, only relatively few are successful in achieving successful long-term weight loss. Further, eating disorders and related disordered behaviours are relatively common as well, the lifetime prevalence of eating disorders being approximately 5%. Since eating disorders and obesity are associated with increased morbidity, mortality, and high economic costs, it is important to study the mechanisms that underlie their aetiology and maintenance and effective ways to tackle them. Both obesity and most eating disorders are characterized by overeating. Overeating presumably often occurs in response to exposure to food-associated cues and contexts that elicit food cue reactivity (e.g., eating desires) – including for example the taste, sight, and smell of food, or certain environments. This dissertation focuses on the role of associative learning in reactivity to food cues. Research into the learning and extinction of appetitive responses can ultimately help design more effective treatments to reduce overeating.

Target groups

The studies reported here are of relevance to clinical psychologists and other specialists who treat overeating and obesity, and individuals who wish to reduce overeating and lose weight. Further, the studies have broader societal relevance, as effective treatments for overeating and obesity will reduce the very high economic costs associated with obesity. The studies highlight that responses to food cues can be learned – and, at least to some extent, extinguished. The studies also suggest that different types of stimuli can become associated with eating and consequently elicit eating desires: geometrical shapes, boxes, virtual environments, and (possibly) times of day. Adequately trained therapists may in the future incorporate cue exposure sessions (the clinical analogue of experimental extinction) in their treatment that include exposure to various (personalized) cues that have become associated with food intake, and techniques that may promote successful long-term weight loss (e.g., occasional reinforcements).
Activities and products

The main aim of the studies described in this dissertation is relatively fundamental – to improve our understanding of the role of Pavlovian learning in responses to food cues. Their ultimate aim, however, is to improve the successfulness of treatments aimed at reducing overeating and facilitating weight loss, and understand the mechanisms that underlie them.

Cue exposure therapy is the most straightforward intervention that may be derived from our findings: we have consistently demonstrated that a (partial) reduction in eating desires occurs over the course of extinction. This suggests that repeatedly exposing an individual to food cues (e.g., the sight and smell of food) in therapy may result in similar reductions in eating desires and other appetitive responses. Indeed, the very few cue exposure studies that have been conducted suggest cue exposure to be effective in reducing US expectancies, cue-elicited cravings, overeating, and binge eating. However, there is also evidence that it may not yet be very effective at preventing relapse. This seems in line with the current finding that conditioned appetitive responses can spontaneously return, and is consistent with the idea that extinction is not “unlearning”. In this dissertation, techniques have been studied that may help improve the long-term successful of cue exposure therapy (and dieting attempts in general): occasional reinforced extinction and eating expectancy violation. Whereas our findings suggest that it is not necessary to attempt to heighten the violation of eating expectancies during cue exposure sessions, we found evidence for the potential effectiveness of occasional reinforced extinction. This technique could be implemented by letting patients occasionally consume foods that they usually overconsume (e.g., taking small bites of foods). Finally, our studies suggest that contexts like environments can also become associated with intake, and we found preliminary evidence that eating desires can become associated with times of day in real-life. This suggests that cue exposure therapy should include not only exposure to the sight and smell of food but also to other stimuli that have become associated with intake in an individual, such as certain environments. In fact, we have recently investigated the effectiveness of an eight-session cue exposure intervention including exposure to individualized cues (e.g., certain environments and situations) and techniques to reduce relapse (e.g., occasional reinforced extinction). We found that participants (overweight and obese women) consumed less of their favourite food that they were exposed to during the intervention, compared with participants who received an active control intervention. Further, women who received cue exposure therapy lost weight during the intervention, whereas those who received the control intervention did not. These effects were maintained at a three-month follow-up. Thus,
(optimized) cue exposure therapy may be a useful addition to existing treatments, though additional research is needed into its mechanisms and manners in which it can be optimized.

**Innovation**

Although obesity is a medical condition, it is characterized by a behavioural problem. Yet, obesity research and treatment have mainly been approached from a biomedical perspective, largely ignoring psychological mechanisms. The current dissertation focuses on the role of one psychological mechanism that may underlie cue-elicited food desires and eating behaviour in humans: associative learning processes. As described in the previous section, a novel clinical implication of the findings presented in this dissertation is that the long-term effectiveness of cue exposure therapy (and weight loss attempts in general) may be facilitated by incorporating occasional reinforced extinction, and by exposing individuals to (personalized) cues and contexts that have previously become associated with (over) eating. Further, the current findings suggest that learning histories (schedules of reinforcement) and certain personality aspects (impulsivity) may explain individual differences in (short and long-term) dieting success in humans by influencing the acquisition, extinction, and return of appetitive responses to food cues. Although more research is necessary, cue exposure therapy might benefit from taking into account individual differences in such learning histories and personality aspects. Thus, the current findings shed more light on the role of learning processes in food desires, dieting success, and obesity, and they provide new recommendations for treatment.

**Dissemination**

Knowledge dissemination has taken place in several forms. The findings have been presented at conferences that were attended by health care professionals (e.g., VGCt, NAE), and articles have been published in Dutch journals (e.g., in de Psycholoog). In addition, several talks were given at local events for the community (e.g., The Parcours of Arts and Science), and for primary and secondary school children (KidzCollege). Findings were also regularly disseminated to the media through (filmed) interviews and demonstrations (e.g., UM Webmagazine; L1). Finally, the findings were incorporated in teaching materials in newly devel-
oped bachelor courses taught at Maastricht University (Eating Behaviours) and University College Venlo (Psychology of Eating).

We plan to continue knowledge dissemination in the future using the channels described above. Before cue exposure therapy can be applied in clinical contexts, more research is needed on its mechanisms, effects, and manners in which it may be optimized. If these additional studies confirm its long-term effectiveness, cue exposure therapy can be incorporated in existing treatments such as CBT. This can be achieved by giving lectures to health care professionals (e.g., clinical psychologists), and providing the necessary workshops and trainings to optimally perform cue exposure therapy.