ANEMELO TEACHER HANDBOOK

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Author: Onno Hansen-Staszyński (Ezzev Foundation)
Revision: Beata Staszyńska-Hansen (Ezzev Foundation), Spyridon Blatsios (Platon), Giulia Zunino (dLearn), Bram Alkema (Beeckesteijn), Arjan Haring (Jheronimus Bosch Academy of Data Science), Geert van Dijk (Centrum voor Bewegen)

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"Very importantly, learn to recognise when Big Food is manipulating your behaviour and food choices. Be critical in your evaluation of the messages you hear and the advertising you're exposed to, and teach your children to do the same. You don't want to pay the price of your and your family's health just so industry can increase its profits."

Professor Felice Jacka – Brain Changer (2019)

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SUMMARY

Over the last forty years food and drinks producers have started to produce ever more processed junk food: many of them have replaced whole grains in their products by state-sponsored refined carbohydrates while adding sugar, salt and fat to extend product shelf life and boost product customer appeal. The producers then heavily pushed their new cheap, tasty, and calorie-rich food and drinks that are poor on nutrients to consumers. As a result, processed food and drinks sidelined traditional, healthy products that are not designed to please the consumer palate, are more pricy, and are more complicated to prepare.

The changes in the food and drinks industry have created the "perfect obesity storm". While forty years ago overweight and obesity were rare, they are now omnipresent, both among adults and among children. Overweight and obesity are linked to a broad range of physical and mental diseases and to genetic alterations. Junk food diet currently even is the leading risk factor for early death in developed countries.

Fighting childhood overweight and obesity is a high priority within the European Union. A first step in the right direction is to promote at schools understanding of how the food and drinks industry is manipulating consumer behavior and food choices.

Food and drinks are important to youngsters. Junk food has become integrated in their identities. Therefore, youngsters can be very defensive when it comes to receiving information critical on junk food. In addition, during adolescence the main drivers of their behavior are not rational but are predominantly social and emotional. Thus, a simple transfer of knowledge on the subject will not do the trick.

The ANEMELO project offers a game to teach students about the main mechanisms that Big Food uses to manipulate them. The visual Augmented Reality technology that is used by the game entices students to play, while them being asked to play cynical villains motivates them to engage. The central message of the game is the only message that has proven effective in youngster campaigns against smoking: adults are brainwashing you to get to your money.

Nir Eyal's book *Hooked* presents a frame to understand how companies try to hook consumers. According to Eyal, the first step in this process is to expose consumers to branded messages by means of marketing. This exposure encompasses more than just displaying products: it also concerns f.i. pricing, packaging and the size of the servings. The industry provides product narratives that link positive and agreeable emotions and experiences to junk food and drinks and stress the product's healthy qualities. Youngsters are very vulnerable to these types of narratives because they are more interested in food and drinks advertisings than in any other type of ads, and they grossly overestimate their marketing and media literacy. The aim of marketing is to prompt both immediate consumption and repeat consumption that leads to consumer loyalty to the products.

The narratives by food and drinks producers in traditional media are amplified by online marketing. Youngsters are attracted to immersive online experiences, often in the form of branded games. In the games they experience the brand narratives, so that not only immediate consumption is prompted but also brand narratives are becoming internalized.

While according to Eyal exposure presents an external trigger for action, internal consumer triggers are as important, if not more important. Internal triggers are negative emotions such as boredom, loneliness, frustration, confusion, and indecisiveness. These negative emotions prompt consumers to action, to try and lessen their unpleasant impact. Adolescence is a period in which these negative emotions are prominently present. The online brand experiences present youngsters with an easy way to quell their negative emotions: they provide entertainment to take the adolescent mind off its internal troubles. By means of repeat actions, the impulse to engage in branded games whenever a negative emotion pops up becomes ever more automated.

While offline marketing presents Big Food with the means to reach a mass audience with their narratives, online marketing allows for microtargeting: reaching small, specific audiences with highly personalized messages that are to influence consumer attitudes and choices. To be able to microtarget a lot of information on potential online customers needs to be harvested. The digital trail of anyone online is thus recorded in legal, semi-legal and illegal ways. This digital trail consists of online user activities such as clicking, opening websites, searching, and buying products. It is assumed that based on these online user profiles consumer preferences and interests can be distillated that predict and influence future consumer behavior.

Online profiling is capable of measuring the short-term and long-term internal states that youngsters experience. According WHO junk food and drinks producers probably use this information to target youngsters when they are at their most vulnerable and then prompt them to action, either to consume or to experience a branded game. Big Food most certainly uses other data harvested by profiling methods to target youngsters.

While external and internal prompting form the first step in Eyal's process of getting consumers hooked, the follow-up action (consuming or engaging oneself) is step two. And this action is to lead to step three: rewards. The most effective type of rewards is variable rewards. Whenever the outcome of an action is unpredictable, the action gets boring less quickly. The gambling industry is based on this principle.

The first type of rewards junk food and drinks producers offer youngsters for their actions is a very pleasant taste during the consumption of their products. Food and drinks engineers are non-stop experimenting to find the ideal pleasing combination of sugar, fat and salt in products.

The second type of rewards is prompted by sugar: dopamine. Dopamine is a hormone and a neurotransmitter that is released by undertaking rewarding activities and by taking in specific chemicals that prompt the release of dopamine without any effort. Sugar is one of these chemicals that cues dopamine release.

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Dopamine is much more than just a pleasure hormone. It plays a role in controlling body movements and constitutes an important element in the process of human learning. Dopamine is produced when a pleasurable activity is expected, and thus rather is linked to craving for something than to actually liking something. Dopamine is important in establishing whether a situation, experience or potential outcome is worth noticing. The chemicals that automatically prompt dopamine, such as sugar, therefore automatically are interpreted as important.

Online branded games evoke the third type of rewards. As all effective games, junk food games cause a state called "fiero" every few minutes: a release of dopamine cued by an event that is worth noticing, such as a gift, a win or a kill. Just as in gambling the precise form the game events take is unknown to players before encountering them. This unpredictability makes the game attractive to players for a prolonged time.

The fourth type of rewards is triggered by the use of social media by junk food and drinks producers. Social media are constructed to trigger dopamine feedback loops in users, and addict them, just as games do. The rewards linked to the use of social media also are variable by design: no one ever knows how many likes or reactions one will get when publishing.

Social media enable junk food and drinks producers not only to offer rewards and thus amplify the effects of consumption and immersion in branded games, but also open up the intimate online world of adolescents to them. Social media enable Big Food to microtarget youngsters in an environment in which youngsters are more open and trusting.

All mechanisms used by junk food and drinks producers to influence adolescent consumers thus are aimed at more than just immediate sales. To them, it is as important to stimulate brand loyalty and repeat consumption – step four in Eyal's model. The goal of Big Food is to nudge customers, including youngsters, to eat and drink their products binge-like as an automated behavior on cue.

The hooked-cycle is supported by the human body. Junk food provides consumers with a lot of calories but with little nutrients. This means that people on a diet of mere junk food get fat but are left hungry at the same time. Junk food also kills off large amounts of our gut species. The ones that remain have a preference for junk food and communicate this to the brain thus causing repeat consumption. The gut preference for junk food is hereditary. In addition, the palate of youngsters is being narrowed by junk food and drinks producers already from birth. The natural preference for sweetness in babies is reinforced by junk baby products.

The metabolic changes in the bodies of youngsters that are caused by overconsumption of junk food and drinks are associated with more negative emotions, with changes in adolescent reactions to their negative internal triggers leading to more impulsivity, anxiety, ADHD and addiction, and with an enlarged adolescent sensitivity to external triggers like images of junk food and drinks. It is therefore tempting to blame the victim by fat shaming: those who are obese are more prone to crave for junk food and consume more of it while it seems that they especially should know better.

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Fat shaming is supported by the dominant Big Food paradigm that getting fatter is the outcome of a simple process: more calories go intp a body than go out of that body. According to this paradigm overweight and obese youngsters either eat too much or exercise too little. In the end their condition is their own fault: they apparently have too little willpower to limit their consumption or to work out sufficiently.

Our thinking of food and drinks consumption and its consequences has been dominated by Big Food narratives, supported by research sponsored by Big Food. Non-industry funded research on the other hand supports the insights shared here: the real culprit is the changes in the food system, with increases in the quantity of available food, and especially of industrialized foods with added fats, sugars, salt and flavors – all designed to make us want more of them.

Youngsters are surrounded by cheap and omnipresent junk food. The General Secretariat of the European Council states that this obesogenic environment is the most important cause of childhood overweight and obesity.

If Big Food's paradigm is not to be believed and the ANEMELO game shows youngsters the workings of industry's manipulation mechanisms, how are adolescents to approach the subject from this moment on? It is clearly not enough to just state that their food environment is to blame and that they are being brainwashed by adults who are out to get to their money.

Unfortunately, advice on better diets and more exercise often come from incompetent self-proclaimed experts like food and sports vloggers or from misinformed medical professionals and government diet recommendations. More often than not these voices either ignore or misinterpret scientific research outcomes or simplify matters, f.i. by not taking into account that individual organisms react differently to different foods as a result of differences in nature and nurture, and that our reactions to food and drinks cannot be reduced to reactions to single ingredients present in food and drinks products.

Regarding exercising it is safe to say that working out makes people healthier but it does not undo the effects of bad diets. Only by exercising for longer periods it is possible to burn fat.

Regarding diets scientists like Tim Spector and Felice Jacka have started to make their voices heard. Spector summarizes his findings: "there are certain facts about diet that are unarguable: diets that are high in sugar and processed foods are bad for our microbes, and by extension for our health, and diets that are high in vegetables and fruits are good for both." He advises to take in prebiotics, fibre, nutritients and probiotics, to try out new foods, to fast occasionally, and to avoid preservatives, antiseptic mouthwashes, antibiotics, junk food and sugar.

INTRODUCTION

This document serves as the teacher handbook created within the framework of the European project Augmented reality and new media against online promotion of unhealthy foods (ANEMELO).

The main subject of this Handbook is obesity among youngsters. In section 1 it will be shown that obesity is an enormous health challenge among youngsters, as well as among adults.

Obesity wasn't always as big a problem as it is now. It has catapulted itself into prominence over the last forty years. The underlying causes for the "perfect obesity storm", as Tim Spector describes the situation, are manifold.

To start with, the food industry has shifted to producing ever more unhealthy food and drinks. A large share of it has rapidly replaced more whole grains and other valuable carbohydrates with highly refined and processed carbohydrates. And it has started to add ever more sugar, fat and salt to products to extend their shelf life and to make their products irresistible to consumers. To give an idea: currently, an estimated 70 percent of all processed foods sold in the USA and the UK contain some added sugar.

The shift in production processes was accompanied by gigantic efforts by the industry to attract customers for their changed products and to keep their customers loyal. In addition, the industry was supported by government enormous subsidies on the four key ingredients for produced foods: corn, wheat, soy and meat.

Junk food, being designed to match the consumers' tastes, offers cheap, ready-made products. As a result, it sidelined traditional, healthy products that are not designed to please the consumer palate, are more pricy, and are more complicated to prepare. This trend is the most visible in the United States where this trend started. While in 1970 Americans spent $6 billion on fast food, by 2014 this was $195 billion. The ratio of fast-food restaurants to supermarkets is five to one. Increasingly, this trend is mirrored around the world.

The handbook focuses on describing five mechanisms that are used by Big Food to attract young consumers and to keep them loyal. These five mechanisms – marketing, immersion by games, personalization of communication, offering food and drinks as a reward, offering social media as a reward and changing the metabolic system – are described in section 3. The frameworks within which these mechanisms work – the process of habit formation in general and the development of the adolescent brain – are covered in section 2.

While the handbook is descriptive, the project ANEMELO aims to provide a means to counteract against the mechanisms: a game for youngsters. In section 1 the underlying logic for choosing a game to counteract the mechanisms and the basics of the game itself are described.

In section 3.6 the handbook glances over some of the strategies that can be chosen to counter the current situation.

The handbook has been enriched by the feedback of many individuals: Beata Staszyńska-Hansen, Spyridon Blatsios, Giulia Zunino, Bram Alkema, Arjan Haring, Rolf Visser, and Geert van Dijk.

TABLE OF CONTENTS

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1 THE GAME

1.1 GAME SUBJECT

1.1.1 CHILD AND ADOLESCENT OVERWEIGHT AND OBESITY

Over the last forty years child and teenage obesity levels (as defined as a body mass index, BMI, over 30) have risen ten-fold worldwide. Currently, an estimated 213 million young people are overweight (as defined as a BMI over 25), and an additional 124 million obese. In Europe around 20% of all adolescents are overweight or obese and around 30% of younger children.

Currently worldwide around half of all adults struggle with overweight or obesity. This percentage is expected to rise to over seventy in the near future. Worldwide being overweight is the cause of more deaths than being underweight.

While in high-income European countries the BMI of youngsters has plateaued, the percentage of overweighed and obese adolescents in Eastern Europe is still on the rise. Children from parents with a lower socio-economic status are more likely to be overweight or obese, and especially children from families without food security.

Felice Jacka states: "Almost unbelievably ... *poor diet is now the leading risk factor for early death in developed countries and number two worldwide".* Poor diet is an effect both of "low intakes of healthy foods and higher intakes of unhealthy foods". According to the head of WHO, Margaret Chan, by 2030 the cost of diet-related illnesses to the global economy is likely to be at least $30 trillion. As a result of unhealthy diets 11 million die globally per year, more than from smoking.

A letter to UK Prime Minister May by UK party leaders characterizes the current level of youngster obesity as "one of the greatest health challenges of our time". It states: "If we don't act now, the current generation of young children could well live shorter lives than their parents". The Local Government Association (LGA), which represents 370 councils in England and Wales, calls it a "multibillion-pound ill-health time bomb".

1.1.2 EFFECTS OF BEING OVERWEIGHT OR OBESE

Overweight and obesity are linked to type 2 diabetes, heart disease, thirteen types of cancer, liver disease, asthma, hypertension, cardiovascular disease, a range of mental disorders including

depression and reduced brain plasticity, as well as a lower quality of life resulting among others from a low self-esteem. Being overweight is one of the major causes for adolescent depression.

Around 2.8 million deaths per year in the EU result from causes associated with overweight and obesity. Around 7% of the national health budgets across the EU are spent each year on diseases linked to obesity. In the UK obesity-related hospital admissions have more than doubled during the last four years.

Two in five adults with overweight or obesity is not satisfied with their body, against 14% of those with some overweight and 4% of non-overweight or non-obese adults.

1.1.3 THE SUBJECT AS A PRIORITY

Preventing overweight and obesity is a priority for the European Union. Unfortunately, existing policies "with the aim of halting the rise in childhood obesity have been insufficiently effective. No single action is enough to address childhood obesity. ... childhood obesity should feature high on the agenda of individual Member States and of the European Union". Various policies, like sugar taxes and banning energy drink sales to children, are being implemented on nation state level but the effectiveness of these policies is unsure. In Norway, for instance, the introduction of a sugar tax in 1922 led to a significant increase in Norwegians buying sweets in Sweden, where no sugar tax exists. In Mexico a sugar tax that was introduced in 2014 did lead to a lower consumption of sugar beverages and an increase in the sales of bottled water. In the UK a sugar tax was introduced in 2018 and immediately some of the producers of high-sugar drinks have reduced the sugar content of their products, but for instance Coca-Cola has not.

1.1.4 ANEMELO

According to the European Union schools are an important place to address youngster overweight and obesity. The ANEMELO project aims to support this. It is inspired by a remark in a text by the General Secretariat of the Council: "The causes of childhood overweight and obesity are complex and multi-factorial, mostly arising from an obesogenic environment", i.e. an environment that tends to cause obesity. Obesity researcher Dr Harry Rutter, from the London School of Hygiene and Tropical Medicine, agrees: "This is a huge problem that will get worse. Even skinny people are heavier than they would have been ten years ago. We have not become more weak-willed, lazy or greedy. The reality is the world around us is changing."

The ANEMELO project wants to address an important element of the reality that has changed around us and that tends to cause obesity: online promotion of unhealthy foods and drinks. The project provides an instrument to empower youngsters' resilience by getting them to reflect on a

crucial question: how do producers of high-calorie low nutrient food and drinks get youngsters aged 11 to 16 hooked to their products? The instrument ANEMELO provides to get youngsters thinking is a game.

1.2 WHY A GAME

1.2.1 INTRODUCTION

Whenever the human brain comes across information, be it facts or opinions, or a mix of the two, it has a need to make sense of it. This is a drive analogous to drives such as hunger, thirst and sex. But, the brain cannot cope with the amount of incoming information that bombards it on a daily basis. It does not have the resources to consciously focus on everything that is being seen or heard, reflect on it, make sense of it and integrate it in already existing views of the world and of the self. The vast majority of incoming information therefore is simplified and then processed by the brain in a non-conscious fashion: no recognizable thought about it ever crosses the mind. Only a small portion of the incoming information is subject to conscious evaluation.

The moment incoming information threatens to have an impact on an individual's views about the world or the self, the process of making sense becomes more complicated. This process is not a neutral process; it is subject to two goals that drive individual behavior: to construe the individual's life as positive as possible and to construe this life in a way that makes maximal sense. These drives are responsible for human curiosity for instance, but also for biases in the way incoming information is processed. Examples of these biases are: superiority illusion (individuals believe that they are better and more skilled than others), unrealistic optimism (the tendency to overestimate the likelihood of encountering positive events while underestimating the likelihood of encountering negative events), confirmation bias (the tendency to seek out and interpret information in a way that supports existing beliefs) and asymmetric updating (beliefs are more readily updated in response to information calling for updates in a positive direction than in a negative direction).

These are not the only biases in the brain dealing with incoming information. As will be described in section 3.3, Robert Cialdini found six types of information input each of which cause automated information processing and decision-making: reciprocation, commitment and consistency, social proof, liking, authority, and scarcity. Others found that biases are likely to occur when the human brain faces a need to act fast, encounters an acute information overload, has to deal with information ambiguity or a lack of meaning, or tries to establish what needs to be remembered later.

1.2.2 UNCOMFORTABLE INFORMATION RECEPTION

Researchers argue that individuals in the first place look for evidence to support their positions, not for evidence that undermines their position. People generally accept the first available evidence that shows that their position makes sense, or that they are better than average, and then stop thinking. Whenever they, on the other hand, encounter information that potentially endangers the positive image they have of their lives or the sense their lives make or face information that potentially requires more focus than the brain is capable of mobilizing at the moment - or is willing to mobilize at the moment - anxiety or other negative emotions are triggered. The reception of undermining information as a result will be biased and the reaction to it can be hostile. This hostility can be phrased as an adherence to intuition rather than to knowledge, as a consequence of group loyalty, as adherence to group identity or individual identity, as adherence to a hype perspective on a topic, as a preference of intuition over factual information, or as arrogance or indifference. In the end, the underlying motivation for resistance against unwanted information is "naive realism": "everyone is influenced by ideology and self-interest. Except for me. I see things as they are."

In some cases incoming uncomfortable information can lead to "attitude polarization": "people of opposing views can each find support for those views in the same body of evidence". It hardly matters whether the information provided is factual: the distinction between complex facts and opinions within the information processing capabilities of the brain is murky.

1.2.3 JUNK FOOD AND DRINKS

Applying the realities of uncomfortable information reception to ANEMELO it can be foreseen that incoming information on the topic of consuming unhealthy food and drinks products is likely to provoke hostile reactions and attitude polarization among students. As will be shown in section 3, junk food and drinks are important for youngsters:

- Consumption of the products is linked to a positive "otherness" that sets adolescents apart from adults;
- Adolescents identify with junk food and drinks marketing tools, games and social media contacts and are therefore prone to be biased by egocentric commitment leading to defensiveness;
- The junk food and drinks producers' consumption and marketing tools aim to provide a relief for negative internal states such as anxiety (see section 3.2) and therefore are likely to be defended;
- The junk food and drinks producers' consumption and marketing tools are also a source of dopamine production, which attaches importance to the consumption and the tools as well as stimulates repeat behavior to the point of near-addiction; this is likely to lead to defensiveness;

- The consumption of the products is experienced as pleasant and is seen as a part of a pleasant life.

As a result of this, it is reasonable to expect a range of biases steering student reception of a transfer of knowledge on the topic of consuming unhealthy food and drinks products rather than a change of attitudes or behavior: superiority illusion, unrealistic optimism, confirmation bias and asymmetric updating.

1.2.4 INEFFECTIVE TRANSFER OF KNOWLEDGE

The expectation that a transfer of knowledge on the topic of consuming unhealthy food and drinks products is likely to be ineffective at best is supported by classroom experience concerning similar topics, like education on psychoactive substances or sex education. In these cases the traditional didactics' track record is unimpressive.

The probable cause for the apparent lack of effectiveness in these fields is that the method of transfer of knowledge presupposes that the decisions to consume junk food and drinks, or alcohol and drugs, and the decision to engage in sexual behavior are rational and are firmly rooted in adequate prior knowledge. As a part of the process of rational decision-making, according to the paradigm underlying the method, arguments in favor and against are constantly weighed by individual adolescents before coming to a conclusion. By transferring additional knowledge it is believed that the arguments that point out the dangers of these activities will gain more weight and thus will win out in adolescent choices.

An ever growing body of neuroscientific research finds that adolescent decision-making rarely is rational, and is even less so when it concerns risky behavior. Raging emotions, peer pressure, a rapidly developing dopamine system and a far from developed control system in the brain are far more likely to steer adolescent behavior, as will be described in more detail in sections 2 and 3. As will be repeated in section 2.2, "the factors that lead adolescents to engage in risky activity are social and emotional, not cognitive".

Jonathan Haidt therefore states: "Trying to make children behave ethically by teaching them to reason well is like trying to make a dog happy by wagging its tail. It gets causality backwards."

During the moment of deciding whether to engage or not to engage in risky behavior, for adolescents knowledge and intentions are far less important than mental shortcuts that are capable of withstanding the social and emotional pressures. Education on topics involving risky behavior therefore needs to empower mental shortcuts that might steer adolescents away from deciding to engage in destructive risky behavior such as overconsumption of junk food and drinks.

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According to researchers, the neuroscientific understanding of the underpinning of risky adolescent behavior creates opportunities for development of new strategies to expand learning in the classroom. One of these new strategies is using interactive technology. These have been tested out with success in sex education, as well as during lessons on risky online behaviour.

Daniel Siegel provides a strategy that actually worked than when it comes to getting teens "to say no to smoking". What does not work are the strategies of giving adolescents more factual information and of frightening them with horrifying images. "The strategy that worked was to inform them about how the adults who owned the cigarette companies were brainwashing them to smoke so that they could get their money." This strategy provided students with mental shortcuts to be able to stand up against smoking.

The ANEMELO game employs interactive technologies and aims to create the mental shortcut that junk food and drinks producers use a bag of tricks to try and steer them and get them to spend money.

1.2.5 USE OF TECHNOLOGY

Communication by youngsters among themselves and with adults is complicated in the age of Internet. While most youngsters value face-to-face contact highly, they often shy away from it. Many avoid eye contact or keep eye contact for a very limited amount of time. Their spans of concentration offline are ever shorter while their levels of shyness and stress in communication offline increase.

Many youngsters feel a blockade in real-life communication. Their biggest issue is that offline they feel that they need to be spontaneous and need to react directly to impulses provided by the outside world. Online they feel they have time to reflect, edit and send their responses according to their own wishes. This does not mean their communication is polished and reflected, far from it. Many youngsters use vulgar, exaggerated language and often regret what they have communicated earlier. Rather, being online provides them with a sense of safety. And safety is very important to the majority of youngsters.

This does not mean youngsters would want to opt-in to online communication only. In a Dutch experiment involving teenagers aged 15 a class of students was invited to communicate online-only for 24 hours. This meant no talking, no eye contact, and no touching at home, at school or anywhere else they would find themselves. They were asked to keep their eyes on their smartphone at all times and to only type words and emojis. During the evaluation after the experiment it turned out none of the youngsters had been able to be online-only for 24 hours. Already during the first lesson break youngsters could be seen talking in real-life while students who did not take part in the experiment were focusing solely on their mobile phones. It also became clear that no one wanted to repeat the experiment, except for one boy, who was diagnosed in the autistic specter. The main complaints about being online-only were that

youngsters felt disconnected from their peers and family. They got frustrated that communication took longer than normal so that they would be permanently too late to express their feelings or make a joke. They confessed to have missed simple everyday banter, gossip and, especially, emotional closeness.

Nevertheless, technology is an important element in youngster communication grammar. Adults who do not know how to communicate online are seen as distant and thus face the blockades many youngsters feel when communicating offline. Communicating online on the other hand for many youngsters means that they open up more and trust more. When students were asked in a Polish experiment what they needed to open up to adults in real life all presented a long list of prerequisites. But when they were asked what they needed to open up to adults online most of them stated that an Internet connection, a communication app and an interesting subject would be more than enough.

The underlying reason for youngster online openness might be the so-called 'ELIZA effect' of technology. The effect was found as early as the mid-1970s and was named after Joseph Weizenbaum's program ELIZA "that engaged in dialogue in the style of a psychotherapist." The program did not understand anything it was told, it just would "take strings of words and turn them into questions or restate them as interpretations". Although Weizenbaum's students were well aware that the program did not understand them in whatever way, they still wanted to interact with it. They were literally queuing up to be alone with the program and tell it their secrets.

Other studies found that humans easily bond with technology: they rate computers they worked on higher, have troubles criticizing them and feel bad to turn off a robot that's begging for its life. Some people start romantic relationships with Artificial Intelligence-based characters in mobile phone apps like Mystic Messenger, similar to the main character in the 2013 movie *Her*. The more robots are perceived as being a conscious being, the more people are willing to even sacrifice human life to save the robot.

The use of visual communication has been found by multiple studies to further enhance openness in communication. Visual communication also reaches a wider target group: it does not depend on a cognitive reception only but can also use visual direct feedback to illustrate which consequences some actions might have. This visual feedback can even illustrate the phenomenon of emergence (a follow-up action that occurs after a trigger without a causal relationship existing between the two events). Therefore, visual communication must be a vital part of any technological solution used concerning youngsters.

1.2.6 HOW TO REACH YOUNGSTERS WITH A GAME

Following the theories and experiences as presented so far a game should be able not only to avoid youngster resistance in communicating on junk food and drinks but even to open

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youngsters up under the precondition that the game is interactive and digital, and offers the right incentives for youngsters to engage. An important additional element is that the game should involve common decision-making and potential conflict resolving, as is usual in commercial video games. Since the game is to be a designed framework it is to be expected that active, meta-cognitive learning among students will take place - according to James Paul Gee's learning principles. But does this also work in practice?

In earlier European and Polish projects similar games to the ANEMELO game were piloted in class rooms in seven EU countries including the UK, Greece and Cyprus. It was found that youngsters do open up when playing this kind of game, and sometimes even to the extent that they lose all caution. But this does not happen by just playing the game. When a teacher sticks to traditional transfer of knowledge types of didactics, the game adds nothing to the lesson. Even while playing the game traditional didactics cause a situation in which students engage in what Dylan Wiliam calls "the game of guessing what is in the teacher's head". In that situation students mostly operate within a digital mode, either agreeing or disagreeing with the teacher. Only when the game is played while a type of interactive didactics is employed by the teacher youngsters start to engage emotionally and open up. Therefore, it is crucial to employ a type of interactive didactics (see section 1.4) when playing the ANEMELO game.

While Augmented Reality technology, being visual and technologically advanced, is ideally suited to address uncomfortable topics, the trust it generates could also be used to promote uncritical consumerism. Therefore, it is important that the game and the teacher lesson plan carry within elements of a constructive confrontation with this consumerism.

1.3 AIM OF THE GAME

The aim of the game is for adolescents to learn about crucial instruments that the foods and drinks industry can use to manipulate their peers and themselves. After the game they need to be able to answer the question: how do producers of high-calorie low nutrient food and drinks get us, youngsters aged 11 to 16, hooked to their products?

The players of the game are to play the role of food and drinks industry representatives who want to influence ("nudge") adolescents. In a game comprising of six levels players need to pick the most effective instruments in order to achieve the game's objective: get adolescents to eat and drink their products binge-like as an automated behavior on cue, either by internal cues or by external cues.

The manner in which students play the role of food and drinks representatives in the ANEMELO game is in line with the adolescent developmental processes of being reward driven, impulsive, thinking hyperrationally, downplaying cons and being heavily influenced by peer pressure (see

section 1.5.1; see for these processes section 2.2). This alignment enables students to receive cognitive information during the game while having fun.

A dramatic visual reversal in the game after the answering of the last question (see document Game Storyboard) is implemented by means of the still relative niche technology Augmented Reality. This visual reversal functions like a constructive confrontation to activate reflection among students. The game conveys the message that they have not only succeeded in the game in getting their peers hooked to junk food and drinks but also themselves. This reflection is to be the basis of a new mental shortcut which is the ultimate aim of the game: junk food and drinks producers nudge youngsters to get hooked on their products in order to make money.

1.4 GAME INSTRUCTIONS

The idea of the game is that it is led by a teacher in a classroom with students. The teacher can act as the player (sitting in front of the screen) or they can select a student to be the player.

To access the game, the player should use the URL: https://genie.anemelo.eu/ and select 'Start Experiment'.

This will take the player to the 'Choose Experiment' page. Here the player can select which language they would like to play the game in. All languages are available. It also allows the player to select which Experiment they would like to play including an Experiment for young people aged 11 – 13 and 14 – 16. The content of these games is tailored to the said age groups.

Once the player has chosen the experiment they want to attempt, they will be taken to the 'Experiment Time' page. Here the player (Techer in this case) can download the Lesson Plans and the documents to help kids create 6 different short films. This can be done using the Question Mark at the top left of the page. Once downloaded, the player can select 'Begin' and start the Experiment.

The time will count down from 3, 2, 1 and the following text will appear;

You have been chosen to help our company to sell our
food and drinks. We need your advice because you know how to
talk to kids. And you have so much experience online. As your advisors we will help you.

At this point a pop up should appear, asking the player to allow the Experiment to use their camera. Please allow to utilise the Augmented Reality aspects of the Experiment. The payer should then select 'Start Experiment'.

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They will then be asked to select a FastFood product to sell. The options are Soft Drink, Fastfood Hamburger and Chocolate Snack. This product acts are the product that the player will try and sell kids/youngsters throughout the experiment.

Once the product is selected the player will be taken to the first of 12 questions. This screen is divided into 3 parts. On the left-hand side of the screen the user can see the product they have chosen. In the middle part of the screen they will see the question and 2 possible answers, as well as a live stream of the players face. On the right-hand side of the screen the user will see the Target Group image which changes based on the answer given, as well as 3 indicators;

- Wrong answer – indicator goes up with every incorrect answer given
- Money - indicator goes up with every correct answer given
- Health – indicator goes down with every correct answer given

The player should read out the question to the classroom and ask what answer they think is correct. REMEMBER: The player is acting as the marketer for their product.

Once the player selects the answer, they believe is correct, they will see the changes to the Target Group image and indicators. They will then immediately be taken to a page which explains if their answer is correct or incorrect and why. They will also see the live stream of their face with an AR face mask superimposed. The user can also move their face left to right and up and down and the facemask will follow.

The player should then select 'Next Question' and this will take them onto question 2. Repeat this cycle until reaching the grand finale.

This page is used as a reflective page to help kids understand that by selling their product to kids, they have made them unhealthy, including themselves. They player will see text that states:

You did this not only to kids like you. You also did this to yourself! Fantastic job! You are now ready to consume our product whenever we want you to consume it. You are ours now!

The player will also see an AR face mask of a young person looking very unhealthy. The player will then select 'Next' and will see the message:

This could have been you

They will also see an AR image of a healthy young person with sunglasses on, smiling and a summary of their score.

The player can then select 'Continue' and this is the point where the teacher can explain how young people get hooked to junk food using the diagrams given.

Finally, they will be taken to the 'Knowledge score' page where they will be told how they did.

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The player can then select 'Finish' and complete the game.

The teacher can now use this document to guide a class lesson about the subject.

1.5 GAME DIDACTICS

1.5.1 GENERAL GUIDELINES BASED ON NEUROSCIENCES

Teachers should have in mind that youngsters in the project age group (11-13 and 14-16) undergo major changes causing them to be, among others, reward driven, thinking hyperrationally, downplaying potential negative consequences and being heavily influenced by peer pressure (see section 1.5.3; see for these processes section 2.2).

Concretely this means, that teachers should:

- Create a safe atmosphere in the class room that discourages negative student peer feedback;
- Make sure that individual students feel heard and seen;
- Not react to emotions with emotions; they rather should encourage a calm atmosphere in the class to which teachers themselves contribute by first listening, observing, analyzing and only then quietly reacting to potential emotional outbursts by students;
- Encourage students to be concrete, referring to concrete real-live examples, and provide themselves concrete, relevant examples too;
- Allow for immediate feedback by students, and provide themselves immediate feedback too – the game too is created to provide immediate feedback;
- Describe mechanisms underlying the project theme in terms of easy to remember mental shortcuts rather than in abstract, theoretical terms;
- Not give up their authority when students react negatively, ironically or hostile; they should always have in mind that they are taken very seriously and that their every move and word is analyzed by students but that students will never admit to this;
- Avoid moralizing or blaming the victim; while blaming the victim vindicates the moral righteousness of the person blaming and presents them with a false sense of control over their own lives, it has no constructive consequences for the person being blamed;
- Provide positive alternatives and recommend positive passions. Helpful is to start off with Martin Seligman's distinction between 'pleasures' and 'gratifications'. Pleasures are, according to him, "delights that have clear sensory and strong emotional components," such as may be derived from food, sex, backrubs, and cool breezes. Gratifications are activities that engage one fully, draw on one's strengths, and allows one to lose one's self-consciousness ". An important difference between the two types of rewards is that pleasures quickly lose their power when enjoyed frequently and do not bring anything

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substantial like making one more wise, resilient or physically stronger while gratifications can lead to a state of flow, can be enjoyed at any time and have the ability to change one for the better.

1.5.2 USING INTERACTIVE DIDACTICS

The basis of interactive didactics is that teachers see it as their job, in the words of Dylan Wiliam, to "engineer effective learning environments for the students". To start with, this means the lesson plans take the students and their levels of cognitive and emotional development as their starting-point, and not teacher or curriculum expectations. It also means that the teacher checks regularly the effectiveness of their teaching.

When using interactive didactics it is important that as many students as possible are engaged. Students need to feel that their being engaged makes sense, that their words and actions impact their surroundings. The game is created to convey that message and teachers should enforce a student sense of agency.

Interactive didactics presupposes a clear frame for students to function within: it is clear to the students what the aim of a concrete lesson is, the atmosphere in the classroom is safe and the teacher is still responsible for the lesson. Within this clear frame teachers and students assume different roles: teachers assume the role of coach or facilitator while students become responsible for the concrete lesson implementation.

Interactive didactics, therefore, runs against top-down protection of students against everything that might stir their sense of wellbeing. It aims at student growth rather than student protection by all means. It avoids safe spaces and trigger warnings since these have been shown by research to increase perceived student vulnerability, decrease student levels of resilience and increase student anxiety. Interactive didactics rather allows and encourages students to take risks and engage in uneasy confrontations. According to Jonathan Haidt, finding fault with oneself is one of the few methods to successfully challenge naive realism (see section 1.2.2), one of the major obstacles in processes of a transfer of knowledge.

The uneasy confrontation ANEMELO provides is to show students in a technological mirror the consequences of them taking the slippery path of moral indifference and cynicism. It confronts the simple promises by the food and drinks marketers with a complex reality. This complexity is to soften the confrontation of the students with the consequences of some of their preferences, routines and actions. An all-out perceived confrontation with their identities is to be avoided at all costs.

1.6 HOW TO USE THE CONTENT MANAGEMENT SYSTEM

This information is only necessary for the Development team

1.7 SOURCES OVERVIEW

1.7.1 GAME SUBJECT

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2. GENERAL BACKGROUND INFORMATION

2.1 HABIT FORMATION

2.1.1 THE CONCEPT

In his book *Hooked* Nir Eyal describes how consumer habits are formed through conscious engineering by companies. According to him, successful companies have found a way to link their products to specific consumer daily routines and emotions. They offer solutions that are to come to mind immediately whenever a consumer enters the specific daily routine or experiences the specific emotion. This enables companies to sell their products to consumers without spending significant resources on advertising.
Eyal distinguishes four steps in the so-called Hooked Model companies use to automate their sales. The first step is the cue that is to be the starting-point of consumer behavior: the trigger. This trigger can be external or internal. External triggers can take the form of advertising or of favorable press mentions. Internal triggers are negative consumer emotions: "Feelings of boredom, loneliness, frustration, confusion, and indecisiveness often instigate a slight pain or irritation and prompts an almost instantaneous and often mindless action to quell the negative sensation."
The second step is the action that is evoked by the trigger. Without an action following a cue, the cue is worthless in the process of habit formation. The initiation of the action should be easier for the consumer than thinking so that the consumer's response to the cue can be automated over time.
The action following the trigger equals behavior in anticipation of a reward. The experiencing of the reward is step three. This reward should be more than a predictable result of the action, it should trigger desire. The reward provided should evoke a further craving in consumers.
The best way to evoke consumer craving is to provide variable rewards, as was found by psychologist Michael Zeiler. While predictable rewards lead to routine, variable awards spark interest and attention. Rewards can take the form of social confirmation, of material objects such as food and physical objects, and of rewards of the Self: "intrinsic rewards of mastery, competence, and competition".
The fourth and final step in the Hooked Model is investment. This builds on the fact that the more time and effort are invested into a product or service, the more these are valued. Ever more investment leads to ever more commitment to a product or service.
Eyal stresses that it is not enough to get consumers to complete the four-step cycle once: "to create the habit, users must first use the product through multiple cycles of the Hook Model.

Therefore, external triggers must be used to bring users back around again and again to start another cycle."

2.1.2 CHANGING ALREADY FORMED HABITS

To change a habit once it is forged is not easy. Charles Duhigg nevertheless presents an option to attempt this. His approach also consists of four steps.

Step one, according to Duhigg, is to identify the routine: "it's the behavior you want to change". Step two is to experiment with rewards: "By experimenting with different rewards, you can isolate what you are ACTUALLY craving, which is essential in redesigning the habit." Step three is to isolate the cue: "identify categories of behaviors ahead of time to scrutinize in order to see patterns." Five possible categories need to be taken into account: location, time, emotional state, other people, and immediately preceding action. Duhigg's fourth step is to have a plan: "you can change to a better routine by planning for the cue and choosing a behavior that delivers the reward you are craving." In other words, Duhigg advises to interfere in Eyal's step two (action) but not in steps one (cues) and three (rewards). In his view bad behavior thus can be replaced with good behavior.

Creating a new habit takes a lot of time and perseverance. During this time it helps to frame one's determination in terms of "I don't" (consume junk food or drinks) rather than "I can't" (consume junk food or drinks). The first frame shows one's power over a situation and declares what kind of person one is. The second frame hands over power to an unnamed outside agent.

Adam Alter agrees with Duhigg's proposition but adds: "Though [Duhigg's] Golden Rule is a useful guide, different addictions demand different routine overrides. ... Each underlying motive implies a different solution. ... Even if the solution doesn't come easy, the first step is understanding why the addiction was rewarding in the first place, and which psychological needs it was frustrating in the process."

Cult experts Steven Hassan describes a similar process for changing negative thoughts and associations: identifying the negative thought or association and writing it down, drafting a thought or association that is to replace the negative thought, identifying the triggers that evoke the negative thought or association, and then visualizing the triggers happening and actively replacing the evoked negative thought or association by the new thought or association.

2.2 THE ADOLESCENT BRAIN

2.2.1 INTRODUCTION

Researcher Ronald Dahl points at a health paradox for adolescents. On the one hand adolescence is a developmental period of strength and resilience: "Compared to young children, adolescents are stronger, bigger, and faster, and are achieving maturational improvements in reaction time, reasoning abilities, immune function, and the capacity to withstand cold, heat, injury, and physical stress." On the other hand during adolescence "overall morbidity and mortality rates *increase* 200%" when compared to younger children.

One of the major causes of Dahl's health paradox is the restructuring process of the brain that takes place during adolescence. While the brain of younger children mainly consists of grey matter that facilitates the learning of almost anything, as a kind of all-purpose organ, in the adolescent brain the amount of grey matter is significantly reduced while the amount of white matter is significantly increased: rarely used brain connections are eliminated while important brain connections are strengthened by means of a white insulation that enables high-speed connections and shorter regeneration time. As a result the brain specializes and becomes more effective.

While the reduction of grey matter ("pruning") proceeds in a region-specific, nonlinear fashion, the strengthening of white matter ("myelination") starts at the back of the brain and slowly proceeds forward. This means that the brain parts associated with body regulation, movement and emotions are upgraded first and the brain parts responsible for the control and coordination of thoughts and behavior stay under construction until one reaches one's mid-twenties. The effect of the reconstruction of the adolescent brain is that in situations in which emotions clash with reflection, emotions nearly always win out. Adolescent brains are not less capable of reflection and control, but their capability to consider and reconsider is ineffective in situations in which emotions flare up.

Besides the changes in grey and white matter another major change related to the adolescent brain takes place: the dramatic growth of the dopamine system. As will be described in section 3.4 the neurotransmitter dopamine is an important factor in learning, as it is linked to desire, rewards and establishing whether a situation, experience or outcome is worth noticing.

The process of brain reconstruction is not the only developmental process taking place during adolescence. Hormonal changes cause the adolescent body to grow fast and to change its composition (f.i. store more fat). Sex hormones prepare the adolescent body for reproduction. All these large developmental processes take place independently of each other and the order in which their separate phases become active may differ significantly per individual.

2.2.2 ADOLESCENCE

Adolescence is a period in which young children start to find their own way in life. The adults on whom they have relied before become relatively less important. Peers and youngsters who are slightly older, such as popular vloggers, for a significant part take over the function of parents and teachers as role models.

Positive peer comments start to trigger large rewards in the adolescent brain, comparable to the intake of psychoactive substances. Since adolescents are far more sensitive to rewards than adults this means peer pressure is a major factor in the lives of adolescents.

While their ability to think abstractly is slowly developing, adolescents' lack of life experience hinders them in coming to balanced decisions. For a lack of data, adolescents approach challenges rationally, which takes time, and hyperrationally, which means considering the immediate effects of actions only, without taking their context or potential side effects into account. At any point during this prolonged process emotions might be triggered to simply overtake the decision-making process and annul the rational efforts.

In addition, adolescents are more reward driven. They expect bigger rewards for activities in comparison to adults and younger children, they assess pleasant situations as less risky, downplay the meaning of cons, love intensity and passion and have a lower base level of satisfaction in life. As a result, it is hard for adolescents to learn from their mistakes, understand the consequences of their actions to the end and keep themselves far from activities that are forbidden. Adolescents therefore are more impulsive, risk-prone and prefer short-term goals.

The presence of peers, and the quest for peer acceptance, is an important motivation for risk-taking, but also potential isolation from one's peer group is. This isolation looks slightly different for girls (being excluded from groups of girls who discuss what is going on around them) and for boys (being excluded from group activities such as team sports or gaming). Other stimulants of risk-taking are low grades at school, a loss of trust of parents or other important adults, a negative home situation and impulsivity in the form of a preference for sensation seeking or for first acting and then thinking.

Risk-taking is an essential precondition for adolescents to find out what is important for them in life and to select peers as friends and sexual partners. Therapists call adolescence a second chance for youngsters, since they are able to reorganize the life they had thus far. It is a time in which a basic identity is created that forms the basis for the adolescent's adult life. Memories formed during adolescents are deeply seated. This can be seen in Alzheimer patients who cannot remember what they did yesterday but do remember their life as a young individual.

While most adolescents do not experience extreme problems as a result of risk-taking, around twenty percent do. Examples of extreme problems are: addiction to psychoactive substances, serious accidents, violence, murder, sex-related health problems, mental health problems such as depression, eating disorders, self-mutilation and suicide. It is important to keep in mind that these

problems are not the result of a lack of knowledge or understanding. As researcher Laurence Steinberg summarizes: "the factors that lead adolescents to engage in risky activity are social and emotional, not cognitive".

2.2.3 ADOLESCENTS AND HABIT FORMATION

Because of its reconstruction the adolescent brain is at its peak of openness to learning and experiencing. This holds good for harmonious activities as well as for obsessive. The adolescent brain can quickly learn a new language, become ever better in sports and in playing a musical instrument, but can also rapidly train itself to smoke cigarettes or marijuana, drink alcohol or eat junk food. The plasticity of the brain during adolescence is so substantial, that significant IQ changes occur: one third of all youngsters acquire a higher IQ at this age while one third of them significantly lowers their IQ.

The adolescent openness to risky and intensely rewarding experiences leaves them more vulnerable to the risk of getting addicted in comparison to adults. Adolescent addictions, in turn, can last throughout the youngsters' whole lives: the majority of adult addicts started their addiction during adolescence. The younger adolescents start taking psychoactive substances, the more impact these substances are likely to have and the more risk they run to stay addicted throughout their lives. This is the logic behind setting age limits on drinking alcohol.

Those adolescents who get addicted have a higher chance on other major problems such as mental health problems. These mental health problems are likely to continue into their adult life, just as addictions are.

2.3 SOURCES OVERVIEW

2.3.1 HABIT FORMATION

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2.3.2 THE ADOLESCENT BRAIN

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3. GAME TOPICS-RELATED BACKGROUND INFORMATION

3.1 MECHANISM 1: MARKETING

3.1.1 INTRODUCTION

Most adolescents think that marketing is the same as advertising. Indeed advertising is the most noticeable part of marketing, since it is prominent by design. But marketing has more and more subtle components. Examples of marketing tactics are: the way products and packages are designed (featuring cartoon characters or celebrities), the availability of the products in shops, the placement of products on the shelves (near the register), the chosen price ranges (now 2 for 1), and upselling: influencing customers to buy larger meals and drinks or to add high-calorie toppings or sides to their order.

On top of these marketing tools public consumption proves to friends what eating behavior is permissible, how big servings should be and what brands are "cool" and which aren't. This signaling behavior is as much part of promotion as the advertising itself. A lot of marketing research, sales planning goes into alignment of event triggers coming from product design, packaging, placement, price and promotion.

Marketing can be described as "any form of communication or message that is designed to, or has the effect of, increasing the recognition, appeal and/ or consumption of particular products and services". Advertising, the most recognizable part of marketing for adolescents, is "the paid public presentation and promotion of ideas, goods, or services by a sponsor that is intended to bring a product to the attention of consumers through a variety of media channels such as broadcast and cable television (TV), radio, print, billboards, the Internet, or personal contact". It is advertising on mass media that provides adolescents with cues that nudge them towards immediate binge-like automated snack eating and drinking behavior.

3.1.2 TRIGGERING BEHAVIOR BY ADVERTISING

The mere exposure of adolescents to marketing messages is sufficient to nudge them to changes in their behavior as desired by the sender of the marketing messages. Exposing adolescents to alcohol-related messages, for instance, increases the probability of them starting to drink alcohol within the next months by 9% - 15%. Every alcohol-related advertisement, seen by adolescents, increases the number of alcoholic drinks they consume by 1%.

Research on advertising attention found that adolescents pay more attention to food and beverage advertising than to any other form of advertising. This makes food and drink advertising effective when aimed at them: exposing children and adolescents to food and drinks advertisements increases their intake. One study for instance found that children, aged 7-11, watching cartoons with food advertisements ate 45% more snack food than children in the same age group watching the same show with non-food related advertisements.

The majority of food and drinks advertisements that children and adults are exposed to promote high-calorie, low-nutrient foods, that are high in fats, salt or sugar (HFSS), especially sugary breakfast cereals, confectionary, high fat savory snacks, soft drinks and quick service restaurants. It is estimated that junk food producers spend around thirty times more on advertising for their products than governments spend on healthy food advertising.

While TV advertising still is the main medium for food advertising in the EU, it is in decline while Internet and digital marketing are on the rise. Parents are mostly unaware of the amount of advertisements for unhealthy food and drinks that children and adolescents are exposed to online.

Studies link the increase in overweight and obese adolescents to the advertising of sugar and fat-dense junk foods. Amy Reichelt of RMIT University concludes: “Advertising for food and beverages communicates food cues, priming the consumption of unhealthy foods and beverages.”

3.1.2.1 ADVERTISMENT PROVIDES CUES

The exposure of adolescents to products by means of advertisements consists of more than just displaying products or brand characteristics. In advertisements narratives are presented in which unhealthy products are not shown as being unhealthy but rather as containing healthy ingredients that empower consumers to live a good life. The promoted image of these products is that these products are normal and innocent: they can be enjoyed every day, even in larger quantities, without negative effects. The advertisement narrative links positive and agreeable emotions and experiences to unhealthy food products.

One of the strategies followed by producers of unhealthy foods and drinks is to support academic research that substantiates claims about the healthy character of some ingredients in their products while trying to suppress studies that might expose hazards of consuming their unhealthy products. The desired outcomes of academic studies are used by marketers to steer the discussion about the products in a positive direction and create a positive narrative around the products and brands (see also section 3.6.4).

3.1.3 AD FILTERING AND AWARENESS

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Most people are unaware of the influence of the external cues provided by advertising. And if they are aware, they think advertising only affects others. The pro-health coalition Living Loud hypothesizes that this is the result of a conscious effort by advertising specialists: "Great advertising is designed to quietly influence people, to go consciously unnoticed, that's why 62% of people think advertising doesn't affect their purchase decisions."

Marketers have various instruments to increase the chances that their messages remain consciously unnoticed. An effective instrument is to blur the lines between advertising and other types of information. Marketers use hybrid content types such as advertorials and try to seamlessly integrate marketing material into general content so that it becomes ever more difficult to distinguish advertisements from regular information. Creating positive narratives around products and brands instead of straightforward promoting the sales of products, as described above, is another effective instrument.

Younger children do not have a mature understanding yet of the persuasion tactics used by marketers. This understanding is slowly acquired, although outdated developmental models of adolescent development claimed otherwise. A slow shift in the judgment about the truthfulness of advertisements by youngsters provides an indicator of this. While 8% of 8-11 year olds think that TV advertisements "always" tell the truth about the products they are selling, 4% of 12-15 year olds do. For "mostly" telling the truth the percentages are 31% (8-11) and 34% (12-15) and for "sometimes" 45% (8-11) and 48% (12-15). With regard to Internet advertising 4% of 8-11 year olds thinks that these "always" tell the truth, against 2% 12-15 year olds. 28% (8-11) and 27% (12-15) think that Internet advertisements "often" tell the truth, and 50% (8-11) and 58% (12-15) think they "sometimes" speak the truth. This example highlights that adolescents do not suddenly become more marketing literate. Age cuts for the legal age that marketers may expose children to marketing will therefore always be arbitrary.

In order to understand the persuasion tactics used by marketers it is essential that children and adolescents recognize advertisements for what they are. And here lies a challenge, partially because of marketer efforts to blur the lines between advertisements and content and partially because of relatively low digital skills that children and adolescents display. Researcher danah boyd writes: "Just because teens are comfortable using social media to hang out does not mean that they're fluent in or with technology. Many teens are not nearly as digitally adept as the often-used assumption that they are "digital natives" would suggest. .... As sociologist Eszter Hargittai has quipped, many teens are more likely to be digital naives than digital natives."

As a result, children and adolescents have a low awareness of the amount of advertising they see and frequently understate this amount. Quite often they do not recognize advertisements as such. For instance, it was found that a majority of adolescents cannot identify advertisements on the search results page of Google, despite them being distinguished in a box with the word 'Ad' in it. Another finding is that almost half of the adolescents are not aware that vloggers, who are an important point of reference to them, may be paid to endorse products. WHO claims that among

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adolescents conscious awareness of food and drinks marketing, as well as the ability and the motivation to resist are "often not present".

Children and adolescents do not perceive themselves as having low marketing literacy. On the contrary many see themselves as "empowered consumers capable of limiting their exposure to or influence by marketing". Many claim to have strategies to avoid advertising, such as looking away, using the time to do something else or ignoring advertisements by mentally filtering them out.

3.1.4 MARKETING AND HABIT FORMATION

Marketing efforts by food and drinks producers are the first step in getting children and adolescents to form and sustain the habit of consuming unhealthy food and drinks products. Exposure to these external cues in the form of advertisement is to trigger children and adolescents into action: the immediate consumption of an unhealthy food or drinks product.

The experience of the actual consumption of a product that follows the exposure to external cues, together with the systematic loading of the brand with positive narratives, providing value in the form of immersive experiences that alleviate negative internal states (see section 3.2), offering personalized communication (section 3.3), using social media channels and variable rewards (section 3.5), and changing the consumers' metabolic system (section 3.6) are to take children and adolescents from one-off consumption to eating and drinking unhealthy products binge-like as an automated behavior on cue.

3.2. MECHANISM 2: IMMERSION

3.2.1 INTRODUCTION

According to the British Heart Foundation food and drinks producers use specialized online marketing instruments to capture the attention of youngsters: in their marketing material they include images of other children, cartoon characters, or of celebrities or other familiar persons; they offer competitions, games or apps that are appealing to the target group; they hand out free gifts or prizes such as free downloads or free merchandise that is appealing to the target group; and provide links to social networking websites. These instruments enable marketers to capture youngsters' attention for longer periods of time and provide a deeper sense of engagement compared to traditional forms of advertising.

The vast majority of food and drinks producers that employ these online instruments to target youngsters, either within their own online environment or on the most popular sites for youngsters, are producers of products that are high in calories and low in nutritional value. The products promoted in the online environments are predominantly not permitted to be advertised on TV. The WHO calls these methods "stealth marketing techniques".

The specialized online marketing instruments are effective, far more effective than TV campaigns. Researchers found a positive relationship between immersive environments and popularity and engagement. For instance, among the 20 most popular gaming websites for children, 11 contain advergames promoting unhealthy food products.

The reason the specialized marketing instruments are effective is that children and adolescents feel entertained by them. Youngsters engage with them to escape negative internal states that they experience far more frequently than adults, such as feelings of boredom, loneliness, frustration, confusion, and indecisiveness. These negative feelings "often instigate a slight pain or irritation and prompt an almost instantaneous and often mindless action to quell the negative sensation." The specialized food and drinks marketing instruments provide youngsters with a relief from their inner anxiety and present an entertaining, immersive world of unhealthy food and drinks as the immediate answer to many of the challenges they face.

3.2.2 STRENGTHENING BOTH CONSUMPTION AND THE NARRATIVE

The aim of the specialized market instruments is to trigger immediate consumption, to expose children and adolescents to the brand narratives behind the products and to get youngsters to draw in their friends.

A study concerning advergames promoting HFSS-products (high in fat, salt or sugar) showed that exposure to these advergames is linked to an increased consumption of HFSS-products, while exposure to advergames promoting fruit led to an increased consumption of fruit, but not at the expense of HFSS foods. As a result of youngsters playing another advergame, it was found that 30% reported to have asked their parents to buy the advertised product.

Youngsters within a branded environment are intended to experience the claim that the brand helps consumers live a good life. Nesquik, for instance, presented in an advergame a Nesquik bunny that jumped higher after eating the cereal. Children who played the game were found to be more likely to think Nesquik made them fit. Another cereal advergame evoked more positive expectations among children about the taste of the cereal. After the game children were also more likely to believe that the cereal is healthy. In general, it has been established by research that immersive marketing content can establish increased brand recognition, increased positive brand associations and brand trust.

3.2.3 REPEAT BEHAVIOR

The immersive nature of the specialized marketing instruments stimulates not only longer and deeper youngster engagement but also repeat visits and repeat product consumption by them. Brand recognition, brand trust and positive brand associations lead to a brand relationship and greater consumer engagement which, in turn, are important elements in the creation of brand loyalty.

Spending more time and repeated time is like an investment users make in the brand. According to Eyal this is the last step in getting hooked: people who invest time and effort in a product or service, value it more. This is supported by research: individuals within online brand communities tend to focus on the benefits, rather than their costs, of their engagement.

3.2.4 IMMERSION AND HABIT FORMATION

Humans possess two different brain systems to interpret the world around them and to come to decisions. The first system, aptly called System 1, is the default system. This system works like an automatic pilot: it operates automatically and quickly, with little or no effort and no sense of voluntary control. Most of the time System 1 helps individuals make the right judgments about situations, relying on the wisdom of the group and on one's unconscious life experiences and successful solutions that have been gathered.

System 2, on the other hand, "allocates attention to the effortful mental activities that demand it … The operations of System 2 are often associated with the subjective experience of agency, choice, and concentration." System 2 helps individuals focus on a subject, think things through well, reflect and come to a conscious decision.

The human brain is constantly looking for shortcuts through reality to save energy. That is why System 1 is the brain's default interpretation and decision-making system: it provides solutions without taking up to much effort. Attention is only focused when individuals assess something as important and there are no other urgent tasks. Since the adolescent brain experiences a complete rewiring, it is harder for youngsters to focus on anything while the need to save effort for them is even more important.

If the brain finds an answer to a situation that works time and again, the answer becomes automatic behavior to save effort. Sequences of actions are "chunked" into routine and stored in the brain for later use when the appropriate trigger presents itself. This way, individuals do not have to invest energy in daily activities like dressing, choosing what to eat, or how to react to a negative internal state.

The specialized marketing instruments used by junk food and drinks producers facilitate automatic behavior. In case of the occurrence of a negative internal state within children or

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adolescents the immersive marketing tools help take youngsters shortcuts through reality. The shortcuts that they offer are easier than thinking or confronting uneasy feelings. Creating automated behavior as a response to problems is the key precondition for turning behavior into a behavioral addiction.

3.3. MECHANISM 3: PERSONALIZATION

3.3.1 INTRODUCTION

Personalization of communication messages to adolescents by food and drinks industry representatives can strengthen the nudging of adolescents towards the aim of getting them to eat and drink unhealthy products binge-like as an automated behavior on cue.

Two types of instruments can be used to strengthen external cues (product producer content that is to trigger consumption of the product in the form of advertising and marketing): profiling and persuasion profiling.

A third type of instrument called 'target audience analysis' can be used to tune in more effectively to adolescents' internal cues (emotions or experiences that become associated with a product so that the product will be consumed when these emotions or experiences occur).

3.3.2 PROFILING

In order to be able to personalize online mass communication for their clients specialized online advertising companies use a technique called 'profiling'.

Profiling consists of the authentication of Internet users and the creation of profiles of their preferences and interests, based on tracking their behaviors on and across websites. Internet users' online behaviors are recorded as a digital trail that they leave behind while performing online activities such as liking, clicking, opening websites, registering at websites, agreeing to two-step verification security features, searching, communicating with other Internet users and linking to them, and buying products online. The resulting user data are stored in databases owned by specialized online advertising companies. Sometimes Internet users share their data willingly and consciously, but often their data are being gathered without them knowing it and used for purposes they never agreed on.

The profiles that are created by specialized online advertising companies help their clients to make predictions about the profiled Internet users' future actions and preferences. Based on these predictions businesses are able to provide personalized services and information and offer targeted advertising: personalized advertising that is assumed to be in line with the profiled Internet users' preferences and interests. In addition, profiles are used by businesses to make decisions with regard to the profiled Internet users, for instance on whether they pose a financial risk or can be considered financially unattractive.

Specialized government organizations use profiling as well. These organizations also gather and interpret online user information. Their aim is to increase security in society by tracking down suspicious Internet users and to detect fraud.

3.3.2.1 THE CONCEPT

The basic idea behind profiling is that individual Internet users are not unique and unpredictable but are more or less like other individual Internet users. It is assumed that the more an individual Internet user exhibits online behaviors similar to other individual Internet users, the more the preferences and interests of this individual user are similar to the preferences and interests of these other Internet users.

This means that if some Internet users have bought a product, this product is deemed to be desirable also for Internet users who are similar to them. Therefore, it is thought to make sense to direct advertisements promoting the product to these similar Internet users. In the same fashion, if some Internet users perform a certain action online or offline, such as liking a page, it seems likely that similar Internet users will also be willing to perform this action. And that these similar Internet users are similar to the other Internet users in other ways too.

This does not mean that the individual Internet user's past behavior is unimportant. A recent trend is to put more weight to an Internet user's own history relative to the dynamic profiles of similar other users.

To enable profiling advertising agencies try to link digital devices to concrete individuals. This can be done by means of cookies, but also by digital fingerprinting: recognizing the unique configuration of apps and add-ons on a user's smartphone, tablet or computer. Even a user's gait can be a means to authenticate a user by means of their smartphone.

Next, the activities of every individual in the world, online or offline, are captured in shadow profiles in databases and individually linked to a catalogue of categories that allow user classification. The catalogue of categories can be extensive: Facebook's catalogue contains over 52,000 categories. It is kept unclear by companies how they acquire insights in the activities of individuals, but it can be safely assumed that they stem from the company's own monitoring and data bought from companies that specialize in registering offline and online activities that are linked to identifiable individuals and sell their data.

Thanks to profiling businesses are hoping to be able to send their advertising messages to individuals who are actually interested in their products, or are interpreted as being interested, and are able to personalize the services and information that they offer to individual Internet users to attain higher user satisfaction.

A recent development in profiling is employing Artificial Intelligence that more broadly predicts how Internet users will behave, what they will buy, and what they will think. Facebook for instance experiments with a self-improving, artificial intelligence-powered prediction engine named "FBLearner Flow". Personalized assistants like Amazon's Alexa refer AI-based interpretations back to the user.

3.3.2.2 PROFILING INSTRUMENTS

The simplest profiling instruments just register what individual Internet users do within a single app or site. To be able to do this effectively the instruments must be able to identify return visits, either by requiring users to log in or to identify their smartphones, laptops or other devices, with or without user consent. More complicated instruments monitor what individual users do across multiple apps or sites. This can be achieved by providing a log-in tool that allows users to log-in to multiple apps and sites, providing services within multiple apps or sites, such as 'Likes' and sharing options, or identify individual user devices. An alternative option is to reverse-engineer big data sets of formally anonymised user activities and make them re-identifiable.

3.3.2.3 PROFILING AND ADOLESCENTS

More than half of 12-15 year olds who go online are aware of personalized advertising. One in five of 12-15 year olds think that everybody sees the same advertisements; one in four is not sure. While adolescents care about online privacy, the majority of them feels there is nothing they can do against profiling.

According to WHO, unhealthy food and drinks producers use targeting to influence adolescents. They analyze their engagement with advertisings, purchase histories, flavour preferences, geo-location data to enable real-time targeting online and offline and, for instance, weather dependent targeting (think for instance: ice-cream). WHO claims that also especially vulnerable subgroups are targeted whose rates of overweight and obesity are significantly higher.

3.3.3 TARGET AUDIENCE ANALYSIS

A more recent technique to enable personalized online communication on a mass scale is target audience analysis (TAA). TAA does not just gather online Internet users' behavior data to predict

their future behavior like profiling does. It strives to understand and then influence individual Internet users' behaviors, values, attitudes, beliefs and norms. To that aim it gathers a broad range of data, from whether the individuals feel in control of their lives to who they respect and what media habits they have.

TAA strives to create "psychographic profiles" for individual Internet users, based on the five factor personality model as developed by Tupes and Christal, Digman, and Goldberg. The five factor personality model discerns five personality dimensions, often called "the Big Five": Openness, Conscientiousness, Extroversion, Agreeableness, and Neuroticism.

3.3.3.1 THE CONCEPT

In 2013 Kosinski, Stillwell and Graepel published an influential paper in which the five factor personality model was linked to easily available digital records of behavior: Facebook Likes. Initially using a "Big Five" personality test, information from individual Internet users' Facebook profiles and online surveys they created a model by means of which they were able to predict a range of highly sensitive personal attributes just by analyzing an individual users' Likes. The sensitive personal attributes encompassed among others: sexual orientation, ethnicity, religious and political views, personality traits, intelligence, happiness, use of addictive substances, age, and gender. For dichotomous attributes such as "single or in a relationship" or "uses drugs" they achieved a 60%-95% prediction accuracy. For numeric variables such as "openness" or "age" the prediction accuracy was much lower: 17%-75%.

In 2014 Youyou, Kosinski and Stillwell followed up with a paper that presented findings of a separate study: computer predictions based on an analysis of Facebook Likes were found to be more accurate in assessing an individual's "Big Five" scores than their work colleagues, cohabitants or friends, family members and nearly equaled the scores of the individual's spouse. The computer predictions also outperformed humans on attributes such as an individual's substance use, political attitudes, and physical health.

A new method developed by Wang and Kosinski is using deep neural networks to analyze faces to determine sexual preferences with an up to 91% accuracy. A replication study confirmed these results but found a lower accuracy.

3.3.3.2 TAA IN PRACTICE

The most known organization to use TAA in order to micro-target and try and influence individual Internet users is Cambridge Analytica. The company was linked to a handful of election campaigns in Africa and, notoriously, to the 2016 Trump election campaign and possibly the 2015-2016 Brexit Leave-campaign. As was described by Kosinski, Stillwell and Graepel the company combined "Big Five" personality tests in the form of online quizzes with information

scraped from many million individual Internet users' Facebook profiles to create psychographic profiles. These profiles were used to micro-target individual Internet users on Google, Snapchat, Twitter, Facebook and YouTube with personalized messages that aimed to influence the future behavior of these users: dissuade individuals with unwanted behaviors, values, attitudes, beliefs and norms from voting while persuading individuals in doubt to decide and vote for the option preferred by the Cambridge Analytica sponsors. This was called: "behavioral microtargeting with psychographic messaging".

In 2018 details of Cambridge Analytica's activities were revealed by whistleblowers and numerous press publications. They caused a public and political uproar, mainly because a large majority of the Facebook data that were used by Cambridge Analytica were used without consent or even knowledge of the individual Internet users involved. As a result of the uproar Cambridge Analytica filed for bankruptcy and Facebook was heavily fined. Cambridge Analytica was only one of many companies employing TAA and one of the many companies that were granted access to user data by Facebook.

Since the Cambridge Analytica scandal the use of TAA on social media platforms like Facebook is under scrutiny. One of the main concerns is the potential meddling by foreign powers in democratic elections and user privacy by means of TAA.

3.3.3.3 TAA AND ADOLESCENTS

WHO claims that unhealthy food and drinks marketing does target adolescents when they are at their most vulnerable, for instance when an adolescent experiences frustration about not reaching another game level.

3.3.4 PERSUASION PROFILING

An alternative to TAA is persuasion profiling based on the work by Robert Cialdini. Cialdini identified six "weapons of influence" to which the System 1 decision-making system (see section 3.2.4) is vulnerable: reciprocation, commitment and consistency, social proof, liking, authority, and scarcity. When these principles of persuasion are used on other individuals their default reaction is to go along with what is proposed. Concretely this means that if individuals receive a gift, they are more open to a request by the giver. The same thing happens when individuals have publicly taken a first step, when a lot of other people do the same thing, when individuals are asked by a person they like or value as an expert, and when they believe there is little time or little of something left.

3.3.4.1 THE CONCEPT

It has been found that each of Cialdini's principles of persuasion work offline as well as online. They are at their most effective when they are used separately.

Cialdini's principles work between humans online, but also between machines and humans: Internet users are easily swayed by machine compliments and feel a loyalty towards the machines they worked with. According to some studies machines are even more trusted by humans than other humans and might have an ever bigger potential to influence individuals (see also section 1.2.5).

Research has found that different individuals are susceptible to different persuasion principles. While for some Internet users social proof is a convincing argument when deciding between options, for others scarcity or authority are more effective weapons of influence while social proof for instance for them might even work counterproductive.

The individual persuasion principles that work for an individual Internet user are relatively stable over time and work for that Internet user on all fields, from buying junk food and drinks products to voting in an election. Stored Internet user persuasion profiles therefore open up the option to personalize nudging individuals towards one choice rather than another.

3.3.5 HAZARDS OF PROFILING, PERSUASION PROFILING AND TAA

As the Cambridge Analytica case show using personalization instruments is not without risks.

First of all, there is the new European Regulation on the protection of natural persons (GDPR, 2016), valid from May 25, 2018. Its aim is to strengthen European citizens' rights on data protection. It concerns all organizations and individuals gathering and storing EU-citizens' personal data. The country of origin of the organizations and individuals processing the data is irrelevant.

Regarding personal data (defined as information related to identified or identifiable natural persons) the Regulation requests transparency on how and why data gatherers use these data, limits the use of the data gathered to the purposes explicitly communicated at the moment of the collection, limits the data collection to the minimum needed to serve the purpose for which they are gathered, requires the data gathered to be accurate, limits the storage of the data for only as long as required by the purpose for which they were gathered, and installs security measures against unauthorized use or accidental loss of the data. In addition, data gatherers are required to manage and track compliance to the Regulation. Thus, profiling, TAA, and maybe also persuasion profiling may only be legally employed under precondition of active and specific consent. The common practice of gathering data without active and specific consent in the European Union could lead to serious financial sanctions and has already led to less Facebook users in Europe.

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Some large tech companies and government institutions try to find loopholes in the GDPR. Facebook allows individual users to view what the company has stored on them but does not provide them with all the data it has gathered on them. Google seems to try and misuse the GDPR requirements mainly to optimize its profits even further. Both Google and Facebook by design employ various tricks to get their users to share personal data. From time to time a national or EU institution prohibits tech giant to collect certain types of data and imposes large fines for not complying to EU legislation.

The next step by the European Commission is likely to be the preparation of a code for social media companies in which users are to be informed why they are targeted to view specific advertisements or stories.

Secondly, profiling and TAA are not popular among Internet users, and especially not among younger Internet users. Persuasion profiling is unknown to them. The younger the Internet users, the less positive they generally are about the personalization instruments. As a result, any supposed overreach of the instruments can result in a public scandal in which trust and confidentially issues are raised. Nevertheless, it seems that public outrage can be avoided when large discounts are provided. For instance, a Burger King app in the USA tracked down people who were near to a McDonald's store and offered them a Whopper for a penny. Over 50,000 people acted upon that deal.

Thirdly, the profiles resulting from profiling, persuasion profiling and TAA are far from infallible to put it mildly. They are based on insufficiently proven psychological and ideological assumptions and imprecise mechanisms. Their best possible outcome is not a description of reality but a prediction about an individual's future behavior that has a chance of actually happening. At the same time, the instruments can have major effects. Based on profiling or TAA, individuals can be stigmatized and as such be excluded from products or services, be charged more than others for the same products and services (such as health insurances), be lured into buying products or services with the highest profit margin for the seller, be intensively monitored or be persecuted or deported. Personalization tools in the future might also be used to protect users against themselves and to guide their behavior, as Google's think experiment Selfish Ledger proposes.

Fourthly, psychologist Dan McAdams suggests that focusing on the 'big five' as defining human identity is too narrow. To him the big five represent an individual's personality's basic traits. On top of this first level he describes two higher levels: level two - "characteristic adaptations", including personal goals, defense and coping mechanisms, values, beliefs, and life-stage concerns, and level 3 - "life story" that is "like a work of historical fiction that makes plenty of references to real events and connects them by dramatizations and interpretations that might or might not be true".

Fifthly, there is a lack of oversight over marketers using profiling and TAA and they are rarely held accountable. For those being profiled there is a lack of redress. It remains to be seen whether these negative sides of personalization marketing will be sufficiently countered by the GDPR.

The most visible example of linking consequences to constructed profiles can be found in China where a "social credit system" collects individual user data both online and offline and nudges behavior TAA-style towards behaviors the government endorses. The credit system aims to "allow the trustworthy to roam everywhere under heaven while making it hard for the discredited to take a single step." In practice this means that people who are interpreted to have a negative profile are banned from buying airplane or train tickets for a year, are less eligible for a mortgage or a job, have less schooling options for their children and have less chances of getting a date. Those who are interpreted to have a positive profile receive special rewards. The social credit system currently is voluntary but will be obligatory in 2020.

In the Netherlands a fraud detection system called "System Risk Indication", or SyRI, creates risk profiles for all citizens using public information that was published by these citizens and information that they provided to government institutions for other purposes. Anyone who appears to match a certain profile is investigated further. In the UK a similar system exists to detect social welfare fraud. Facebook has also been working on a reputation score system to rate user trustworthiness.

On the other hand, some government institutions start to backtrack from overstretching the gathering and interpretation of all data possible. For instance, the city of San Francisco is banning the police use of facial recognition technology. Currently, these institutions are the exception.

3.3.6 PERSONALIZING COMMUNICATION AND HABIT FORMATION

Studies show that targeting individual Internet users with individual persuasion principles changes the outcome of decision-processes significantly: one in five individuals is influenced to make another choice. But not all personalization based on profiling strengthens the effectiveness of external cues (product producer content that is to trigger consumption of the product in the form of advertising and marketing). Important is, besides choosing the right persuasion principle, the moment of the external cue, the depth of the cue and the breath of the cue. For immediate reminders a high level of personalization is effective but for later reminders a medium level is more effective. For trusted producers high depth and narrow breath is effective, while for less trusted producers high depth rather raises privacy concerns.

The effectiveness of TAA on strengthening internal cues (emotions or experiences that become associated with a product so that the product will be consumed when these emotions or experiences occur) is less clear. The internal cues provided by Nir Eyal as being conductive to habit formation (feelings of boredom, loneliness, frustration, confusion, and indecisiveness) are not easily identified by TAA. In the 2013 paper by Kosinski, Stillwell and Graepel the attribute that seems the closest to these cues, satisfaction with life, showed a prediction accuracy of only 17%, the lowest of all studied attributes: "The relatively lower prediction accuracy for [satisfaction with life] ... may be attributable to the difficulty of distinguishing long-term

happiness from mood swings which vary over time. ... users' Likes accrue over a longer period and, so, may be suitable only for predicting long-term happiness." In the 2014 study by Youyou, Kosinski and Stillwell found that computer predictions outperformed humans on twelve of the thirteen studied attributes but not on life satisfaction.

The doubts surrounding the effectiveness of TAA with regard to the attribute life satisfaction in specific did not stop Cambridge Analytica to include it in its list of potential attributes of the psychographic profiles they offered their clients.

Facebook itself tinkered in 2014 with TAA regarding life satisfaction in an experiment on 689,000 Facebook users. During the experiment the platform studied the effects of reducing user exposure to their friends' posts with positive emotional content and to friends' posts with negative emotional content. Facebook concluded that posted emotions are contagious. The experiment caused a public outcry.

In 2017 Facebook took the question of identifying internal adolescent cues related to habit formation a step further. An internal Facebook report claimed that the social network can establish when young users feel "stressed", "defeated", "overwhelmed", "anxious", "nervous", "stupid", "silly", "useless", and a "failure" by means of real-time monitoring of posts and pictures. This report was allegedly presented to a client, an Australian bank, but this is denied by Facebook. Facebook stated that it does not "offer tools to target people based on their emotional state".

In 2018 The Guardian and the Danish Broadcasting Corporation found that "Facebook allows advertisers to target users it thinks are interested in subjects such as homosexuality, Islam or liberalism, despite religion, sexuality and political beliefs explicitly being marked out as sensitive information under new data protection laws [GDPR]." No user consent is requested by Facebook if the profiling is based on inferred information. Facebook argues that this is no profiling of users but a profiling of user interests. It made the same claim in 2016 regarding a racial affinity tool it had created for advertisers arguing that affinity does not equal ethnicity.

In 2019 Facebook was found to spy on users among which a large group of youngsters, in a paid program. Although it is unclear what Facebook actually stored, theoretically the company had access to: private messages in social media apps, chats from in instant messaging apps – including photos/videos sent to others, emails, web searches, web browsing activity, and location information. Not much later Google was found out to have a similar program.

Besides Facebook Spotify is a growing source for interpretations of personality and mood. A 2017 New York University study for instance searched for correlations between individual songs listened to by users and high scores on the psychopathy scale. A Spotify employee declared: "Nothing says more about someone than the music they listen to and their porn habits."

The New York Times in 2018 launched a mood targeting tool for advertisers called Project Feels. In an explanation for its readers the newspaper explains: "We were able to build a performant set of models that predicted the emotions articles would evoke in our readers. We tested that these

models performed well over time both in offline evaluations, spot checks and online experiments." ESPN and USA Today also started to use similar tools.

It is unclear how effective TAA might be in using internal user cues to influence user behavior. Of the three requirements needed to be effective (alternative messages must be available to send to different types of Internet users, individual Internet users must be identified and a method must be available to measure success) the crucial requirement, a method to measure success, often is absent.

During the 2018 uproar about Cambridge Analytica the effectiveness of TAA was fundamentally questioned, especially since company representatives did not seem to rely on TAA only but seemed willing to add dirty tricks to their digital toolkit in order to achieve changes in the behavior of the individual Internet users they micro-targeted with their messages. Potential clients also disclosed that these representatives were "surprisingly vague about its specifics and too quick to dismissively cry 'Analytics'".

Scientist Aleksandr Kogan, who worked with Cambridge Analytics, does not believe that micro-targeting is an effective way to use datasets. According to him the accuracy of the data in the profiles is extremely exaggerated. In his opinion the possibility to be completely wrong about a profiled person is much higher than the possibility to be completely right.

Sandra Matz, a colleague of Kosinski and Stillwell, states that there might have been some impact on people who have no idea what they're voting for, but, according to her, different targeting methods would have gotten similar results. Business psychologist Andrew Redman and MIT Sloan professor Dean Eckles agrees with her. The only advantage that Eckles sees is that the method is cheaper than comparable methods.

On the other end of the spectrum stands Brad Parscale, Donald Trump's digital director. He claims that the targeted ads on Facebook by the Trump campaign are the reason Trump won the 2016 elections. Former Google design ethicist Tristan Harris sees the identification of internal adolescent cues by Facebook as an example of the kind of granular information that is "a perfect model of what buttons you can push in a particular person" to keep people hooked.

Whatever the case, institutions within the EU and the USA have started calling on big tech companies to provide transparency on political ads and own and third party data gathering. The UK House of Commons report Disinformation and 'fake news' by the Digital, Culture, Media and Sport select committee states that companies like Facebook should not be allowed to act like "digital gangsters". The committee's chairman, Damian Collins warned: "Democracy is at risk from the malicious and relentless targeting of citizens with disinformation and personalized 'dark adverts' from unidentifiable sources, delivered through the major social media platforms we use every day".

Big tech companies are more and more complying to the requests on transparency, but at the same time new scandals about unlawful targeting users, disinformation or illegal user data selling

keep popping up. What is interesting is that Facebook found a way to successfully deal with disinformation about Facebook but has so far not been able to deal with other 'fake news'.

3.4. MECHANISM 4: FOOD AND DRINKS AS A REWARD

3.4.1 DOPAMINE

Of all chemicals that play a part in human functioning dopamine probably is the best known. It has been called the Kim Kardashian of neurotransmitters because it has acquired a celebrity status within pop culture as the pleasure chemical. But, dopamine is far more than that. Dopamine plays a role in controlling the flow of information in the brain, in supporting memory, attention and problem solving, as well as in planning and controlling body movements. As such, dopamine, or rather the loss of dopamine, has been linked for instance to Parkinson's disease.

Certainly, dopamine is released by rewarding experiences, but sometimes unpleasant experiences evoke a dopamine release too. Dopamine is also produced when a pleasurable activity is expected, whether it will happen or not. Therefore, neuroscientists see dopamine rather as involved in desire than in pleasure only. Dopamine seems to be important in establishing whether a situation, experience or potential outcome is worth noticing. It co-decides about the importance individuals attach to stimuli. In the end, dopamine is not about "liking" something, it is about "wanting" something. This wanting can be very intense and it can occur even without actually liking something.

3.4.2 ADOLESCENTS AND DOPAMINE

During adolescence the dopamine system evolves dramatically. The basic level of dopamine production seems to be lower during adolescence in comparison to younger children and adults while seemingly important actions trigger more dopamine and the resulting high dopamine levels are far less kept in check. Since expected and experienced rewards involve higher levels of dopamine, risky and unhealthy but seemingly pleasant activities are associated by adolescents with positive consequences.

This does not mean that the logical thinking and basic information-processing abilities of adolescents are impaired. Adolescents perform no worse than adults at perceiving risks or assessing their vulnerability to risks. Rather, the parts of the brain that enable adolescents to calmly assess, reflect and come to a decision are less developed during adolescence than the dopamine system and have a weaker voice in choosing which types of behavior to pursue. In case

of stimuli that are deemed important, dopamine wins out in decision-making. Reward-seeking adolescents thus are more prone to engage in risky and unhealthy behavior than younger children or adults.

Between adolescents large variations in the amount of dopamine released can be found. According to studies some adolescents are "high risk takers", while others are "low risk takers". Alcohol and other addictive psychoactive substances can induce adolescents who generally are not seen as "high risk takers" to take more risks. The presence of friends is another factor: it doubles the amount of risk-taking behavior among adolescents. Social acceptance and compliments by friends trigger the released of large amounts of dopamine.

3.4.3 SUGAR, FAT AND HABIT FORMATION

The consumption of high sugar food and drinks, and especially those that are fructose-ridden, leads to a release of dopamine. Withdrawal from high sugar foods, on the other hand, can lead to cravings. Researchers found that the rewards and cravings that are evoked by sweetness, and especially by a binge-like consumption of sugar, are even more profound than that of addictive drugs like cocaine.

Every addictive drug, be it amphetamine, cocaine, nicotine, alcohol or sugar, causes the dopamine system to release many times more dopamine than usual, without any additional effort being necessary. These unnaturally large rewards are not filtered in the brain because the brain pathways that tame impulses are still weak and easily overrun. The drug-related rewards go directly into the brain and overstimulate the brain.

The release of large amounts of dopamine as a result of consuming sweet foods and drinks, and ever more also as a result of the expectation of the taste of these foods and drinks, is crucial in the process of habit forming. Dopamine draws attention to important actions, noting that a reward is on its way, and, if the reward is met, it enables the behavior to become a habit. If the reward is not met, behavior will be adapted in the future.

When released in natural amounts dopamine stimulates learning. The dopamine released in large amounts by long-term binge-like consumption stimulates bad learning, i.e. addiction. Natasha Dow Shultz comments: "When that happens, we lose our willpower. Evolution has not prepared our brains for these drugs, so they become overwhelmed and screwed up. We are abusing a useful and necessary system. We shouldn't do it, even though we can."

When the overstimulation occurs over a longer period of time the dopamine system starts to release less and less dopamine as a reaction to the repeated triggers so that increasing amounts of junk food and drinks or psychoactive substances are needed to claim the same level of rewards. At the same time, the production of dopamine between hits decreases ever more, leading to ever more intense craving. In this way an addiction spiral is created.

3.4.4 SUGAR, FAT AND ADOLESCENT HABIT FORMATION

Studies have found that for adolescents external cues, and especially food-related cues, are more likely to draw their attention compared to adults. These cues evoke responses that are independent of whether adolescents are actually hungry: snacking of unhealthy food can be triggered by food advertisements even when an adolescent is in no need of food. This is mainly caused by the increased adolescent sensitivity to reward-related cues.

When stimulated by external rewards, more dopamine is released by the adolescent brain than by the adult brain while checks on dopamine production in the adolescent brain are still mostly under construction. This means that the desire for high fat and high sugar food and drinks products and the consumption of these products trigger a higher dopamine production and thus is more important for adolescents. The result is hardly surprising: adolescents consume more unhealthy food and drinks products compared to adults. Adolescents eat more fast food, eat more often in fast food restaurants, and have a higher intake of sugar. They also are more prone to unhealthy food overconsumption. Research has found that the independent money adolescents typically have is used to buy junk food and drinks as an identity marker to set them apart from adults.

Increased impulsiveness and higher risk-taking among adolescents lead to higher adolescent vulnerability to addiction. The increased amounts of dopamine released as a result of the desire for and the consumption of unhealthy food and drinks stimulate a learning process in which snacking fast food becomes a bad habit. This habit formation is only very ineffectively countered by logical thinking and balanced reflection. Concern about the negative consequences of ever more automated binge-like eating and drinking of unhealthy product is often drown out by impulse snacking and the positive short-term rewards that are expected by adolescents. The adolescent brain is not yet very skilled in seeing the big picture.

3.4.5 LONG-TERM EFFECTS

The dopamine-related long-term effects of high fat and high sugar products overconsumption are profound, especially in case of prolonged binge-like consumption. The overconsumption of unhealthy food and drinks can have an impact on behavior as well as on mental processes like perception, memory, judgment, and reasoning. This impact is comparable to effects resulting from the intake of psychoactive substances.

Changes in behavior that might be caused by long-term overconsumption are: intolerance to delayed gratification, exaggerated emotional responses, and the development of responses that are not appropriate to the context to which an individual reacts.

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Long-term overconsumption can also lead to, among others, deficits in long-term memory formation, learning impairments, higher levels of anxiety, and higher risks of developing neuropsychiatric disorders, including depression, eating disorders and addiction. Research links obesity to impulsive and risky decision-making, anxiety, drug abuse and ADHD.

Habits formed as a result of these changes can be self-sustaining. Obese individuals overall have an even higher sensitivity to external cues, like images of high-calorie food images such as commonly displayed in food advertising. This sensitivity is probably caused by the gut microbes that remain after the overconsumption of junk food (see section 3.6): these microbes have a preference for junk food and send this preference to the brain. These gut microbes are passed on to next generations thereby passing on the preference for junk food.

In rats it was shown that already after five days of junk food their brains had become desensitised to dopamine so that, in the words of Tim Spector, "they required yet more of the same to keep the pleasure going". He continues: "When the junk food was stopped, the now obese rats preferred to slowly starve for two weeks rather than return to eating their healthy but less tasty replacement fare."

The changes in the adolescent dopamine system caused by long-term overconsumption are very likely to continue in adult life, thereby making the formed habits, and their associated changes, permanent.

3.5 MECHANISM 5: SOCIAL MEDIA AS A REWARD

3.5.1 INTRODUCTION

Adding high doses of fat and sugar to their products is not the only option producers of unhealthy food and drinks have to trigger adolescent dopamine. Another powerful option is using social media as a channel of communication with youngsters. Social media like Facebook and Instagram are designed to hook users by means of providing little hits of dopamine every now and then.

While the dopamine shots stimulates users to form habits, social media communication channels in addition enable junk food marketers to build one-on-one relationships with consumers. Teenagers are an important user group for social marketing since they are heavy users of mobile devices and social media. Because of their sensitivity to peer attention and compliments they are also eager to share experiences and content with their peers on social media.

Social media provide producers of junk food and drinks the opportunity for direct communication with youngsters and for publishing their marketing messages immediately into youngsters'

media feeds. Social media extend the reach of unhealthy products to adolescents' social networks – a place where they are more open and trusting.

3.5.2 THE CONCEPT

Sean Parker, the founding president of Facebook, sheds light on the relation between social media and triggering dopamine: "The thought process that went into building these applications, Facebook being the first of them, … was all about: 'How do we consume as much of your time and conscious attention as possible? … that means that we need to give you a little dopamine hit every once in a while, because someone liked or commented on a photo or a post or whatever. And that's going to get you to contribute more content, and that's going to get you … more likes and comments … It's a social validation feedback loop … you're exploiting a vulnerability in human psychology. … The inventors, creators – it's me, it's Mark [Zuckerberg], it's Kevin Systrom on Instagram, it's all of these people – understood this consciously. And we did it anyway." This is why tech gurus like Steve Jobs made sure that their children had only limited access to technology.

The effectiveness of social media is based on the principle of variable rewards. Whereas high fat, high sugar products always provide similar rewards in the form of dopamine, social media are less predictable. Social media users do not know if and when they will receive Likes and comments, and how much. This unpredictability lies at the heart of for instance gambling addictions.

Social media companies are well aware of the power of variable rewards. When an app called Lovematically was launched that let users automatically like every picture on their newsfeed, and thus eliminated the variability out of the reward system, Instagram shut it down after two hours for violating its Terms of Use.

For Nir Eyal variable rewards form the third phase in the process of habit formation. He explains why this type of rewards is so powerful: "Experiences with finite variability become increasingly predictable with use and lose their appeal over time. … Variable rewards … satisfy users' needs while leaving them wanting to reengage with the product."

3.5.3 THE IMPACT OF SOCIAL MEDIA

Social media are competing among themselves to grab as much digital attention as they can because digital attention equals revenue streams. The fierce competition forces social media sites to employ any means possible to draw people in and keep them in. In a provocative internal memo Facebook vice-president Andrew 'Bozz' Bosworth wrote: "We connect people. … Maybe it costs a life by exposing someone to bullies. Maybe someone dies in a terrorist attack coordinated on our

tools. And we still connect people. The ugly truth is that we believe in connecting people so deeply that anything that allows us to connect more people more often is *de facto* good. …That's why all the work we do in growth is justified."

Although Facebook representatives, including Zuckerberg and Bosworth, have publicly distanced themselves from these statements, Bosworth's ugly truth is probably not far from describing the philosophy of many social media founders and developers to expand by any means possible and think about the consequences later. According to Chamath Palihapitiya, former Facebook vice-president of user growth the short-term, dopamine-driven feedback loops lead to the destruction of "how society works. No civil discourse, no cooperation, misinformation, mistruth". Sean Parker agrees: "It literally changes your relationship with society, with each other. It probably interferes with productivity in weird ways. God only knows what it's doing to our children's brains." Media watchdog Common Sense, adds: "Tech companies are conducting a massive real-time experiment on our kids". James Williams, a former Google executive, summarizes the critique on the industry most succinctly: "the technology industry [isn't] designing products; it [is] designing users".

Most probably the effect of tech on its users is grossly overstated by these former big earners from the tech industry who now try to grab headlines for themselves as being 'the good guys'. The amount of dopamine released as a result of using tech is far less than as a result of the intake of alcohol or drugs. Some critics even go so far as to call the dopamine claim "more sales pitch than science". Also, the amount of screen time online does not have a proven negative effect on users be they children or adults.

What does happen is than social media platforms like YouTube use algorithms to serve users with ever more extreme content in order to keep the users attention. The New York Times even accused YouTube of leading users to ever more pedophile content. This so-called 'rabbit hole effect' is linked to the rise of extreme movements such as the flat earthers and anti vaxxers.

3.5.4 SOCIAL MEDIA AND ADOLESCENTS

Some research indicates that the longer people dwell on social media sites like Facebook, the more negative their mood is afterwards – although this outcome is challenged by Orben, Dienlin and Przybylski. This effect, if it exists, does not occur when people are merely browsing on the Internet while feeling bored. Several potential reasons have been found for this negative effect of social media use. This effect seems to be caused, first of all, by a feeling that nothing meaningful has been done while being on Facebook. Secondly, many users, and especially girls, compare themselves negatively to the curated self-presentations by others. In general, it seems that when people spend a lot of time on social media while only passively consuming information, that is: reading but not interacting with people, they tend to feel worse afterwards.

The social media dopamine feedback loop only seems to function when people use social media to interact with others and receive affirmation. Even scrolling through one's own Facebook pages helps individuals to feel better, because the activity reminds them of past affirmations.

Social media allow junk food producers to enter the dopamine-steered adolescent domain of peer pressure. By means of personalization, immersion, and games, they provide dopamine rewards for adolescents. They do not only entertain youngsters but also affirm them, thus imitating their meaningful interactions with peers and helping them to avoid the disappointment that usually follows just wasting time on social media. Especially the games that marketers of unhealthy food and drinks provide bring excitement, evoking small shots of dopamine. The rewards in the games can be as small as a sound or a white flash on the screen emerging as a reaction to player activities or as big as winning a game. The phenomenon of dopamine highs triggered by a game is known as "fiero". The game micro-feedback that immerses players is called "juice".

By following-up on the expectation of social media rewards by adolescents and allowing them to avoid negative moods caused by not finding peer affirmation, producers of high fat high sugar products stimulate learning: dopamine as a reward follows dopamine released by the expectation of rewards. This process causes the stimuli provided by the marketers to seem important to adolescents. It enables high fat high sugar product marketers to effectively push their advertisements and narrations to youngsters.

Marketers employ social media directly by means of profiles and games, or indirectly through vloggers on YouTube. As was described in section 2.2.2 peers and slightly older youngsters such as vloggers for a significant part take over the function of parents and teachers as role models. A study found that youngsters who saw vloggers promote junk food and drinks afterwards consumed 448 calories while youngsters who saw vloggers promote healthy food and drinks or non-food and drinks products consumed 357 calories.

3.6 MECHANISM 6: CHANGING THE METABOLIC SYSTEM

3.6.1 INTRODUCTION

In the previous sections a number of important instruments were presented that are available to producers of junk food and drinks in order to nudge adolescents to eat and drink their products binge-like as an automated behavior on cue.

In section 3.1 the most commonly used type of external triggers, advertising, was discussed as part of Nir Eyal's step one to activate adolescents in a four-step process of getting them hooked. In section 3.2 it was shown how Eyal's second type of cues, internal triggers, can be made

instrumental to activate adolescents into action. Both types of triggers can be employed more effectively by means of personalization, as was put forward in section 3.3.

In sections 3.4 and 3.5 Eyal's step three was described: rewards that follow upon adolescent activities that are triggered by external and internal cues. Adding significant amounts of fat and sugar to food and drinks product evoke predictable releases of dopamine, while communicating by means of social networks triggers variable dopamine hits.

The marketing instruments portrayed in sections 3.1 (advertising), 3.2 (immersion), 3.3 (personalization) and 3.5 (social media) lead to Nir Eyal's fourth step: investment. These instruments do not just aim at immediate consumption of unhealthy food and drinks but also aim at ensuring future repeat consumption. The logic behind this is, according to Eyal, that the more time and effort is invested into a product or service, the more the product or service is valued.

The ever more positive valuation of junk food and drinks that is the consequence of step four leads adolescents back to step two, an action that is easier than thinking, again and again nudged towards this action by means of external triggers and the experience that the action helps them to escape their frequent negative internal states.

While the marketing instruments create a product-specific lasting consumption loyalty enabling automated binge-like eating and drinking, biological instruments lay a general groundwork for eating and drinking high fat high sugar products by means of stimulating addiction-like behavior (section 3.4) and by changing the metabolic system.

3.6.2 THE CONCEPT

The NGO Living Loud, a coalition of health professionals, digital technology experts, and marketing and communication specialists, explains the process of changing the metabolic system by means of product ingredients: "the main meals we now eat are much higher in refined carbohydrates, such as pasta, bread and rice and much lower in high-density whole grains and good natural fats such as animal fats and dairy. Our gut rapidly digest refined carbs into glucose, which courses through our body sending our pancreases, liver and other organs into overdrive. Your body is so concerned by the damage that high glucose (think sticky blood) could cause that is releases extra insulin to burn the glucose and rapidly turns the excess glucose into fat. The big problem is a couple of hour later your fully revved engine has burned through all that fuel, your blood glucose drops and your brain switches to emergency lifesaving mode, it powers down all non-critical energy-burning functions, releasing hormones to make you feel lazy and hungry. So you reach for the quick energy-fix carb snacks, burn through those until lunchtime, then tea, dinner, and a bedtime snack all the while knackering your metabolic system, piling fat on your organs and setting yourself up nicely for diabetes. This is all no accident of nature. It is the creation of extraordinary food scientists working in laboratories. They have refined the perfect blend of salt, sugar and fat to feel great in the mouth, stimulate the pleasure sensors in the brain

and still leave us feeling hungry."Raised blood glucose is responsible for twenty-one percent of deaths from heart disease and thirteen percent of deaths from stroke worldwide. It is linked to dementia and to neurodevelopmental issues in children.

It's refined carbohydrates and added sugar in high-calorie, low nutrition junk food in combination with lacking fibre and nutritients, that make us fat and sick. Felice Jacka refers to this state as "malnubesity": "This refers to a situation where too much energy is consumed but that energy comes with very little nutrition. The ultra-processed foods make up so much of the modern diet are high in calories from fats and sugars but very low in nutrients, which mean that they make people fat without actually providing the nutrition needed for all the body's processes ... And so the current food environment has given rise to a common situation where individuals are both overweight or obese *and* undernourished." Tim Spector adds: "This is probably because when an individual has some persistent nutritional deficiency their body and fat cells experience an increased drive to lay down protective fat."

The food and drinks industry promotes the development of sweet preferences already among babies, who are programmed to love sweetness. Many companies add concentrated fruit juice or pureed fruit (read: sugar) to make the food taste sweeter. This is very likely to narrow the baby's palate for the future. In the UK at least one-third of the parents across the socioeconomic spectrum, buys commercial baby foods. It is not surprising, therefore, that the average ten-year-old has consumed during their lifetime as much sugar as the recommended limit for eighteen-year-olds. Children are consuming the equivalent of eight excess sugar cubes a day.

3.6.3 LONG-TERM EFFECTS

The changes in the metabolic system that can be induced by added fat and sweetness, and especially fructose, perpetuate ever quicker the hooked-cycle: they induce hunger, a greater sensitivity to external food triggers such as commonly displayed in food advertising, and a desire for eating more food, as well as greater impulsivity in the form of a greater willingness to give up long-term rewards for immediate high-calorie foods.

One of the major effects of overconsumption of junk food is the loss of nearly half of our gut species. As seen in section 3.4.5 this implies a change in preferences to food and drinks: the remaining microbes love junk food and communicate their preference to the brain. Tim Spector explains: "studies show that we can change our gut-microbe composition more easily than we had thought, just within a few days. The altered microbiome community produces a whole new set of metabolites and chemicals, which can alter our bodies in ways beyond just the effects of the fat and sugar." The loss of gut species means a loss of health. The altered state of the microbiome means that our body is being brought into an inflammatory state, more unneeded fat is stored and, in the end, our lives are shortened. To give an idea: eating a bacon sandwich or a hot dog

reduces life expectancy by one hour per sandwich – equivalent to smoking one-fifth of a package of cigarettes. The changes in gut composition are hereditary.

Research found that high fructose intake can cause modifications at the level of genes in a process called epigenetics. At first two genes are changed in the brain and then, through these changes, more than 900 genes in the brain major metabolic control center (hypothalamus) and the center for regulating learning and memory (hippocampus). Tim Spector adds: "We don't know yet why sugar seems to interact so strongly with our geners but it does suggest that our bodies have a hard-wired need to seek out sugar ... Interestingly, most of the genes interacting with sugar turned out to be those acting on the brain." The potential effects of the modified genes are, among others, memory impairment, type 2 diabetes, and obesity.

Obesity, in turn, is associated by research with impulsivity, anxiety, drug abuse and ADHD. Obese are shown to be triggered even more by external junk food and drinks images. Those who have obesity during adolescence usually also have obesity in adulthood.

3.6.4 DISCUSSION

Although the description above stems from many scientific studies, on the moment it is hard to provide a definitive account of the processes related to high intakes of unhealthy food and drinks. Some of the research on the effects of sugar has been performed on rats or mice, rather than on humans.

As a result, larger health organizations take a rather cautious stand on the effects of sugar. WHO for instance writes: "Free sugars contribute to the overall energy density of diets, and may promote a positive energy balance. Sustaining energy balance is critical to maintaining healthy body weight and ensuring optimal nutrient intake. There is increasing concern that intake of free sugars – particularly in the form of sugar-sweetened beverages – increases overall energy intake and may reduce the intake of foods containing more nutritionally adequate calories, leading to an unhealthy diet, weight gain and increased risk of NCDs [Noncommunicable diseases]. Another concern is the association between intake of free sugars and dental caries."

The stance by larger health organizations follows the dominant paradigm that obesity is the effect of taking more energy in (by means of consumption) than using up energy (by means of physical activities). According to this paradigm sugar is no more than a form of energy intake. The answer to obesity, according to the paradigm, is more exercise (more energy out) while reducing the overall intake of energy, including the intake of sugar and fat. The dominant paradigm ignores the sugar-related changes in the metabolic system that occur, as well as the addictive-like qualities of sugar. Within the dominant paradigm sugar is just another form of energy in.

The narrative that sugar is just another form of energy in has been promoted by the food and drinks industry for quite some time now. Cristin Kearns and her colleagues found that industry

representatives have deliberately derailed the discussion about sugar for decades. The industry for instance has suppressed the outcomes of studies that linked eating lots of sugar to heart disease while at the same time sponsoring a research program that successfully cast doubt about the hazards of sugar. Natasha Schüll Dow found the same type of behavior within the gambling industry.

Felice Jacka summarizes the differences in outcomes between research funded by junk food producers and independent research: "Industry ... funds research 'showing' that obesity comes from a lack of exercise rather than diet, or that sugar-sweetened beverages don't make a big contribution to the obesity epidemic. Non-industry-funded research tells us, however, that the real culprit is the changes in the food system, with increases in the quantity of available food, and especially of industrialized foods with added fats, sugars, salt and flavors – all designed to make us want more of them."

The biggest downside of the dominant paradigm is that it blames the victim, among them adolescents who assumedly eat too much and exercise too little, while letting the food and drinks industry off the hook. George Monbiot writes: "After spending billions on overriding our willpower, they [food and drinks companies] blame us for failing to exercise it." According to him a large part of the general public and the vast majority of policymakers as a result indulge in fat shaming.

There is a parallel to be found here with the tobacco industry, the gambling industry, and the tech industry. Representatives of these industries also tried to frame the problem of addiction as a problem not inherent to their products but as a problem of a specific niche category of people only: people who are somehow predisposed to become addicts. Industry marketers push this narrative into the public debate while trying to silence alternative narratives.

This industry narrative is unsubstantiated. Research by Peter Milner and James Olds showed that anyone can become an addict under the right circumstances. Adam Alter summarizes the implications of their findings: "there is so much more to addiction than an *addictive personality*. Addicts aren't simply weaker specimens than non-addicts; they aren't morally corrupt where non-addicts are virtuous. Instead, many, if not most, of them are unlucky. ... Even the sturdier of our ranks – the young G.I.s who were free of addiction when they left for Vietnam – are prone to weakness when they find themselves in the wrong setting. And even the most determined addicts-in-recovery will relapse when they revisit the people and places that remind them of the drug." Felice Jacka agrees: "we shouldn't be blaming ourselves but rather the food environment, which makes eating unhealthy food so much easier and cheaper that eating whole foods. This is where we need to be focusing our blame". This is in line with the earlier quoted assessment by the General Secretariat of the European Council (section 1.1.4) "The causes of childhood overweight and obesity are complex and multi-factorial, mostly arising from an obesogenic environment."

And, last but not least, the industry narrative is factually untrue. In comparison to the nineteen seventies, for instance, people currently on average take in less calories while their physical

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activity is at a comparable level. According to the industry narrative this should mean that people in the nineteen seventies should have been more obese than they are currently since they had more energy coming in while having similar amounts of energy going out. But, in the nineteen seventies almost no one was obese while at the present time obesity is rampant. The main difference between the nineteen seventies and the present day is that the average intake of refined carbohydrates and sugar has rocketed while the intake of healthy food has plummeted.

3.6.5 ENERGY IN AND ENERGY OUT

The doubts that are cast on the dominant paradigm do not imply that the amount of consumption by youngsters and the amount of body activities by them are totally irrelevant. Rather, the relations between energy in and energy out are far more complicated than those portrayed in the paradigm.

Research in the field of metabolic flexibility shows that in a situation of little or no exercise mainly carbohydrates (sugars) are used as fuel for bodily activities. This type of fuel is in short supply in the human body. The alternative fuel present in the body, fatty acids, remain unused, although it is present in large amounts. This leads to a situation in which the fat reserves in the body are kept at a stable level, or are even added to, while the quick depletion of carbohydrates in the body leads to exhaustion and a craving for sugars. The same process occurs in case of short, intense exercises only.

The situation changes when individuals exercise for longer periods of time. The duration of the exercises forces the body to metabolic flexibility: to use both sugars and fatty acids as fuel. This flexibility does not just concern the periods in which the exercises are performed but also extends to periods of inactivity.

In case of longer periods of inactivity the ability to flexibly use both sugars and fatty acids as fuel diminishes. This means that individuals do not lose fat, even when they do exercise profoundly, and permanently crave for sugars. This process, fortunately, is reversible. A combination of intense exercising, better sleeping patterns, lower stress levels, and a more balanced intake of food and drinks can restore metabolic flexibility within 6 to 9 weeks.

In the end, it probably all boils down to this: while exercise makes people healthier, it does not undo the effects of bad diets. The effect of calories in cannot be undone by it. The one thing that does seem to help against overweight and obesity is taking less calories in while eating more healthy food and staying away from junk food and drinks.

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3.6.6 DIETARY IMPLICATIONS

Unfortunately, when it comes to dietary recommendations the situation is dramatic. There are many self-proclaimed experts who direct us in any direction, sometimes based on their personal experience or on a faulty reading of scientific literature, sometimes based on greed and a will to fame. But they are not the only ones confusing us. Also medical professionals and governmental diet recommendations can get it wrong, sometimes very wrong.

It's important to remember that individual organisms react differently to different foods as a result of variations in nature and nurture between us. Also, these reactions cannot be reduced to reactions to single ingredients in our food or drinks. Fortunately, in the last few years the situation has started to improve. Scientists like Tim Spector and Felice Jacka have started to make their voices heard. Spector summarizes his findings as follows: "there are certain facts about diet that are unarguable: diets that are high in sugar and processed foods are bad for our microbes, and by extension for our health, and diets that are high in vegetables and fruits are good for both." He adds: "You won't go wrong if you just treat your own micobes like you would treat your own garden. Give them plenty of fertiliser – prebiotics, fibre and nutritients. Plant new seeds regularly in the shape of probiotics and new foods. Give the soil an occasional rest by fasting. Experiment, but avoid poisoning your microbiotic garden with preservatives, antiseptic mouthwashes, antibiotics, junk food and sugar."

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