

A Theoretical Framework and Design Intervention for Treating Emotional Eating in Adults

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ABSTRACT

This paper explores the prevalent issue of emotional eating, focusing on the different individuals' dependency on food as a coping mechanism for negative emotions. Through an extensive literature review, the study tries to understand the underlying factors that contribute to emotional eating. Genes, gender differences, food preferences and sensitivity are among all investigated. Additionally, existing solutions are explored and examined, revealing that there are limited solutions available yet for this problem. However, it is found that psychological therapy can help to address the root causes of emotional eating. As one of these root causes is stress, the design intervention is aimed at reducing stress by using exercise as an alternative to emotional eating. Exercise and eating are both proven to reduce stress, making the former a healthier alternative. To provide a structured perspective on this issue, this study explores various behaviour change theories, including cognitive dissonance theory, attribution theory, self-determination theory, and social cognitive theory. These theories contribute to the development of a framework that is used to form a design intervention, the E-Motion Box, which allows the user to store their food and requires them to reflect on what option they want to make each time they go to get said food: emotional eating or exercise. The user is not forced to exercise but rather is encouraged to do so by making use of fun games that also teach the user about emotional eating. The intended goal of the E-Motion Box is to break the impulsive habit of emotional eating and replace it with a new stress reduction strategy.

Keywords: Emotional Eating, Stress, Behaviour Change

1. INTRODUCTION

Emotional eating is a prevalent problem in today's society. A Finnish study found that 30% of women and 25% of men occasionally eat to cope with negative emotions (Laitinen et al., 2002). These negative emotions, which typically stem from emotions such as stress, anxiety and the feeling of pressure, can often cause a higher food intake. This type of overeating is called emotional eating; it is considered to be affected by mostly negative emotions and not by any social obligations, free time or just hunger. Emotional eating can be seen as a form of self-treatment (Ekim & Ocakci, 2021); people are trying to control their emotions and how they express them (Evers et al., 2010).

The emotional eating theory is based on two assumptions: negative emotions make people eat more, and eating makes negative emotions less intense (Bruch, 1973; Slochower, 1983). In some cases, emotional eating can eventually lead to obesity (Bruch, 1973). In general, emotional eating is a larger problem for people with eating disorders (Weiland et al., 2006). There is no large gender difference in the proportion of emotional eaters in boys or girls. However, there is a difference in the reason for emotional eating for the different genders. Boys are more inclined to overeat when they have a confused mood, while girls start emotional eating when they are stressed or worried (Nguyen-Rodriguez et al., 2009).

People start emotional eating when feeling negative emotions to regulate their feelings. Emotional eating then becomes a coping mechanism. This coping mechanism is both automatic and deliberate. People can intentionally eat more when feeling negative emotions, but when this becomes a habit, or even compulsive, emotional eating is a more automatic behaviour (Parkinson et al., 1996). Emotional eaters keep overeating because they have experienced that eating reduces their negative mood (Spoor et al., 2007). There are, however, also studies that have expanded the definition of emotional eating by showing that positive emotions can also lead to it. In both cases, it can be problematic as it can cause weight gain, interference with weight loss, binge eating and depression. There is also a strong connection between emotional eating and other eating problems (Bongers & Jansen, 2016). People who restrain themselves from eating and are constantly dieting are especially perceptive to eat after a negative event or when they feel bad (Evers et al., 2010). Even though it will invoke positive emotions while eating, the feeling of guilt that immediately follows can bring the negative emotions back (Bongers & Jansen, 2016).

2. CAUSES AND CONSEQUENCES OF EMOTIONAL EATING

There are several potential causes for emotional eating, such as upbringing, cultural influences and genetic factors. One example of upbringing as a cause of emotional eating is the relationship between parents and their child. Children can cry, not only when they are hungry, but also because of emotional reasons. When parents then feed their children to soothe them, these children could be more likely to use emotional eating as a coping mechanism when they are adults (Macht & Simons, 2010). Therefore, it is important for parents and caregivers to take this into account when taking care of children in a younger age group, as they are not only influenced by their emotions but are also forming their eating habits, which could lead to long-term health issues. Among adolescents aged twelve to seventeen, stress related to school and family emerges as the most common trigger for emotional eating (Ekim & Ocakci, 2021).

Cultural influences that cause emotional eating are prevalent in today's society. In a society with increased workload and stress where there is a high amount of unhealthy food available, people could more easily resort to emotional eating (Thayer, 2001). Besides, genetic factors can

also play a role in emotional eating behaviours. Genes that make people feel better when eating sugar could also have an influence on emotional eating (Macht & Simons, 2010).

Emotional eating can elicit diverse reactions among different population groups. For instance, individuals with obesity may struggle more with cues such as the sight and smell of food, which can intensify their drive to overeat and contribute to further weight gain (Van Strien & Koenders, 2014). Similarly, children, particularly those with a preference for certain foods, may also be susceptible to the influence of food-related cues (Soussignan et al., 2012). Furthermore, sleep deprivation affects women differently, leading to cravings for fatty or sweet foods such as chocolate, candy bars or cake. In addition, women receive an increased tendency towards smoking compared to men (Koenders & Van Strien, 2011).

Not only does emotional eating have different causes, but it can also have different effects, as not all foods provide the same effect for emotional eaters. What specific foods influence their mood could have to do with serotonin. Consuming meals that are high in carbohydrates but low in proteins can lead to the release of serotonin, which affects hunger, pain, sleep, and overall mood. Therefore, specific types of food can indeed positively influence one's mood (Wurtman, 1982). Sweet and fatty foods that are energy-dense can reduce tiredness and feelings of tension, which can help to cope with negative emotions. The chemical process of changing mood does not happen instantly. Emotional eaters are also influenced by taste. If something tastes sweet, it can have a positive effect on someone's mood as well (Macht & Simons, 2010).

Mood shifts can already happen with small portions of food. For example, 5 grams of chocolate already has a positive effect on a person's mood and is able to reduce stress (Macht & Müller, 2007) Furthermore, research by Hwang et al. (2018) demonstrates that comfort food does reduce stress. Furthermore, when larger amounts of food are consumed, people also gain more energy, and tension is reduced. In the final step, where people are binge eating, more neurotransmitters are released which improves one's mood even further. Therefore, there are three degrees of emotional eating (Macht & Simons, 2010). These are also shown in Figure 1.

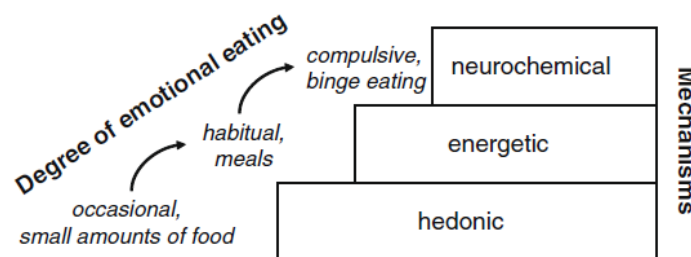


Figure 1. The Three-Stage Model of Emotional Eating (Macht & Simons, 2010)

Regardless of the cause, it can be assumed that emotional eating is not a desirable habit as it can cause weight gain and feelings of guilt (Bongers & Jansen, 2016). Hence, solutions to reduce or prevent emotional eating have been developed. These will be discussed in the next chapter.

3. EXISTING SOLUTIONS

The problem of emotional eating can be solved on two different levels. On the one hand, emotional eating can be reduced by health information technology (HIT) that focuses on weight reduction (Maior et al., 2018). On the other hand, the underlying psychological problems could be solved

through therapy, mindfulness or medication (e.g. Katterman et al., 2014). While the former type of solution is applicable to a larger group of people, the second type focuses on the underlying causes of individuals.

3.1 Health Information Technology

A study by Maier et al. (2018) found that existing HIT is not very effective for emotional eating yet. Existing HIT often focuses on goal-setting and self-monitoring, but does not allow for tracking of emotions. Participants in this study identified the need to set goals that are broader than just reducing weight in numbers, such as reaching a weight limit (Maier et al., 2018). It would also help if HIT would be more focused on changing habits than reaching goals. Furthermore, emotional support could help reduce emotional eating, especially when the support comes from people in a similar situation, age, or social position (Maier et al., 2018). Finally, HIT could support users by allowing them to track emotions in tandem with eating. This could help users understand their eating behaviour better and change their mindset towards eating. The smartphone application Eat Right Now is a noteworthy example. This particular app includes a program that is easily accessed by smartphone and includes a number of standard routines backed up by scientific research, leading to a notable 40% decrease in eating driven by cravings. Eat Right Now tries to foster a transformative shift in people's relationship with food by providing services to people at different stages of their health journeys while employing mindful eating methods as a catalyst for change (Eat Right Now®, 2023).

3.2 Therapy and Mindfulness

When trying to solve the problem of emotional eating through therapy, restricting people to eat certain types of food or prohibiting emotional eating can have a reverse effect. These kinds of restrictions can make people more stressed, which can stimulate emotional eating even further (Scaglioni et al., 2011). Instead, it is important to focus on the underlying reasons for binge eating and to break the habit of emotional eating. This can for example be done by creating positive associations with eating. Concrete examples are to motivate people to have dinner together, put on nice clothes, and take the time to prepare the food (Macht & Simons, 2010). Related to this is using mindfulness to prevent emotional eating. Studies have shown that practising mindfulness can significantly reduce the likelihood of people showing emotional eating behaviour (Katterman et al., 2014). The use of mindfulness to reduce emotional eating is reflected in current treatment options that are easily available to people: apps. Mindful eating apps such as Noom and Recovery Record focus on things such as mindful eating aiding in creating healthier coping methods (*About Us - Noom*, n.d.; App Store, 2011).

3.3 Medication

Furthermore, a negative mind can increase the drive for emotional eating. So for solving this issue the mood of the person needs to be changed to positive. Antidepressants increase the availability of serotonin in the brain which leads to an improved mood. However, there are more options available which can lead to an increase in serotonin. Carbohydrate-rich meals (bread, potatoes, beans) also cause more serotonin which helps to improve someone's mood and can therefore help to decrease the drive for emotional eating (Macht & Simons, 2010).

3.4 Solution-Focused Social Interest Program

Conversely, it is essential to note that studies on different topics can offer implications. For example, the Solution-Focused Social Interest Program (SFSI) is a treatment method for reducing internet addiction and academic stress (Busari et al., 2016). The Solution Focused Social Interest Programme (SFSI) encourages good social relationships and community involvement. It offers clients the tools and resources they need to actively engage in their own therapy by putting an emphasis on their objectives. SFSI provides a fresh approach to dealing with technology and social media addiction by combining stress reduction, solution-focused relaxing techniques, Adlerian social interest, and existential thoughts. Results from the study's post-treatment evaluations were statistically significant, which indicated an effective treatment impact (Busari et al., 2016).

The use of certain elements from the SFSI program can be helpful to control the desire for binge eating. First, SFSI recognizes the importance of relationships with others and supports the use of social networks for help. This could include talking about their struggles with family and friends or joining support groups where they exchange experiences and gain knowledge from those who have successfully managed to stop emotional eating. In addition, understanding everyone's specific situations and what sets them starting for emotional eating is an essential part of SFSI. This method includes figuring out the triggers and reasons behind emotional eating as well as its patterns and emotions.

While there are different solutions, there is a gap between what is available and what is needed in treating emotional eating. Based on the research described so far, it appears that emotional eating ideally is reduced by looking at the root cause (experiencing negative emotions) while providing people with the ability to reflect on their eating behaviour without placing an emphasis on weight reduction. Existing solutions either look at the psychological or at the food intake itself separately, rather than combining them. Additionally, existing solutions are non-tangible, i.e. apps; no physical items were found in the research, though no reason was found as to why this is the case.

4. OPPORTUNITIES

Even though emotional eating and its consequences have been the subject of substantial study, there are only a few studies that focus on effective strategies for behavioural change for those who are dealing with eating disorders. However, there are several potential possibilities found that could be implemented during this project that were not found in the existing solutions. These will be discussed in this chapter.

4.1 Stress Management

First of all, adopting effective strategies for managing stress can decrease the need for eating as a coping method. According to Bennett et al. (2013), a multidisciplinary intervention with an emphasis on stress and emotion management as well as dietary behaviour change should be created to reduce the risk of weight gain associated with emotional eating. Therefore, regular exercise, calming techniques, or getting expert help could be possibilities for managing stress and emotions better.

4.2 Advertising

External factors, like advertising, have a big impact on how hungry people feel and how much they think about eating. Emotional eaters frequently use prefactuals and hedonic justifications to support their consumption of harmful foods. Additionally, it's thought that emotional eating is a taught behaviour (Kemp et al., 2011). Therefore, educating people via external factors can be an opportunity to inform people about eating habits.

4.3 Emotion Regulation Techniques

Aparicio et al. (2016) investigated the role of emotion regulation in the context of childhood obesity and put forth the suggestion that instructing children on effective emotion regulation techniques could serve as a viable strategy in the treatment of childhood obesity. The majority of weight reduction plans do not meet each person's unique demands, which makes it difficult for people to lose weight and keep it off. Treatment should be individualized to meet each individual's unique causes of emotional eating because it occurs for various reasons in different people (Van Strien, 2018).

4.4 Eliminating Emotional Triggers

Certain aspects of emotional eating, such as emotional triggers, can be challenging to address. Emotional triggers are often linked to complex emotional states, and although coping strategies can be helpful, eliminating these triggers may not be entirely possible (Abramowitz & Berenbaum, 2007). Recent studies emphasize the significant influence of boredom on eating behaviour and propose strategies to break the connection between boredom and eating as an emotional trigger (Guerrero-Hreins et al., 2022).

4.5 Controlling Emotions

Considering how emotions play a significant role in emotional eating, there are design opportunities to create products or interventions that focus on helping individuals cope with their emotions and regulate their eating habits. The main goals of these opportunities are to help individuals control their emotions (Tanofsky-Kraff et al., 2007), enhance their eating habits (Costa et al., 2022), and tailor the interventions to meet their specific emotional needs. By focusing on these objectives, the design interventions aim to effectively address emotional eating and help individuals develop a healthier relationship with food.

These opportunities could be taken into account when designing an intervention for emotional eating. As mentioned in the previous section, there are not many design solutions available to reduce emotional eating. Therefore, it is decided to focus on designing a physical object that helps people reduce emotional eating.

5. BEHAVIOUR CHANGE

When designing a physical product that reduces emotional eating, a method of changing the habitual behaviour of the user will need to be found. To do this successfully, several behaviour change theories are considered. Based on these theories, a framework will be established to use for designing an intervention to reduce emotional eating.

According to Prochaska et al. (1993), the transtheoretical model provides the foundation for the change in addictive behaviours such as smoking and obesity. According to this model, there are several processes involved and change takes place in stages. The results of the research have several implications, including how important it is to assess a client's readiness to change and adapt interventions. However, both clinical treatment and self-change attempts frequently overlook this. Addictions must be effectively treated throughout several stages before long-term maintenance is reached. According to the transtheoretical model, the *action stage* is essential for individuals trying to stop their addictive behaviour. In order to solve their issues, people actively change their behaviour, experiences, or environment at this stage (Prochaska et al., 1993).

The most prominent behavioural changes demand action, which requires some time and energy investments. Addicts who change their addictive behaviour throughout the action stage usually see the most external acknowledgement and visibility. Therefore, an understanding of the individuals' model stage is needed.

According to Prochaska and Velicer (1997), individuals use cognitive, affective, and evaluative processes to go through the different phases of behaviour change. Change processes have been identified, some of which are more suitable for a certain stage of change than others. These processes lead to the development of change-supportive strategies. Strategies that are helpful in the contemplation/preparation phase are; education, increasing the importance of cognitive dissonance, gamification with extrinsic rewards and persistent visual feedback to increase users' awareness of their current behavioural patterns (Ferron & Massa, 2013).

The initial step to establish the framework is to assess the stage that the target group (adults between the ages of 18 and 34 dealing with emotional eating) are currently in, to understand their viewpoint on emotional eating. In this paper, the focus will lie on individuals who are aware of their emotional eating problems and evaluate the benefits of change. This means that they are in the contemplation/preparation stage of behaviour change according to the transtheoretical model (Prochaska et al., 1997). This paper focuses on the contemplation/preparation stage of behaviour change with the aim to offer a valuable "tool" to make the start of their desired behavioural transformation easier and transform to the action stage. The emphasis will be especially on people who experience negative emotions, specifically stress, as a trigger for eating, but it's still necessary to understand what emotions lead to it and what food they were seeking out. In most cases the context is similar: the individual was not hungry but alone at home and felt negative emotions. However, the food they reached for and the amount will be different for each situation. Therefore, the goal is to understand the situation and find a different coping mechanism, a change in environment or a distraction that can guide them away from emotional eating.

To determine what solutions can help with their behaviour change a few behaviour models can be used that will be implemented at the action stage, so individuals who recognize the issue but can not change it themselves. Therefore the framework will be based on the cognitive dissonance theory, the attribution theory, the self-determination theory and the social cognitive theory.

5.1 Cognitive Dissonance Theory

The cognitive dissonance theory explains how difficult it is for individuals to have beliefs that differ from their actions. As a result, they will try to reduce the inconsistency by changing their behaviour or their beliefs, or trying to find a middle ground to be able to cope with the differences. In the context of emotional eating, it can help people understand the difference between their normal eating habits, their values, goals and their emotional eating behaviours. This way a new approach can be created that goes with their values. (Harmon-Jones & Mills, 2019) For the intervention, this

could mean giving them a better understanding of the problem and letting them decide on their action and then they will choose the action that will help them improve their habit.

5.2 Attribution Theory

The attribution theory looks at what causes people to fail or succeed in certain achievements. Specifically, three factors for this are identified: locus, stability and controllability (Weiner, 1985). Locus describes if people attribute an event to an internal or an external factor. If it is internal, people are more likely to feel as though they are in control. Next, there is stability, which describes if people feel the causes for their success are stable or not. Lastly, there is controllability, which concerns the amount of control people feel they have over the cause of their success or failure.

Weiner (1985) notes that people will make attributions based on the three factors mentioned, which in turn influences their motivation and eventual behaviours (Weiner, 1985). If an individual feels as though they are in control, for example, their motivation will likely be higher. This, however, requires an understanding of both internal and external factors that are reducing motivation. Therefore, according to the Attribution Theory, to solve the problem of emotional eating, the solution should also take into account that people still feel in control over their own eating habits while trying to overcome this habit to be a successful invention. During the intervention, the user should always have the control to choose their own actions and not be forced into something they don't want. Only then will they be motivated to change.

5.3 Self-Determination Theory

This theory highlights the importance of the psychological needs of a human to have autonomy, competence, and relatedness to feel motivated. This means that people should feel like they are in control of their choices. They should also feel capable and they should have connections with others. Only then can they feel satisfied and motivated to change. Especially because emotional eating is not just a small phase but a habit that needs time to change. It is important to support the individual's autonomy and help them figure out their own reasons to change and give them intrinsic motivation. This means that it's important to understand their motivation (Ryan, Williams, Patrick, & Deci, 2009).

5.4 Social Cognitive Theory

The social cognitive theory emphasizes the importance between the environments people are living in, their relationships and their behaviour. This is due to the fact that people are influenced by the people they are surrounded with and change their behaviour according to their observations. Providing a social circle that is supportive, can reduce emotional eating as it is mostly a habit that is done alone (Bandura, 2001). This could also be in the form of interaction with others who are going through the same situation or just people that can be contacted when the situation arises.

5.5 The Framework

The framework is made as a basis for the development of the intervention design. It combines the theories explained in the previous chapter with the other findings regarding emotional eating to create a guideline for what the intervention design should adhere to. The framework is shown in Figure 2 and will be explained in more detail.

Framework Emotional Eating

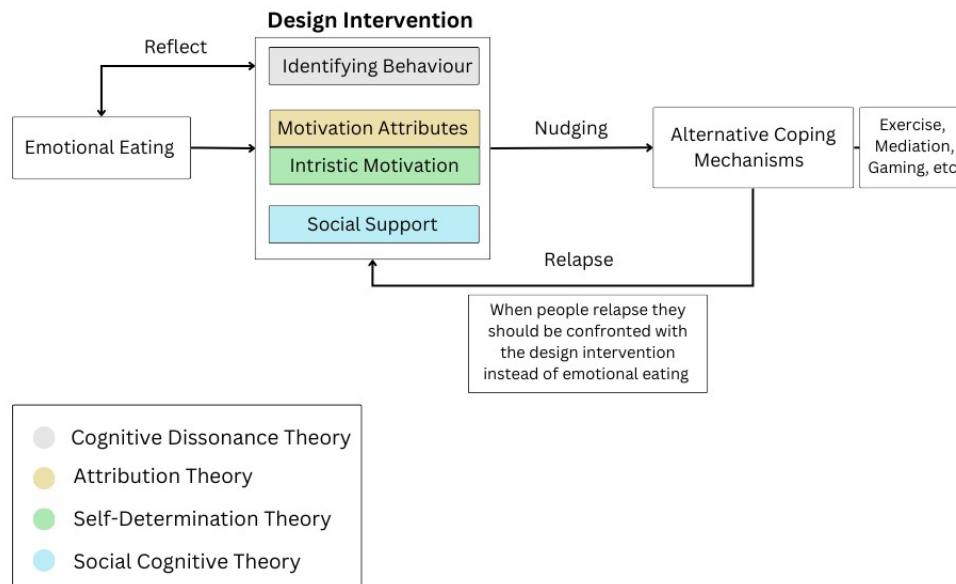


Figure 2. Emotional Eating Framework

To identify and change someone's behaviour regarding emotional eating a few steps can be taken. For the first step, it can be helpful to use cognitive dissonance theory to help the user understand their behaviour and why the habit is colliding with their values.

Next, the identification of the motivational attributes needs to be assessed to have a better picture of why emotional eating is reoccurring. Both internal factors such as lack of self-control and external factors like stress should be analysed. From there, strategies for increasing motivation (related to self-determination theory) can be made by understanding the individual's psychological needs. Both the attribution theory and the self-determination theory are connected and can be combined, as they are both heavily influential for motivation. Changing the environment or adding social support can help trigger behaviour change and should be part of the change.

By understanding and using all four theories the user can change their behaviour and choose a different coping mechanism than eating. If that doesn't help, a new analysis should be made.

Based on this comprehensive research, the following research question is formulated: How can a stress-responsive tool be designed to stimulate self-reflection on behaviour and eating patterns among people that experience emotional eating?

6. IMPLEMENTATION OF FRAMEWORK

In this section, the focus is on the implementation of a framework designed to enhance emotional well-being. Further research is done into opportunities based on the established framework. Two specific approaches within this framework will be examined: learning emotional skills through games, and stress reduction through exercise instead of eating. The objective is to explore the potential benefits of these interventions in managing stress and anxiety, and fostering emotional resilience. This chapter aims to provide insights into their scientific impact on promoting mental health and well-being.

6.1 Learning Emotional Skills Through Games

Social and emotional skills learning (SEL), among other things, aims to teach self-management, which includes managing stress and controlling impulses (Slovák & Fitzpatrick, 2015). These are the two main factors that address the cause of emotional eating, so including SEL in a product can help in making a product more effective. Teaching these skills should, however, also be somewhat fun to keep users engaged with the product and ensure they do not feel as though they are being lectured. Hence, it can be considered to teach through gaming (Hromek & Roffey, 2009).

There are several aspects that need to be considered for the game. The main point is finding the best way to apply SEL. Slovák and Fitzpatrick (2015) found several design factors that can be used as guidelines when developing something that supports SEL: utilising self-driven learning, designing to “teach and disappear” (i.e. being there during the teaching process but disappearing afterwards, while the taught skills remain) and supporting engagement. One example of an SEL game that was proven to be successful is ‘Aislados’, which teaches emotional intelligence to adolescents by letting them interact with non-playable characters (NPCs) to let players understand their emotional state through that interaction (Cejudo et al., 2020). This type of game could be emulated, with the inclusion of physical activity, as this is necessary for the product.

Another example of using and creating games for children with Autism Spectrum Disorder (ASD) is to reduce their anxiety and stress levels (Carlier et al. 2019). Their method involves implementing different mini-games within a larger game, which can be played as short breaks when feelings of anxiety and stress start to increase. Each mini-game has its own goal, with some focusing on incorporating elements of cognitive behavioural therapy, such as relaxation techniques (Carlier et al. 2019).

6.2 Stress Reduction through Exercise Instead of Eating

Exercise is widely recognized as an effective method for reducing stress and combating emotional eating. It achieves this by releasing endorphins, which are natural mood boosters that contribute to a sense of well-being and stress reduction (Dishman & O'Connor, 2009; Salmon, 2001). In addition, exercise helps regulate cortisol, the hormone associated with stress. Elevated cortisol levels during times of stress can lead to emotional eating. However, exercise helps normalise cortisol levels, reducing the tendency to overeat in response to emotions (Hill et al., 2008). Additionally, exercise promotes self-awareness and mindfulness, enabling individuals to better cope with emotions (Stults-Kolehmainen & Sinha, 2014).

In a pilot study by Meekums et al. (2012), dance movement therapy (DMT) was found effective for obese women with emotional eating issues. The DMT group showed reduced psychological distress, body image distress, and increased self-esteem compared to controls. (Meekums et al., 2012). Designing a product that incorporates incentives for individuals to engage in exercise can not only contribute to physical fitness but also have a profound impact on emotional wellbeing.

6.3 Just-In-Time Interventions

To increase the effectiveness of the intervention, it can be used on a just-in-time manner. Just-in-time interventions, as the name suggests, are presented to the user at the moment they need it (Smyth & Heron, 2016). This is in contrast with interventions that are e.g. presented at set intervals or are always present. Using just-in-time interventions has been shown to be more effective in managing stress compared to ‘regular’ interventions, as shown by Smyth and Heron (2016). Hence, it can be assumed that it can also increase the effectiveness of an intervention that treats

emotional eating caused by stress. It is for this reason that the intervention design should be just-in-time.

7. INTERVENTION DESIGN: THE E-MOTION BOX

Now that the method in which the framework will be implemented has been decided, it is possible to make the intervention design. The design was created after several rounds of ideation, of which the final outcome will be discussed.

7.1 The design

It is important that individuals who experience emotional eating acquire efficient coping mechanisms for dealing with stress and start changing their eating habits. Therefore, people need to reflect on their actions, change actions, and change their behaviour. Individuals can change their ingrained food habits that they previously used to deal with stress by using an efficient coping mechanism, and instead develop new, healthier nutrition and eating habits (Bennett et al., 2013). A variety of potential design interventions are provided to help in this quest through the framework and opportunities discussed in Chapters 5 and 6. However, it is crucial to stay away from very strict strategies, making the development of a compromise strategy important. Based on the research, the E-Motion Box was designed. This design is shown in Figure 3.

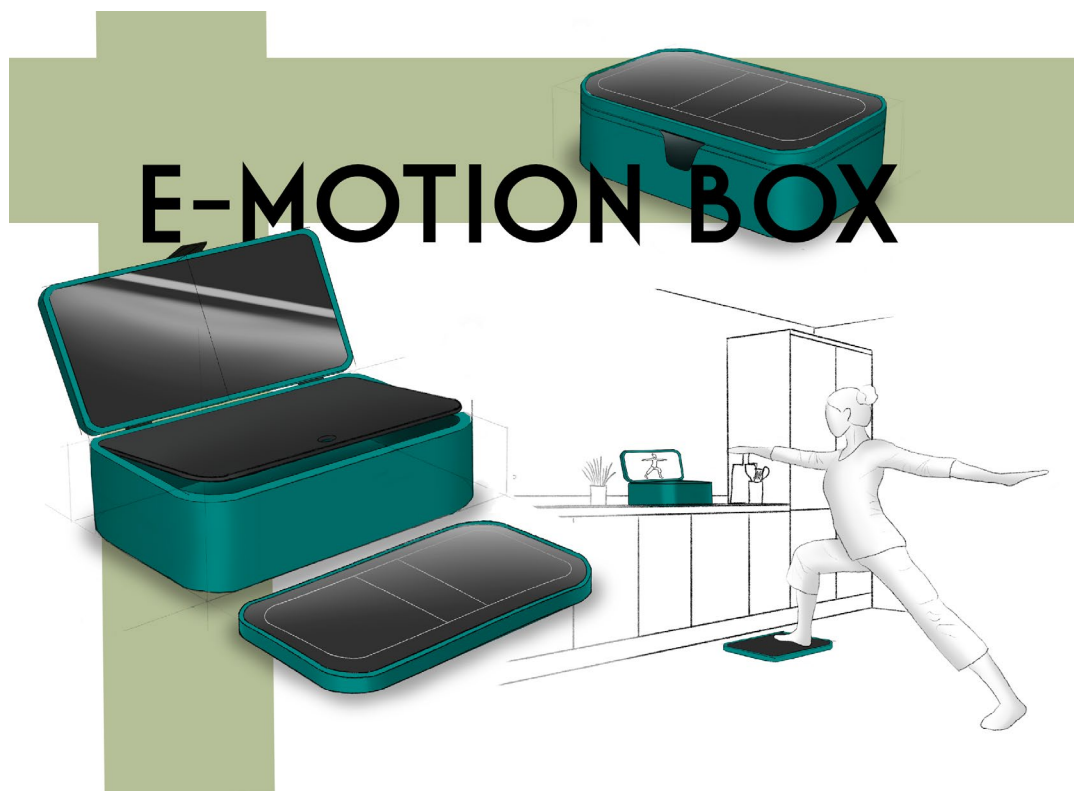


Figure 3. The Design of the E-Motion Box

The E-Motion Box is designed precisely to hold the food that people eat while they're under a lot of stress. When individuals experience stress and feel the inclination to engage in emotional

eating, they encounter the E-Motion Box (Figure 4). Users have to first get off the balance board that is on top of the E-Motion Box in order for it to open. An interactive screen and a lid are visible when the box is opened. The main game is displayed on the interactive screen with the intention of getting individuals to think about their actions and decide whether they still want to eat or play a stress-relieving game.

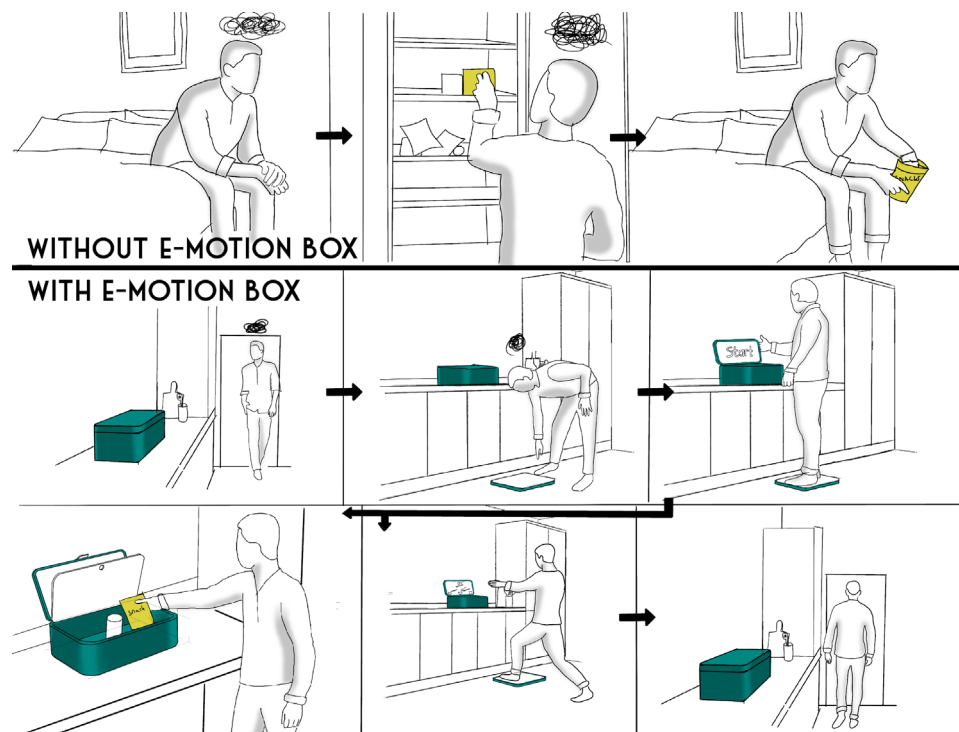


Figure 4. The E-Motion Box in Use

The stress-relieving games are an engaging way to reduce stress and increase healthy decision-making through exercise. In this way, exercising can be a coping mechanism to emotional eating to reduce stress, reduce emotional eating, and make healthier choices. The games entail physical movement facilitated through the balance board. These interactive games not only encourage individuals to engage in exercises but also serve as a viable coping mechanism for emotional eating. Furthermore, the games provide educational aspects for individuals to acquire knowledge about healthy nutrition. It is important to note that people are free to decide what they want and are not forced to exercise. Furthermore, since emotional eating requires little effort for the individual, the alternative coping mechanism has this requirement as well. In a matter of seconds, the exercise can be started and the user can control the duration of the activity themselves.

In addition to its functional attributes, the E-Motion Box is designed to integrate into the diverse contexts of its users. Regarding visibility, the design ensures that the E-Motion Box remains unobtrusive. The box mostly blends harmoniously with the surroundings due to the modern design. Furthermore, the consideration of mobility enables users to easily reposition the E-Motion Box according to their preferences. Lastly, the product's seamless integration into the home environment is achieved through a combination of sleek design elements, versatile colour options, and ergonomic placement options. Therefore, users can seamlessly incorporate it into their living spaces without disruption or risk of stigmatisation by visitors.

The E-Motion Box not only empowers individuals to engage in self-reflection and exercise control over impulsive actions but also facilitates a profound shift in their decision-making and eating habits. The intervention is a crucial tool in this process as it gives people the power to decide for themselves whether to indulge in snacks or choose a more healthy alternative coping mechanism. This intervention supports increased self-awareness and a mindful approach to food preferences and habits by giving people the chance to consider their alternatives and think back on their actions. Individuals can start on a transforming journey through mindful decision-making in search of improved well-being through their freedom of personal choice.

7.2 Games, Learning and Exercise

The product will make use of games to make the exercise more engaging and allow for learning to be implemented. To make the game more interesting and add a level of control for the user, there will be a main game, which will have the main teaching function, and several minigames that are mainly meant to encourage the users to engage in physical activity but could also provide some insights into the user's eating behaviour.

7.2.1 Main Game

As the main game has a teaching function, the controls should be simple so that the user will not be overwhelmed. It is for this reason that the main game uses walking in place (steps). Additionally, as SEL-type games can include interaction (e.g. Cejudo et al., 2020) to more easily explore emotional states, interaction with an NPC will also be included. For the design of the game, the user will walk through a nature-inspired environment, as these types of environments can be relaxing (Choe et al., 2020). They will then encounter NPCs on their walk, with whom they can interact. They can respond to dialogue options by either stepping on the left or right side of the board to select a dialogue option. The dialogue will be constructed in a way that enables users to better understand the mechanisms behind emotional eating. Concept drawings of what the game can look like can be seen in Figures 5 and 6.



Figure 5. Walking Scene in the Main Game



Figure 6. Dialogue Scene in the Main Game

The dialogue options would consist mainly of questions. To formulate these questions, inspiration was taken from the ‘mindful eating questionnaire’, which was developed by Framson et al. (2009), as it can be used to better understand the connections between eating and emotions. An example of a partial dialogue tree is shown in Figure 7.

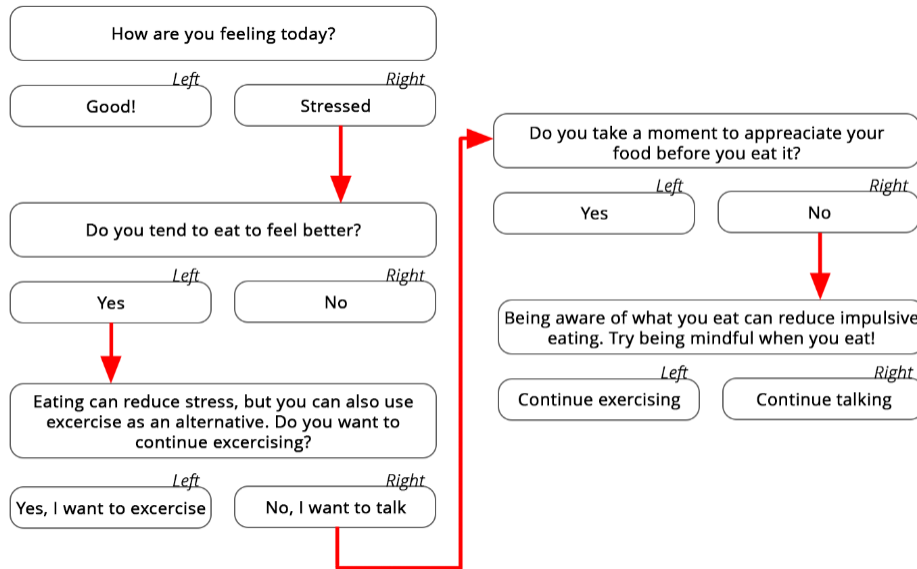


Figure 7. Example of a Partial Dialogue Tree for the Main Game

7.2.2 Minigames

Other than the main game, individuals also get the option to participate in a variety of interacting and entertaining minigames. Besides providing fun these minigames also encourage physical activity and can provide valuable knowledge about healthy eating. Participants are able to go on a multifaceted journey that combines fun, physical activity, and educational aspects through their engagement with these minigames. The minigames are aimed at creating a strong understanding of the principles of healthy eating habits and reducing stress by doing exercises. Two examples of minigames are provided.

For the first minigame, balancing is used as an exercise. Food is falling from the sky, and landing on a balance board. Using their feet, users have to guide the food to the different baskets to indicate how often they eat that type of food. At the end of the game, the contents of the baskets are presented to the user and they are given some advice relating to their food consumption. A visualisation is shown in Figure 8.

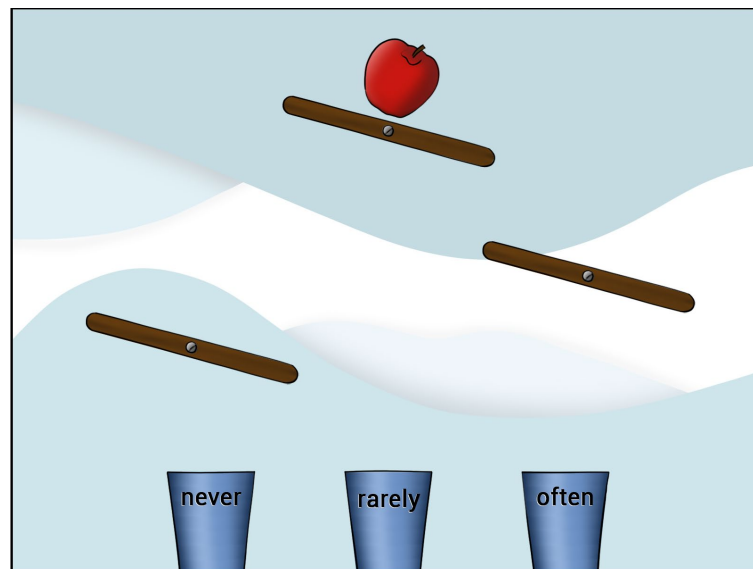


Figure 8. Balancing Minigame

Individuals actively participate in physical activity while playing this minigame and learn about healthy eating habits at the same time. In addition, the game offers an environment to gain knowledge about healthy eating habits and gives individuals the instruments to reflect on their current eating habits.

The second minigame utilises dance. It does not have an educational purpose but rather is used as a fun minigame that makes physical activity more attractive as a coping mechanism. The user is shown a dancer on the screen. This dancer has two circles beneath their feet, each representing one side of the balance board. The user must step in the circles at the same time as the dancer does to replicate their moves. A concept drawing is shown in Figure 8.

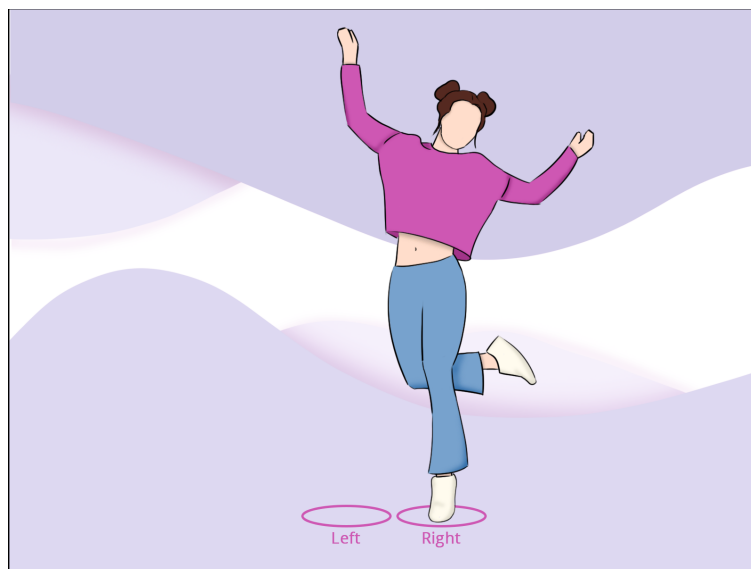


Figure 9. Dance Minigame

To keep the E-Motion Box interesting, additional minigames can be developed over time. These can then be added through software updates.

8. DISCUSSION

In this paper, the research question “How can a stress-responsive tool be designed to stimulate self-reflection on behaviour and eating patterns among people that experience emotional eating?” was answered. A design intervention to reduce emotional eating for individuals in the contemplation phase was designed based on extensive literature research and an established framework, taking behaviour change theories into account.

The designed intervention focuses on reducing negative emotions in a different way than emotional eating. There were several aspects to take into account when designing this intervention. First of all, the product should not prohibit emotional eating, because this could have a reverse effect (Katterman et al., 2014). Restricting people to eat could make them more stressed and stimulate emotional eating even more. Instead, the habit of emotional eating needs to be broken. The E-Motion Box is therefore not restricting people to eat snacks but makes it harder to reach them. The food is hidden behind different layers of lids while presenting an alternative coping mechanism first: exercising. Since emotional eating is not directly related to the feeling of hunger, the alternative coping mechanism does not have to be related to food.

This alternative coping strategy is based on research that says that exercise is a very effective coping mechanism for stress (Meekums et al., 2012). Furthermore, gamification and creating awareness of people’s behaviour patterns proved to be helpful for people in the contemplation phase (Ferron & Massa, 2013). The gamification element of the intervention also prevents boredom, which could break the connection between boredom and eating as a cause for emotional eating. Boredom has a significant influence on emotional eating, studies show (Guerrero-Hreins et al., 2022). Furthermore, the intervention was designed in such a way that the option of exercising should be just as easy as eating. Because emotional eating is a coping mechanism that is effective right away, the alternative one should be that as well. Therefore, it was

necessary to design an intervention that is low-effort and indoors. This is achieved by having a just-in-time intervention that people can immediately start to use, without having to put effort into starting it up or having to change their clothes and location.

The intervention design can be connected to the framework. First, there are the four behaviour change strategies that were identified, which have been implemented into the design intervention as well. The cognitive dissonance theory, attribution theory and self-determination theory shaped the development of the intervention during the design process. The intervention helps people to understand their emotional eating behaviour, which could help them to match their beliefs to their actions, according to the cognitive dissonance theory (Harmon-Jones & Mills, 2019). Furthermore, the design does not limit or restrict the user in emotional eating, but gives them a tool to control themselves. By letting users make the choice between exercising and eating, the user feels in control. When they choose exercising over eating, this could give them a feeling of success and motivation to change their eating habits. According to the attribution theory, if the user feels they are in control of their decisions, their motivation for behaviour change will likely increase (Weiner, 1985). This is also closely related to the self-determination theory, where the autonomy of an individual should be supported to help them find their own reasons for behaviour change and provide intrinsic motivation (Ryan et al., 2009). Lastly, there is the social cognitive theory, which is implemented, but at a lower level compared to the other behaviour change strategies. The E-Motion Box does not allow for direct interaction with a social support system, but it does allow for a form of social interaction through the NPCs used in the main game. While this does allow for easier teaching of emotional skills, the NPCs cannot replace real social interaction (Cejudo et al., 2020).

Based on the theory and the design choices, it can be assumed that the intervention would be an effective tool in reducing emotional eating. Existing solutions for emotional eating fail to break emotional eating patterns because they focus on goal-setting and self-monitoring and are not just-in-time. The E-Motion Box presents itself every time a person wants to indulge in emotional eating. This makes people who are in the contemplation phase of the transtheoretical model actively think about their habit, and help them to choose a different coping strategy to reduce their negative feelings. The product would be successful if users achieve to break the habit of emotional eating as a strategy to deal with negative feelings by using the product.

There are also some questions that remain. Since the product focuses on providing different coping strategies for stress, other types of negative emotions are not taken into consideration. Especially for boys, this could have significant implications, because they mostly indulge in emotional eating when they are confused, instead of stressed (Nguyen-Rodriguez et al., 2009). However, the intervention would still help to break the pattern of emotional eating, by providing a distraction and making people reflect on their behaviour. If there is a significant difference between the effectiveness of the intervention in boys and girls would need to be researched further.

Furthermore, the social cognitive theory could be implemented in the intervention more. Currently, the social aspect is represented by the use of NPCs. However, the social cognitive theory explains that a supportive social circle could also help to reduce unwanted behaviour patterns, such as emotional eating (Bandura, 2001). In order to make the intervention low-effort and not too complex for the user, it was decided to leave this aspect of the framework out. Nevertheless, it would be interesting to further investigate the opportunities of including a social aspect in the intervention.

Ultimately, users would not need the product anymore, because they used it to break the habit of emotional eating. There are opportunities for finding alternative uses for the product for users to keep the product for long-term use. One option could be to use the product as a regular exercise device. This would require the product to allow tracking of activities and introducing longer exercises. Of course, many solutions could be made because of the flexibility of the screen in combination with the balance board.

9. CONCLUSION

Emotional eating is an unhealthy coping mechanism to deal with negative emotions such as stress. However, it can often lead to guilt and other bad feelings. By providing an alternative option that is not only healthier but also regulates stress, the habit can be slowly changed.

The E-Motion Box gives the user the option to either eat or exercise which is a stress release method while nudging them towards the exercise option. By using the behaviour change theories a product was designed that would give them a moment of reflection before they could make a decision between eating or movement. The gamification of the product however adds to the nudging and the short amount of time it takes to use it.

Overall the E-Motion box is an intervention that empowers individuals to make their own choice and reflect on their behaviour without constricting them or denying them to eat or get their snacks. This is especially important as it should be their choice to break the emotional eating habit and restricting them will only make it worse. The games that encourage physical activity provide an alternative coping mechanism that is proven to be stress-reducing. Therefore another option is available at the moment of the contemplation and the moment they have to choose if they want to eat or not. Additionally, it fits into its surrounding seemingly in the kitchen context but could also be moved to any other preferred place.

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