



**Trinity College Dublin**  
Coláiste na Tríonóide, Baile Átha Cliath  
The University of Dublin

Topic:

**The Use of Video Games for Behaviour Change Towards a Sustainable Lifestyle**

**Research Paper**

Course:

**Interactive Digital Media M.Sc.**

Facility of Supervision:

Trinity College Dublin

School of Computer Science

Supervisor: Ms. Diana Wilson, Assistant Professor, Computer Science

Submission by: Milena Fluck  
128 Hazelwood Park  
Dublin 5  
0049 17670223891  
[REDACTED]  
fluckm@tcd.ie

Date of Submission: 2020-05-07

**Affidavit**

**Permission to lend and/or copy**

I agree that Trinity College Library may lend or copy this research Paper upon request.

Signed: 

**Declaration**

I have read and I understand the plagiarism provisions in the General Regulations of the University Calendar for the current year, found at: <http://www.tcd.ie/calendar>

I have also completed the Online Tutorial on avoiding plagiarism 'Ready, Steady, Write', located at <http://tcdie.libguides.com/plagiarism/ready-steady-write>

I declare that the work described in this research Paper is, except where otherwise stated, entirely my own work and has not been submitted as an exercise for a degree at this or any other university.

Signed: 

## **Abstract**

Global climate change caused by human actions, referred to as anthropogenic climate forcing, is an enormous issue that is permanently present in our daily lives and poses threats for our futures. While scientists, politics and other instances have pointed out behavioural guidelines individuals should follow in order to reduce their environmental footprint, it has been shown that people have difficulties to adapt to a sustainable lifestyle.

In this paper a new approach on how to help people change behaviour patterns and attitudes towards a more sustainable lifestyle is being researched.

Video games have already been effectively used to change people's behaviour in areas such as eating or exercising. Furthermore, it could be shown that video games can lead to long-term changes in attitudes and cognitive constructs. While this paper gives an overview on existing games related to global climate change it will further follow the transtheoretical model of behaviour change (TTM). This model describes behaviour change as an evolving process. Moreover, psychological theories will be set in connection with each stage of the TTM. Specific scenarios for potential implementations in common games will then be given and analysed. These show that there are possibilities of integrating strategies in video games that can help people to adapt to a sustainable lifestyle.

## Table of contents

List of abbreviations .....	I
List of figures .....	I
List of tables .....	I
1 Introduction .....	1
2 Current state of science .....	2
2.1 Climate change and human behaviour .....	2
2.2 Behaviour change through games .....	4
3 Theoretical background.....	5
3.1 The transtheoretical model of behaviour change (TTM).....	5
3.2 Precontemplation: Serious games and persuasive technologies .....	7
3.2.1 Environmental education through educational games .....	8
3.2.2 The use of persuasive technologies in games .....	11
3.2.2.1 Principles of persuasive technologies .....	12
3.2.2.2 Overview on primarily used persuasive strategies.....	13
3.2.2.3 Design principles for a beneficial use of persuasive strategies....	14
3.3 Contemplation: The pivotal experience and goal setting theory .....	15
3.4 Preparation and action .....	16
3.4.1 Decision-making process .....	16
3.4.2 Subliminal priming .....	17
3.5 Maintenance: Long-term consolidation of sustainable behaviour patterns .....	19
3.5.1 Forming procedural and cognitive constructs and change of attitude.....	19
3.6 Games and sustainability.....	20
4 Method.....	22
5 Results.....	24
6 Discussion.....	29
7 Conclusion .....	30
Bibliography and list of primary sources.....	32
Appendix.....	37

## List of abbreviations

GCC	Global Climate Change
TTM	Transtheoretical Model of Behaviour Change
FBM	Three Factors of behaviour model
GtCO <sub>2</sub> -eq	giga tonnes of equivalent carbon dioxide
GTA	Grand Theft Auto (name of a video game)
AI	Artificial Intelligence
PC	Personal Computer

## List of figures

Figure 1 The TTM and discussed theories .....	7
Figure 2 Clim'Way.....	9
Figure 3 Disaster Detector .....	9
Figure 4 Future Coast .....	10
Figure 5 The FBM in Gaming.....	12
Figure 6 Eco .....	20
Figure 7 Sims 4 off-the-grid mode.....	21
Figure 8 Dirt Rally 2.0 car crash.....	26
Figure 9 GTA coffee shop.....	27

## List of tables

Table 1 Scenarios.....	23
------------------------	----

## 1 Introduction

2017 has been ranked either second or third warmest year - depending on method used - for global surface temperature since 1880 as analyses by the National Aeronautics and Space Administration (NASA) and the National Oceanic Atmospheric Administration (NOAA) show.<sup>1</sup> Global climate change (GCC) brings temperature elevation, extreme weather events, like droughts, floods, and strong storms, as well as increased air pollution. Further, these conditions cause intra- and intergroup conflicts and psychological distress. Forty-five percent of Americans and Western Europeans (Saad, 2017; Steentjes et al., 2017, as cited in Evans, 2019) are concerned about GCC. However, the population most affected by GCC is not the Western world, but often habitants of non-digitalized cultures. For instance, the Inuit report changes to their land that impede traditional hunting and fishing practices. Moreover, they draw attention to higher occurrences of mental health problems due to the stressful adaptation to these new conditions (Evans, 2019). As a matter of fact, the connection between high temperatures and suicide has been researched extensively. An 11-year analysis has shown that when temperatures exceed 18°C, the risk of suicide in the United Kingdom increases by 3,8% for each 1°C (Page et al., 2007, as cited in Evans, 2019). Though currently not as affected, Western countries will not be spared by GCC as time progresses. The rise in temperatures will have an impact on tourism (e.g. skiing season), outdoor physical activities and, other outdoor activities (e.g. gardening) (Evans, 2019). This might seem endurable, but once people become aware of the restrictions in their daily lives, they will not take it as lightly. Grievous consequences of GCC can already be seen. For instance, in Australia, farmers have suffered from prolonged droughts, which has led to uncertain financial conditions and, in turn, life stress (Staniford, Dollard & Guerin, 2009). An increased rate of post-traumatic stress disorder (PTSD) follows natural and human disasters with an estimated 30-40% prevalence rate (Galea, Nandi & Vlahov, 2005). Additionally, people will be forced to move or flee due to coastal flooding or soil degradation. Approximately 150 million people will be displaced worldwide in the next 50 years (Watts et al., 2015, as cited in Evans, 2019), and families will be torn apart. It is time for change. According to Fabricatore and López (2012), a sustainable system demands changes not only on a governmental level, but also within the public's social and cultural values, attitudes, and behaviours. A drastic change of the perspective individuals have on the world and their position in it is necessary. This change can be initiated and supported by education. As pointed out, not only is knowledge within the domain needed, but also changes in attitudes and actions. As expressed by Sipos, Battisi and Grimm (2008), sustainability has to be engaged by "head, hands and heart". The purpose of this paper is to

---

<sup>1</sup> <http://www.fao.org/economic/ess/environment/data/temperature-change/en/> (2020-04-02)

present an innovative way to address a specified, but large group of consumers in order to change their behaviours and make them more sustainable. Gamers might not be facing the impacts of GCC yet, but due to their high consumption of electricity through high-efficiency PCs, they form a vital group of consumers. A survey based on responses from 4.500 consumers in France, Germany, India, Italy, Japan, Singapore, South Korea, the United Kingdom, and the United States aged 18, 2019 people played over 7 hours per week on average. Gamers aged 26 to 35 played over 8 hours per week on average. Video games are a common leisure activity for today's youth (Verheijen, Burg & Stoltz, 2019), and 72% of teens play video games (Lenhart, Smith, Anderson, Duggan, & Perrin, 2015; van Dorselaer et al., 2016, as cited in Verheijen, et al., 2019). Video games provide captivating storylines which become even more absorbing with the use of interactivity (Atkins, 2003, as cited in Kelly & Nardi, 2014). As Brown and Thomas (2008, as cited in Kelly & Nardi, 2014) point out, characteristics of good game mechanics are the extent to which they encourage the player to think outside the box when encountering problems and scrutinize situational potentials carefully. These are exactly the skills needed when it comes to fighting GCC. Furthermore, video games address a broad group of people and therefore present a powerful tool of influence. In this paper, the following research question will be explored:

**RQ:** How can video games be used for behaviour change towards a more sustainable lifestyle?

This paper will give an overview on human behaviour in connection with GCC, on behaviour change through games, and on video games as a form of persuasive technology. Further, the reader will be led through the transtheoretical model of behaviour change (TTM) as introduced by Prochaska and Velicer (1997), and each stage will be studied, including underlying theories. Examples from the world of gaming will be given. In chapter 4, the method will be explained, followed by the results, the discussion, and finally the conclusion, with the goal of answering the research question introduced above.

## **2 Current state of science**

### **2.1 Climate change and human behaviour**

Science has proven that human behaviour is the main factor causing GCC (Williamson, Satre-Meloy, Velasco, & Green, 2018). To separate so called anthropogenic climate forcing - also called 'enhanced greenhouse effect' - from natural divergencies has been a scientific challenge (Boykoff, 2007). Research on this topic was started 1896 by Swedish Nobel prize-win-

ning physicist Svante Arrhenius (Fleming, 1998, as cited in Boykoff, 2007). Collecting evidence through decades of research reinforced that human activities play a vital role in climate change (Flanery 2006; Weart, 2003, as cited in Boykoff, 2007). Further the United Nations-sponsored Intergovernmental Panel on Climate Change (IPCC) concluded that humans contribute undoubtedly and to a large extent to GCC (Argrawala, 1998b, as cited in Boykoff, 2007). Soon, Baliunas, Idso, C., Idso, S. and Legates (2003) point out that the 20th century is seen as a distinguished period. It differs from other climatic anomalies such as the Medieval Warm Period or Little Ice Age. Human's influence on the global climate is done by interfering in earth's atmospheric composition. Naturally occurring greenhouse gases are augmented by human-produced greenhouse gas emissions. Expansive deforestation and desertification in Amazon rainforest and the Sahel are just two main factors that expand the layer of greenhouse gases trapping outgoing radiation from Earth to space and lead to a heating of this planet (Karl & Trenberth, 2003). Human's significant role in the ongoing GCC can also be seen in connection with the recent Corona Virus Crisis of 2019/2020. Scientists say that in May 2020, CO<sub>2</sub> emissions could be at their lowest since the financial crisis of 2007/2008. Further, carbon monoxide emissions have dropped nearly 50% due to decreased traffic<sup>2</sup>, and the effects of which can already be seen. For instance, in Venice, Italy, the water became clearer, and birds came back to build their nests<sup>3</sup>. Many people rely on changes at the scale of government and industry, but individual consumption behaviour can also have a significant impact (Williamson et al., 2018). The resource consumption and resource consumption practices of people as individuals pose a large threat to the environment. As defined by the UN World Commission on Environment and Development, the most commonly used definition of sustainability is "[...] development that meets the need of the present without compromising the ability of future generations to meet their own needs." (Fabricatore & López, 2012). Resource Consumption in the home and commercial sector is responsible for up to 20% of overall consumption in the USA, which is 20 times higher than in the third world. Europe and Asia follow right behind with twelve- and ten-times higher consumption, respectively (Oakley, Chen & Nisi, 2008). Even the use of everyday paper coffee cups is a huge problem. Humans use approximately 16 billion cups annually, which requires 6.5 million trees and 4 billion gallons of water within the production process. Whether recyclable or not, the production process releases greenhouse gases like methane and carbon dioxide. Further, these cups produce 253 million pounds of waste per year<sup>4</sup>. Williamson et al. (2018) created a list that presents 30

---

<sup>2</sup> <https://www.bbc.com/news/science-environment-51944780> (2020-03-25)

<sup>3</sup> <https://www.theguardian.com/environment/2020/mar/20/nature-is-taking-back-venice-wildlife-returns-to-tourist-free-city> (2020-03-25)

<sup>4</sup> <https://www.whirleydrinkworks.com/about-us/sustainability/> (2020-03-25)

behavioural solutions that can easily be implemented in everyday life. Among others, these include reduced food waste, composting, plant-rich diets, ridesharing, mass transit, cycling (alternatively electric bicycles), walking, LED lighting, the use of video conferencing-technologies, and household recycling (glass, paper, metal, plastic). If every individual would adopt these behavioural solutions, an optimum of approximately 36,8% in emissions (measured in GtCO<sub>2</sub>-eq) reduction could be achieved between 2020 and 2050 (Williamson et al., 2018). Often, consumers are aware of the solution to a problem, but struggle with taking appropriate action (Lee, 2016). During his research, Lee (2016) studied whether customers of non-reusable cups were aware of the problem, and, if so, what stops them from acting appropriately. Using disposable cups nowadays is seen not only as a comfort, but as a lifestyle. People tend to ignore the problem or the importance of the problem and cannot detect immediate improvements from their actions due to insignificant or even invisible change (Lee, 2016). Facing the drastic, negative impacts of climate change and its fatal impact, one might think that personal consumption behaviour might become more sustainable, but that, unfortunately, is not the case. Oakley et al. (2008) explain this issue as a lack of motivation which causes unwillingness to integrate sustainable behaviour schemes into our daily lives. As Manzini (2006, as cited in Oakley et al., 2008) writes, the favourable outcomes of sustainable behaviour cannot be detected immediately. Additionally, the costs of living sustainably can be high, due to giving up certain comfort. The image of sustainability needs to be improved, and sustainable consumption must become associated with a better lifestyle. As Williamson et al. (2018) further point out, sustainability "requires finding innovative ways of engaging individuals, households, and communities, and changing patterns of production and consumption that are ingrained in routine ways of life". These innovative solutions should be provided where consumers will see them, and they should use "the power of emotional appeals, social incentives, and choice architecture as expertly as we apply economics and policy" (Williamson et al., 2018). In the following, a potential solution will be explored: the use of different strategies within video games in order to promote behaviour change towards a more sustainable lifestyle.

## **2.2 Behaviour change through games**

Numerous technological tools have been created which are effectively used to change people's behaviour in areas such as eating (Grimes, Bednar, Bolter & Grinter, 2008), exercising (Consolvo McDonald & Landay, 2009), smoking (Hossain et al., 2012, as cited in Bhattacharya, 2018) or sleep (Bauer et al., 2012, , as cited in Bhattacharya, 2018). Man-made GCC, just like lack of physical activity or smoking, is a vital problem which poses a threat to a person's life and well-being and, therefore, needs to be addressed. In games,

players define a goal. This might be done quickly or through an evolving process. Players contemplate problem-solving strategies that include careful decision making and creativity. This planning process involves predicting outcomes and managing resources. As players take action, their plans might change according to their success in achieving the goal (Fabricatore & López, 2012). All of this can be done within the game environment, whereas in the real world, the complexity of problems can be harder to grasp. The connection between enjoyment and learning is much deeper in games than in other domains (López, 2010, as cited in Fabricatore & López, 2012). Not only can games aim for behavioural change in the gaming environment, but also for behavioural changes in the outside world. This is pointed out by Campbell, Ngo and Fogarty (2008), who reference games such as Dance Dance Revolution (1998) or Wii Sports (2006) that initiate physical activity even in people that usually avoid physical effort. This example of behavioural change was so popular that Dance Dance Revolution eventually led to higher participation in physical education classes (Brown, 2006, as cited in Campbell et al., 2008). The aforementioned games are played with the intention to help players change behaviour patterns (e.g. if they want to lose weight or become fitter). Technologies can also trigger a change in behaviour even when it is not explicitly desired by the player. Information technology is never neutral (Ionas-Kukkonen & Harjumaa, 2009), which also means that technologies have a great responsibility (Goos et al., 2013). With the power to influence people's behaviour or even attitude come ethical obligations, especially in cases when the user is not aware of a strong influential message. This might lead consumers to question whether creators of games like GTA, that demonstrably lead to more violent behaviour, should be held responsible in cases of associated misconduct. A step further, one might suggest that creators of messages that reach millions of people have a duty to use their influence to make the world a better place.

### **3 Theoretical background**

#### **3.1 The transtheoretical model of behaviour change (TTM)**

Prochaska and Velicer (1997) point out that behaviour change has often been seen as an event (e.g. quitting smoking) rather than being understood as a process consisting of various steps. According to them, behaviour change is structured as a transtheoretical model that presents behavioural change as a process comprising of six stages.

In the following, these stages will be introduced.

According to Prochaska and Velicer (1997), the first stage can be referred to as precontemplation. In this stage, the person lacks adequate information concerning the field of change. For example, a person with no knowledge concerning genetic engineering will not know that choosing cisgenic apples can help reduce environmental impact due to a reduction of chemicals. The rejection of genetically modified apples forms a barrier on the market that prevents taking advantage of the environmental benefits obtained from this bio-technological solution (De Marchi et al., 2019). People in this stage are more likely to avoid any change to their counterproductive behaviours (Prochaska & Velicer, 1997). In the stage of precontemplation, re-evaluation of one's current behaviour must be encouraged, and risks should be explained and personalized (Lee, 2016).

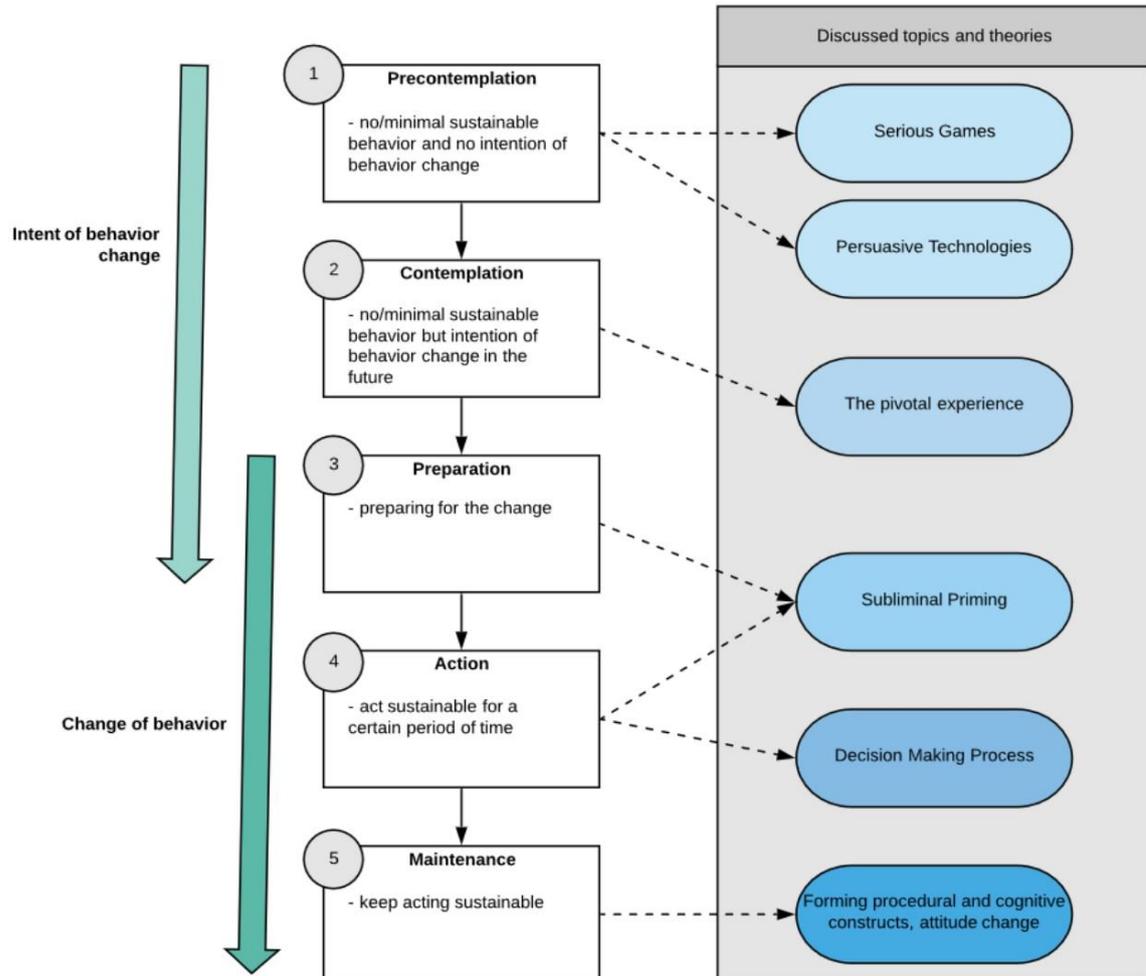
In the second stage, referred to as contemplation, the person intends to change. The core of this stage is the inner conflict of balancing costs and benefits. People are likely to get stuck in this stage for longer periods of time weighing the pros and cons. For example, a person may be aware that the decomposition process of disposable coffee cups causes a release of methane, a greenhouse gas with 23 times the heat-trapping power of carbon dioxide (Lee, 2015). The benefits of using a reusable cup instead meet the moral norms one endorses (Dunlap, 2006) which reduces cognitive dissonance (Festinger, 1957, as cited in Miller & Jehle, 2015) as well as potentially supports self-impression management (Chaubey & Kandpal, 2017) and self-concept as a social identity in "green" societies (Postmes, Rabinovich, Morton & van Zomeren, 2015). On the contrary, a person may consider the costs of having to bring a reusable cup or of missing out on the daily coffee routine.

The third stage, preparation, relates to planning further actions after a definite decision to change has been made (Prochaska & Velicer, 1997). This could be planning to only eat cisgenic apples or to avoid to-go coffee orders.

Action is the stage in which changes are put into practice, and certain criteria, such as completely avoiding to-go coffee cups, are observed. In this stage, the danger of relapse is at its highest.

Whereas the stage of action refers to changes in behaviour by introducing requirements and rules, the sixth stage of maintenance refers to the prevention of relapse. People in this stage have already overcome the action stage and are more self-assured of maintaining changes. This stage can last from six months up to five years, and the risk of relapse decreases over time. This last stage focuses not only on changing behaviour, but also on the resetting of the

mind, the changing of attitude, and the forming of new procedural and cognitive constructs. For instance, smokers that have stopped smoking for a bet will relapse once the bet is over. They will only quit definitely if their attitude towards smoking changes.



**Figure 1** The TTM and discussed theories<sup>5</sup>

### 3.2 Precontemplation: Serious games and persuasive technologies

The three key aspects of sustainability are the social, the economical, and the environmental dimension (Fabricatore & López, 2012). Most common games such as *FarmVille*<sup>6</sup> or *SimCity* already deal with two of these: the social and economic dimension. Adding the environmental dimension could not only lead to a better understanding of the complexity that underlies sustainability, but also educate a target group that has been neglected by educational games in

<sup>5</sup> Created using Lucidchart: <https://www.lucidchart.com/>

<sup>6</sup> <https://www.zynga.com/games/farmville/> (2020-03-22)

the past. Educational games (Richter, 2010) serve an educational purpose rather than an entertainment purpose. In contrast, there are persuasive games that make use of persuasive technology. Persuasive technology is defined as "interactive information technology that is designed to change the users' attitude or behaviour" (Fogg, 2003 as cited by Oinas-Kukkonen & Harjumaa, 2008). Educational games and persuasive games are both often referred to as Serious Games, as this term generally describes games with the main purpose of changing the players' behaviour (Fogg, 2003 as cited in Orji, Mandryk & Vassileva, 2017). However, educational and persuasive games differ fundamentally. While educational games focus on supporting learning processes, persuasive games are often commercial and focus on entertainment. Both kinds of games can be used to send messages to the player and raise awareness of issues.

### 3.2.1 Environmental education through educational games

Educational games exist over a wide range of genres. According to Fabricatore and López (2012), most are quizzes (30%) and simulations (25%). Another category is action-adventure games (15%) (e.g. where the player must solve an environmentally related crime). Forty percent of these games are specifically created to be used within school education, and only thirty percent provide in-game communication tools. Educational games began as board games 35 years ago, and video game versions followed around 14 years later (Wu & Lee, 2015). In the following, examples of existing Educational Games (referred to as Serious Games) related to GCC will be given.

*Clim'way*<sup>7</sup> is a visually appealing, highly detailed simulation game. The goal is to reduce greenhouse gas emissions and energy consumption and increase the production of renewable energy. Every in-game year, the players earn points with which they can take new actions to achieve their goals. Under Climate Interactions<sup>8</sup>, a variety of simulation games like this can be found that help policy makers, educators, and scientists easily examine a wide range of scenarios and manipulate factors such as fuel prices or population growth (Wu & Lee, 2015). *Keep Cool*<sup>9</sup> is a similar game that can be played online as well as against others; therefore, it is not strictly a simulation game. The game also comes with educational material for teachers. Another similar game is *Climate Challenge*<sup>10</sup>, where the player plays as the president of Europe. While these games are all about prevention, *Anno 2070*<sup>11</sup> deals with GCC's potential

---

<sup>7</sup> <https://www.ecogamer.org/climate-change/clim-way/> (2020-03-12)

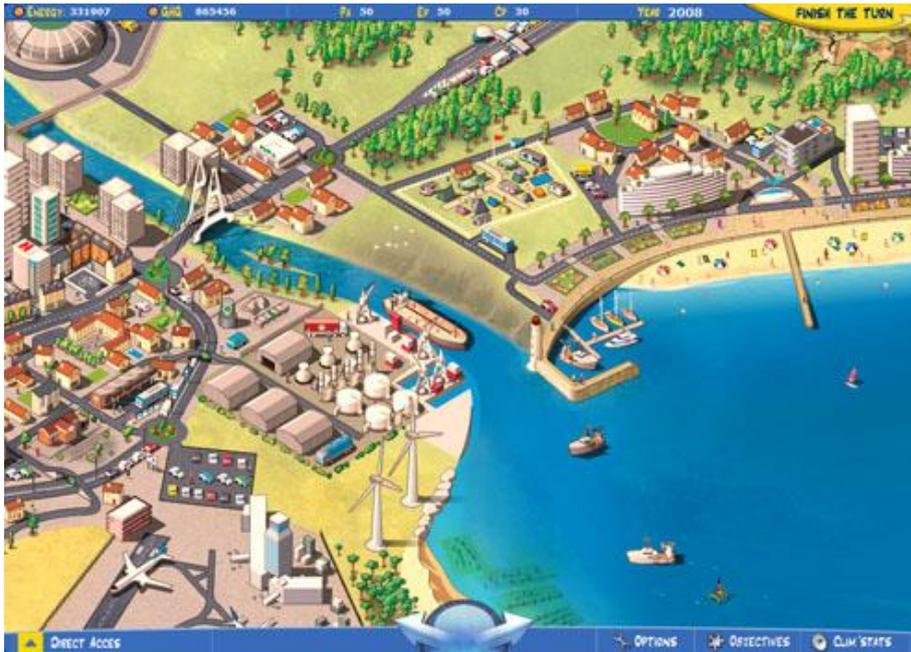
<sup>8</sup> <http://www.climateinteractive.org> (2020-03-12)

<sup>9</sup> <http://keep-cool-mobil.de/> (2020-03-12)

<sup>10</sup> <http://www.gamesforchange.org/game/climate-challenge/> (2020-03-12)

<sup>11</sup> [https://store.steampowered.com/app/48240/Anno\\_2070/](https://store.steampowered.com/app/48240/Anno_2070/) (2020-03-12)

aftermath. For example, high sea levels have already flooded entire cities when the game begins. In *Disaster Detector*<sup>12</sup>, the player must predict natural disasters and take action to save cities. *Future Coast*<sup>13</sup> is a reality game based on interactive storytelling. The players call the virtual Future Coast Hotline and share their version of the climate-changed or non-climate-changed future. These stories can be heard by other players and form interesting narratives.



**Figure 2** Clim'Way<sup>14</sup>

---

<sup>12</sup> <https://ssec.si.edu/disaster-detector> (2020-03-12)

<sup>13</sup> <https://tactica.ca/project/future-coast/> (2020-03-12)

<sup>14</sup> <https://www.ecogamer.org/climate-change/clim-way/> (2020-03-12)



Figure 3 Disaster Detector<sup>15</sup>

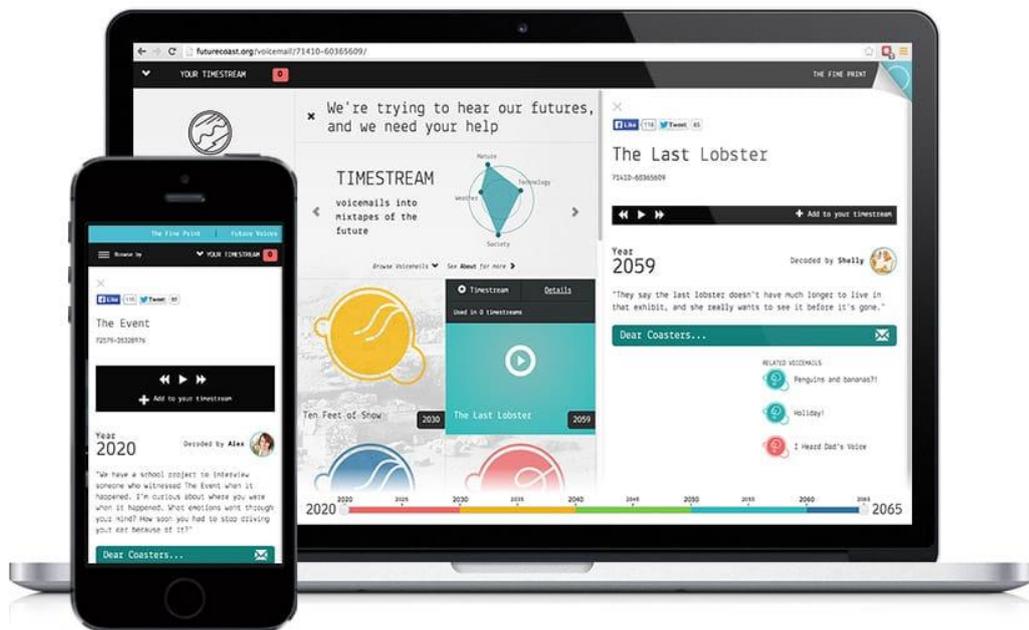


Figure 4 Future Coast<sup>16</sup>

As Fabricatore and López point out, most Educational Games focusing on sustainability are designed specifically for children and official educational purposes, even though adults form

<sup>15</sup> <https://ssec.si.edu/disaster-detector> (2020-03-12)

<sup>16</sup> <https://tactica.ca/project/future-coast/> (2020-03-12)

the largest group of current gamers (ESA 2010). This highlights a neglect of the potential that video games have to increase knowledge and influence attitudes and behaviours towards sustainability. Further, Educational Games lack complexity and, therefore, do not motivate new players. This arises from the fact that these games are often produced by non-profit or state organisations that lack financial resources and market knowledge. The target group is mainly children, and the goal is to successfully integrate the games in daily education. Most games with a Question & Answer scheme are missing important game characteristics which are necessary not only to learn, but also to have fun. The predominant absence of social interactivity is disadvantageous, especially since a complex topic like sustainability calls for collective understanding (Fabricatore & López, 2012).

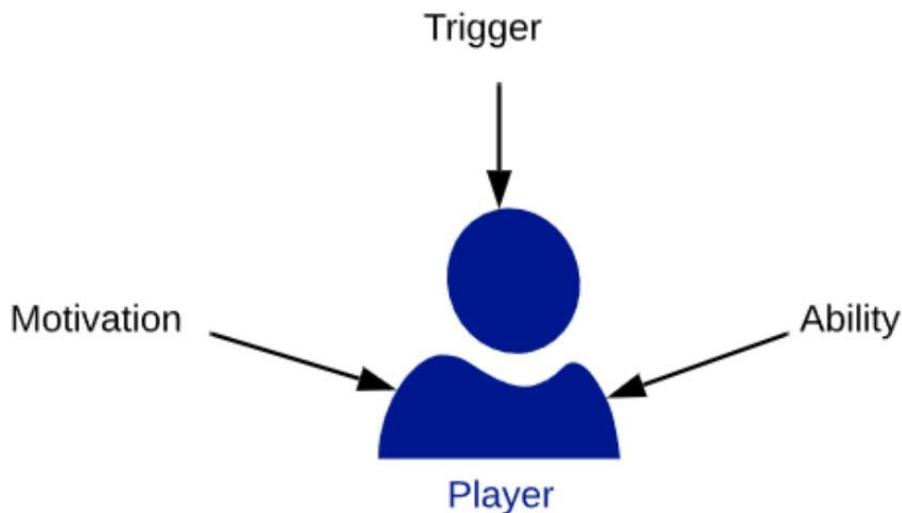
### **3.2.2 The use of persuasive technologies in games**

Technologies can not only be designed to help people who have already decided to change, but also to motivate people who have not yet decided to change (Bhattacharya et al., 2017). Every day, humans are confronted with content made by persuasive computing, also called captology, which is designed to change people's attitudes and behaviours (Davis, 2009). The reason games are a good fundament of persuasion is pointed out by de Kort et al. (2007). Games provide "simulated environments" that give the player the opportunity to discover and explore recent and potential behaviours in relation to their outcomes without having to deal with the consequences. The second advantage of games is the use of operant conditioning. The players' actions are constantly assessed, and they will be rewarded or punished (e.g. losing points or lives) accordingly. Davis (2009), citing Fogg (2003), even addresses computers' special characteristics, which are advantageous for instances of persuasion. Computers have a reputation of being "intelligent and fair". They only do that for which they are programmed, and users can not argue with them as they might with other persuasive instances. Computers, unlike a person, cannot become emotionally affected and will not be held responsible for unethical consequences of their actions. In relation to this, it is important to note that the persuasive system, which could be a device, game, or other media, cannot be seen as a persuader itself due to the fact that the persuasive system does not have the intention to influence the users' attitude or behaviour. The persuasion is done by a person through computer-mediation (Oinas-Kukkonen & Harjumaa, 2008).

Referring to Fogg's (2009) Three Factors of behaviour model (FBM), behaviour depends on three factors. The motivation to perform a certain behaviour and the ability to do so are the first two factors, which trade off (e.g. one has the ability to buy coffee in a reusable cup but lacks motivation). Another example would be a person who is highly motivated to buy a sustainably produced coat but does not have the money for it. Here, the ability is low and the

motivation high. Even if both factors are high, a third factor often decides whether a target behaviour is performed. This is the trigger, also called the prompt, cue, or call to action. As Fogg (2009) points out, the presence as well as the timing of a trigger are vital. While triggers will be covered in chapter 2 and 3, persuasive technologies issue the increase of motivation. People with high ability and low motivation need to increase their motivation in order to perform the target behaviour. The ability, a pre-set factor, is formed from available resources such as time, money, and physical strength (Fogg, 2009).

To produce and increase motivation, Fogg (2009) gives three central motivators. These are Pleasure/Pain, Hope/Fear, and Social Acceptance/Rejection. All the introduced persuasive strategies will address at least one of these motivators.



**Figure 5** The FBM in Gaming

### 3.2.2.1 Principles of persuasive technologies

As Oinas-Kukkonen and Harjuma (2009) remark, there are three postulates referring to the user and how he is perceived to be a target of persuasion. The first postulate, that information is never neutral, shows that persuasion is a constant process that takes place even when unintended.

The second postulate, that people like their views about the world to be organized and consistent, refers to the making of commitments - either privately or publicly. Commitments can help the user maintain their target behaviour. If, for example, users commit to biking to work every day for a week and to log the kilometres on a public platform, they are more likely to stay committed to their goal.

The third postulate, that direct and indirect routes are key persuasion strategies, refers to the fact that the user might detect the persuasive message and evaluate it carefully. Compared to the direct route, persuasion can also follow an indirect path. The direct path has proven to be more successful, because indirect messages could lead to undesired results depending on the background and surroundings that influence the interpretation of the message by an individual.

The fourth postulate states that persuasion is incremental, meaning that persuasive suggestions should be given one at a time (e.g. suggesting the user drink soda only twice a week instead of completely avoiding soda).

The fifth postulate recommends that persuasion through persuasive systems should be open, meaning that the information is based on truthful information and that the creators' message is clear to prevent misguidance of the user. Even when the initial intention of persuasive computing might be good, there is a higher risk of overstepping ethical lines (Davis, 2009). One example is the game *Raft*<sup>17</sup>, in which the player is stuck on a raft in the ocean. In order to build life-sustaining applications (e.g. water filter) the player must retrieve garbage (mostly plastics) from the water. This could be referred to as a minimalistic survival game that teaches the players that they do not need much to survive. Another message that could be perceived by the players is that throwing plastic in the ocean might be good, because someone might be able to use it to survive.

The sixth postulate claims that persuasive systems should aim at unobtrusiveness, which refers to the fact that persuasive messages should be placed in the right moment as well as not distract the users from their main task. For example, players should not be reminded to turn off the lights in a haunted house while he is fighting a killer.

The seventh and last postulate says that persuasive systems should aim to be both useful and easy to use. A persuasive system should, therefore, be free of errors and attract the user (Oinas-Kukkonen & Harjumaa, 2008). Additionally, if players do not feel challenged, discover new elements, or have the opportunity to improve, they will not be motivated to continue playing a game (Fabricatore & López, 2012).

### **3.2.2.2 Overview on primarily used persuasive strategies**

Orji et al. (2014) produced a list of persuasive strategies, nine of which were referred to as the most common. In the following, these main strategies will be the focus.

---

<sup>17</sup> <https://store.steampowered.com/app/648800/Raft/> (2020-03-10)

The first strategy, as stated by Orji et al. (2014), is *Competition*. Users compete with one another while the performance of the desired behaviour decides who is more successful. Another strategy is *Simulation*, which lets the user directly view the "cause-and-effect linkage" of their behaviour. *Suggestion* is a less proactive strategy that will give users hints about what kind of behaviour will lead them to their target. *Praise*, like *Suggestion*, does not force the users to adapt a certain behaviour but rather gives positive feedback on desirable performed behaviour (e.g. using words or sound). *Reward* takes *Praise* a step further and gives virtual rewards when the desired behaviour is performed. *Cooperation* works in games that involve players working with other players or with an AI companion. Players will push each other to perform desirably in order to reach their goal/s collectively. The final strategy, *Personalization*, refers to personalizing any in-game content based on the user's individual preferences and characteristics. Orji et al. (2017) point out that persuasive strategies cause different effects depending on the gamer type. Their study showed that *Reward* as a strategy led to a higher change in attitude, intention, and self-efficiency among achievers than *Competition*, whereas for conquerors, the opposite was the case. In the following, gamer types will not be targeted individually, but rather as a homogenous group. Studies on which strategies should be implemented to reach certain target groups to trigger behaviour change towards sustainability will require further research.

### **3.2.2.3 Design principles for a beneficial use of persuasive strategies**

The persuasive strategies as presented can be supported by using certain design principles. Ionas-Kukkonen and Harjumaa (2008) identify 28 design principles for strategies to create a persuasive effect in a game. Each of these principles is vital to create a persuasive environment. Ionas-Kukkonen and Harjumaa (2008) split the design principles into four groups. The first group refers to principles that support the primary task within the game. This includes *Reduction*, *Tunneling*, *Tailoring*, *Personalization*, *Self-monitoring*, *Simulation*, and *Rehearsal*. While *Reduction* considers how much effort the user must take to perform the target behaviour (minimum effort), *Tunneling* is the option to guide the user through a process and send persuasive messages (e.g. by telling the user why a behaviour like saving energy might be advantageous). *Tailoring* is the principle of providing information with focus on the addressed target group and its needs and characteristics. *Rehearsal* means that the game technology provides a medium through which the behaviour can be practised (e.g. a stepper connected to the Wii in order to practise physical activity). The second group presents design principles regarding dialogue support, or how the game should communicate with the user. These principles are *Praise*, *Reward*, *Reminders*, *Suggestion*, *Similarity*, *Linking*, and *Social Role*. *Linking* means that the users must perceive the system as visually attractive. Additionally, the

users can adapt to a *Social Role*, which the game assigns (e.g. being the hero who saves the world from GCC). The third group refers to the game's credibility. This includes *Trustworthiness*, *Expertise*, *Surface Credibility*, *Real-world Feel*, *Authority*, *Third-party Endorsement* (e.g. a recommendation by a popular gamer), and *Verifiability*. The final principle, *Verifiability*, means that communicated information within the game can be scientifically assured by other sources. In the fourth group, principles regarding Social Support are presented. These are *Social Learning* (e.g. watching others perform a target behaviour), *Social Comparison*, *Normative Influence* (e.g. peer pressure), *Social Facilitation*, *Cooperation*, *Competition*, and *Recognition* (e.g. other people will see how the users managed their resources). These design principles will increase the probability that users will adapt to the target behaviour or even change their attitude. Further, aesthetics play a vital role. Therefore, the visual appearance should be comforting and "attractive to support the user's personal style". This aspect might be challenging to implement in a game environment (Consolvo et al., 2009), but video games, especially as a type of interactive media, increase their influential potential by improving their graphics as well as their freedom to interact on a yearly basis (Konijn, Bijvank, & Bushman, 2007, as cited in Coyne, Warburton, Essig & Stockdale, 2018). Additionally, the technology must be the positive companion of the user. Even through times of less discipline, the technology should support the user. Desired behaviour should be rewarded, and undesired behaviour should be neither rewarded nor punished (Consolvo et al., 2009). As Orji et al. (2017) point out, it is important to mention that the "one-size-fits-all" approach might not work in the area of behaviour change. Factors like age, level of experience, and cultural background can have different effects on behaviour change. This was shown in a study on the game *Smoke?*, a game to help smokers quit and was developed in two versions (for collective and individualist culture). In addition, a study by Berkovsky et al. (2010, as cited in Orji et al., 2017) showed that the adjustment of difficulty based on the physical ability of the user within the game *PLAY, MATE!* led to overall higher activity without a loss of perceived enjoyment.

### **3.3 Contemplation: The pivotal experience and goal setting theory**

A pivotal moment (Bhattacharya et al., 2017) is triggered by one or more pivotal experiences and leads to an immediate change of behaviour. It is a moment of radical change (Grocke, 1999). When aiming to lose weight, this would be the moment when the person starts to eat less or starts doing regular physical exercise. Pivotal experiences can be internal and external. In the case of health behaviour, this could be pain (internal) or a statistic referring to the outcome of recent unhealthy behaviour (external). In the case of climate change, this could

come as the experience of an unbearable heatwave (internal), or as an article about the death of thousands of species (external).

Connected to this is the goal setting theory (Locke & Latham, 1984, 1990a, as cited in Tosi, Locke & Latham, 1991), which is the guideline to the behaviour of all creatures. Goal-oriented actions do not necessarily need to be conscious (e.g. breathing to survive). A goal is the aim of an action that should be reached within a defined time limit (Locke & Latham, 2002).

Compared to other species, human beings have the ability to set goals that require more than one beneficial action and will be reached after an uncertain period of time. Purposefully directed actions will be seen as single behaviours from the outside world, which will be unaware of the person's individual performance goal. People with the same abilities and knowledge might perform differently in school due to differing performance goals (Tosi et al., 1991). When reaching a pivotal moment that leads to immediate change, people set a goal to which the new behaviour should lead.

### **3.4 Preparation and action**

In these stages, the players have learned about the issue and has already decided to change their behaviour. Referring to the FBM (Fogg, 2009), ability and motivation are high, and previous decisions and actions must be permanently reconsidered. In these two stages, a reset of behaviour patterns takes place. To facilitate better understanding, the decision making process will be introduced. Further, Subliminal Priming, which can help the players to stay on track to reach their goals, will be explored. The third trigger component of the FBM will also be introduced.

#### **3.4.1 Decision-making process**

The Dual Process Theory by Kahnemann (2011) states that making a decision happens through two systems that cooperate: the automatic system and the reflective system. The automatic system makes behavioural decisions unconsciously and intuitively. This process is fast and requires little cognitive effort. Decisions are often based on feelings, emotions and associated inferences (e.g. prior experiences). The secondary, slower reflective decision-making process requires greater effort and is knowledge-based. During this process, various pros and cons will be weighed and reflected upon. Typically, the reflective system takes over when the automatic system cannot handle a decision unconsciously (Kahnemann, 2011). An automatic decision would, for example, be deciding how much toilet paper to use. Usually, one does not think about this process and unconsciously performs it. A reflective decision

would take place in the supermarket, where options such as the comfort, price and eco-friendliness of the toilet paper are considered. Of course, nowadays the use of toilet paper might also be considered a reflective decision process in some countries. Due to a high demand and low availability as a consequence of SARS-CoV-2 a more thoughtful, conscious decisions will take place.

Manipulating automatic decisions can be one way to change behaviour. Food served on smaller plates, for example, can lower caloric intake without the person noticing (Adams, Costa, Jung & Choudhury, 2015). Automatic processes are important for saving time in the decision-making process. Reflective processes have the power to overwrite automatic decisions. When buying coffee in a paper cup, one does usually not think about the impact and decides automatically. However, if a person has recently read an article on the emission these cups cause, the reflective system might make the person more aware of the decision-making process, causing the person to reconsider. This would be referred to as Priming (Bargh, Chen & Burrows, 1996). Other possible distractions from automatic decision making in this scenario could be reduced prices for using a reusable cup in combination with reusable cups sold directly in the store. Mechanisms used in the decision process are habits, which are defined as familiar situations that lead to a learned routine. Another mechanism is the intuitive response. This mechanism is activated by less familiar situations, where prior experiences are used as a base. Intuitive responses require focused, conscious calculation to make important decisions and lead to situations that require careful consideration. Another mechanism is the use of heuristics. These also require conscious attention, but they simplify the decision-making process by using shortcuts (e.g. the best gamers are Asian, so all Asian gamers are good). The last mechanism is the active mindset, or self-concept, which is used for ambiguous situations with only a few options (Lee, 2016).

### **3.4.2 Subliminal priming**

As shown in numerous studies, not everyone can rely on self-regulation (Caraban et al., 2017). People tend to abandon certain behaviour when the costs exceed the perceived benefit. Sometimes, this is a result of the benefit not being immediately perceptible. For example, a person biking instead of driving to work will expend more physical effort but will not perceive the reduction of air pollution. Another reason for people to have a relapse is unawareness of sustainable behaviour alternatives. A person that knows about E-Bikes is able to try them, whereas an uninformed person is not. Légal, Chappé, Coiffard and Villard-Forest (2012, as cited in Caraban et al., 2017) say that "implicit suggestions, positive reinforcements, or

nudges" as triggers can help favourable choices prevail in decision-making. An example scenario is a sale sign in a supermarket that slightly pushes a customer to purchase a reduced-cost product. As Caraban et al. (2017) state, another approach is to create tension at decision-making moments by presenting an alternative. For instance, an advertisement for a sustainable alternative may appear while shopping online for a less sustainable product. Even though the decision-making process can be influenced subliminally, the user must also pay attention to the distractions (e.g. sale sign, alternative advertisement) and additionally reflect on the alternatives provided. Various studies have shown that subliminal priming can influence people's behaviours and even attitudes (Caraban et al., 2017). Dijksterhuis (2001) has shown that stimuli connotated with relaxation can lower participants' heart rates and blood pressures. Bargh et al. (1996) primed people with words connected to "old age", which caused them to walk down a corridor more slowly. On one hand, subliminal priming is often researched by considering the way people are exposed to these influences without being able to fight back consciously (e.g. commercials that encourage buying certain products). On the other hand, certain studies show that subliminal priming could have a positive influence on people's behaviour. For instance, Jraidt and Frasson (2010) showed that subliminal priming with words connected to self-efficiency and self-esteem led to a positive impact on problem-solving abilities. Dijksterhuis, Aarts and Smith (2005) indicate that subliminal priming can only have an impact if one's consciousness does not become aware of the priming stimuli. Concerning the field of priming sustainable behaviour, this would not pose a threat to advantageous decision making. Customers who decide to buy a reusable cup could be primed by reading a brochure about pollution from cup production when visiting a coffee shop. If they realize that the store had them read this brochure to make them purchase a reusable cup, they become aware of the manipulation attempt. Instead of rejecting the reusable cup feeling tricked, they might still consider buying the cup in a reflective decision process weighing out their options. Exposure to subliminal priming supports behaviour change and minimizes the risk of relapse (Epstein, Kang, Pina, Fogarty & Munson, 2016). Further, subliminal priming can be used to prime goals (Légal, Chappé, Coiffard & Villad-Forest, 2012), which leads back to the Goal Priming Theory. Strahan, Spencer and Zanna (2002, as cited in Légal et al., 2012) propose that a subliminally perceived message is more persuasive when it responds to active motives or needs. Therefore, the use of subliminal cues can be used in the stage of preparation and action where the player already has the active motive and need to act more sustainably.

### **3.5 Maintenance: Long-term consolidation of sustainable behaviour patterns**

As Bhattacharya et al. (2017) summarize fundamental findings of theories on behaviour change, they present several theories which involve intrinsic and extrinsic motivations that influence behaviour change. Each theory concludes that the process of behaviour change is not a proportional increase and is threatened by relapse or stagnation. As seen in other areas, behaviour-changing technologies do have an impact, but the behaviour-changing process rarely lasts for an extended time period. As Karapanos (2015) mentions, over a third of users of commercial fitness trackers abandon them within the first six months.

#### **3.5.1 Forming procedural and cognitive constructs and change of attitude**

The use of media has been linked to a variety of positive and negative results. Media supports cognitive developments and fine motor skills (Green & Bavelier, 2006, as cited in Coyne et al., 2018). Further, it can serve as a basis for prosocial behaviour (Greitemeyer & Mügge, 2014). Media content has been found to be a model for prosocial behaviour (Coyne et al., 2018). Violence (Anderson et al., 2003, as cited in Coyne et al., 2018) and risky behaviour (Klein et al., 2013, as cited in Coyne et al., 2018) are negatively associated outcomes of media use. It has been shown that video games can especially influence perceptual and cognitive constructs, such as normative beliefs (Greitemeyer & Mügge, 2014), views on aggressive behaviour, and stereotypes. An example from Saleem and Anderson (2013) shows that Arabs in video games are often depicted as terrorists, which leads to negative perception of Arabs as a whole. A wide variety of video games require proactive aggression to reach a goal (Dodge & Coie, 1987, as cited in Verheijen, et al., 2019). According to Greitemeyer and Mügge (2014), the influence of video games on emotional constructs can lead to "desensitization to aggression" as well as "trait anger" and ultimately lead to a fundamental change of personality features in the long term. Steadily being exposed to certain behaviours, beliefs, and attitudes can cause change. In the case of violent games, moral standards (e.g. helping others in need) will be affected, as they might not be advantageous and will be accepted by others (Coyne et al., 2018). In Grand Theft Auto, for example, non-social behaviours are rewarded (Coyne et al., 2018). This leads to violent video games not only increasing violent behaviour of a player, but also to decreasing social behaviour (Coyne et al., 2018). The use of persuasive systems can lead to strengthened attitudes and/or behaviours, therefore making them more resistant to changes as well as to being changed or formed (Oinas-Kukkonen

& Harjumaa, 2008). The process of forming attitudes requires careful consideration of involved elements until the attitude is set (Figueiredo & Paiva, 2011). The influence of video games on procedural and cognitive constructs as well as attitudes has been researched widely in connection with violent and prosocial behaviour. It has been shown that video games do cause change. This paper focuses on how we can use the influence of video games on players' attitudes and procedural and cognitive constructs in order to change their behaviour in the long term.

### 3.6 Games and sustainability

Because it is not possible or beneficial to list all non-educational games that relate to GCC, only insights into well-known games that deal with the topic will be given. To discover more games, I utilized crowdsourcing on Reddit, an American discussion website. I posted in the subreddit r/EnvironmentalEngineer. The full thread from Reddit can be found in the appendix (Page 34). Games that deal with sustainability and/or resource consumption – topics this paper addresses and that are connected to GCC - are, for instance, *Stardew Valley*<sup>18</sup>, *Sim Park*<sup>19</sup>, *Sims 4* (off-grid mode)<sup>20</sup>, *Sim City*<sup>21</sup>, *The Universim*<sup>22</sup>, *Eco*<sup>23</sup>, *Empyrion*<sup>24</sup>, *Skylines*<sup>25</sup>, *Minecraft*<sup>26</sup>, *Settlers of Catan*<sup>27</sup>, *Tropico 5*<sup>28</sup>, *Don't Starve*<sup>29</sup>, *Anno 2070*<sup>30</sup>, *Fallout*<sup>31</sup> and *Raft*<sup>32</sup>.

*Eco* is a visually appealing simulation game which simulates even the smallest details of existing ecosystems. The player must oversee the economy and manage resources carefully all while focusing on the environment. One action can lead to chaos (butterfly-effect) and destroy entire ecosystems. The relationships between resources, nature, and economy are made comprehensible and presented in a realistic way.

---

<sup>18</sup> <https://www.stardewvalley.net/> (2020-04-01)

<sup>19</sup> <https://en.wikipedia.org/wiki/SimPark> (2020-04-01)

<sup>20</sup> <https://simscommunity.info/2017/09/24/the-sims-4-off-the-grid-challenge/> (2020-04-01)

<sup>21</sup> <https://www.ea.com/de-de/games/simcity> (2020-04-01)

<sup>22</sup> [https://store.steampowered.com/app/352720/The\\_Universim/](https://store.steampowered.com/app/352720/The_Universim/) (2020-04-01)

<sup>23</sup> <https://store.steampowered.com/app/382310/Eco/> (2020-04-01)

<sup>24</sup> [https://store.steampowered.com/app/383120/Empyrion\\_\\_Galactic\\_Survival/](https://store.steampowered.com/app/383120/Empyrion__Galactic_Survival/) (2020-04-01)

<sup>25</sup> [https://store.steampowered.com/app/255710/Cities\\_Skylines/](https://store.steampowered.com/app/255710/Cities_Skylines/) (2020-04-01)

<sup>26</sup> <https://www.minecraft.net/de-de/> (2020-04-01)

<sup>27</sup> [https://store.steampowered.com/app/544730/Catan\\_Universe/](https://store.steampowered.com/app/544730/Catan_Universe/) (2020-04-01)

<sup>28</sup> [https://store.steampowered.com/app/245620/Tropico\\_5/](https://store.steampowered.com/app/245620/Tropico_5/) (2020-04-01)

<sup>29</sup> [https://store.steampowered.com/app/219740/Dont\\_Starve/](https://store.steampowered.com/app/219740/Dont_Starve/) (2020-04-01)

<sup>30</sup> [https://store.steampowered.com/app/48240/Anno\\_2070/](https://store.steampowered.com/app/48240/Anno_2070/) (2020-04-01)

<sup>31</sup> <https://store.steampowered.com/agecheck/app/38400/> (2020-04-01)

<sup>32</sup> <https://store.steampowered.com/app/648800/Raft/> (2020-04-01)



**Figure 6 Eco**<sup>33</sup>

The *Sims 4* off-the-grid mode offers Sims players a whole new experience. This mode takes their 21st century characters off their land to live in a tribe where they cannot buy groceries or use technology or electricity. This game gives players the option to simulate what it would be like to dispense certain comforts like candy, fast food, phones, fashionable clothes or even lighting. This provides an opportunity to learn about alternative ways of living using resources and consumption.



**Figure 7 Sims 4 off-grid mode**<sup>34</sup>

<sup>33</sup> <https://store.steampowered.com/app/382310/Eco/> (2020-04-01)

<sup>34</sup> <https://simsvip.com/2019/06/04/build-with-me-off-the-grid-home/> (2020-04-01)

Most of these games are considered Simulation Games. They ask the player to manage resources and focus on strategic consumption. Some games have an educational touch, and some are even classified as Education Games, teaching the player about global relations and production. Games that start with a post-apocalyptic setting might have a persuasive quality to make the player more aware of the possible outcome of GCC. Sims 4 or Stardew Valley contain ideas for users on how to lead a sustainable life. However, most games do not exceed the precontemplation stage. The purpose of this paper is not to persuade readers that games should be more about sustainability, but rather to show that small integrations in well-known games can support the process of influencing players' behaviours to be more environmentally friendly.

## 4 Method

In order to study the potential of video games for behaviour change towards more sustainability, a method had to be found that could cope with the uncertainty and unpredictability of this undertaking. The method called scenario thinking (or scenario planning) presents one of the most complex approaches (Grunwald, 2002, as cited in Kosow & Gaßner, 2008). The term scenario describes "a description of a possible future situation (conceptual future)" (Kosow & Gaßner, 2008). Greeuw et al. (2007) refer to scenarios as the most effective tool to "broaden perspectives, raise questions and challenge conventional thinking". Scenarios as research tools can help users discover surprising developments (Ramirez, Mukherjee, Vezzoli & Kramer, 2015) and help identify future research needs (Thompson et al., 2012, Öborn et al., 2013, as cited in Ramirez et al., 2015). The scenarios created through scenario thinking in this paper are normative scenarios with a strategy development function. They will be used to predict methods that will encourage gamers to behave more sustainably by developing possible functions that can be strategically implemented in well-known video games. To make use of qualitative scenarios, a creative-narrative scenario technique will be deployed (Kosow & Gaßner, 2008). This technique is characterized by less formalization, and the focus lies on the particular process examined rather than its specific outcome. The scenarios present potentialities with roots in the present reality (existing video games) and draw attention to desired developments (implementation of triggers for a change of behaviour towards more sustainability). The narrative component leads to a fictitious literary shape (Kosow & Gaßner, 2008). When creating the scenarios, the structure used is based on the guidelines of creating Value Scenarios as proposed by Nathan, Klasnja and Friedman (2007). Value Scenarios help envision the potential of futuristic persuasive technological systems. Predefined elements will be studied step-by-step. These are direct and indirect stakeholders, persuasiveness, long-

and short-term effects, systemic effects (cultural, psychological, for society and environment), and value implications (evaluating possible negative consequences). Table 1 shows an overview of the created scenarios and their integration within the TTM.

Scenario	Stage of TTM	Discussed Theory	Scenario	Game
1	Precontemplation	Education through Games	Post-apocalyptic world turns green	<i>Fallout 4</i> <sup>35</sup>
2	Precontemplation	Persuasive Strategy - Reward	Environmental trophies	<i>Gone Home</i> <sup>36</sup>
3	Precontemplation	Persuasive Strategy - Cooperation	Eco-friendly Partner	<i>Bioshock Infinite</i> <sup>37</sup>
4	Precontemplation	Persuasive Strategy - Competition	Protecting nature while driving	<i>Dirt Rally 2.0</i> <sup>38</sup>
5	Action	Subliminal Priming / Decision Making Process	Use of reusable cups	<i>GTA</i> <sup>39</sup>
6	Maintenance	Change in attitude	Riding bikes	<i>GTA</i>
7	Maintenance	Forming procedural and cognitive constructs	Hidden trophies	<i>inFAMOUS Second Son</i> <sup>40</sup>

**Table 1** Scenarios

<sup>35</sup> [https://store.steampowered.com/app/377160/Fallout\\_4/](https://store.steampowered.com/app/377160/Fallout_4/) (2020-04-03)

<sup>36</sup> [https://store.steampowered.com/app/232430/Gone\\_Home/](https://store.steampowered.com/app/232430/Gone_Home/) (2020-04-03)

<sup>37</sup> <https://2k.com/en-US/game/bioshock-infinite/> (2020-04-03)

<sup>38</sup> [https://store.steampowered.com/app/690790/DiRT\\_Rally\\_20/](https://store.steampowered.com/app/690790/DiRT_Rally_20/) (2020-04-03)

<sup>39</sup> <https://www.rockstargames.com/grandtheftauto/> (2020-04-03)

<sup>40</sup> <https://www.playstation.com/en-us/games/infamous-second-son-ps4/> (2020-04-03)

## 5 Results

### Scenario 1

**Description:** In *Fallout 4*, the players play as a man who emerges from a nuclear fallout shelter. After the man's son is kidnapped, the players are given the mission to find him. The environment in *Fallout* looks dry, sad, and destroyed. A possible feature would be a game environment that evolves over time. For example, flowers could start growing and trees could start to look healthy again. The nature would return visually as the game progressed.

**Stakeholder:** The players who detect the change of nature around them and the developers.

**Persuasiveness:** The simulation of the recovering nature educates the players on what a world could look like without the influence of humans and how nature can recover once we let it.

**Long- and short-term effects:** Immediately after playing, the player might perceive the world differently and start to wonder what nature and abandoned places might look like when humans were gone. This knowledge is not directly connected to behaviour cues. This addresses the first stage of change.

**Systemic effects:** The player might pay more attention to nature around him.

**Value implications:** The integration of this strategy is an expensive and difficult approach from a developer's point of view that comes with the risk of the player not even noticing the change of nature.

### Scenario 2

**Description:** *Gone Home* is an Exploration Game in first person perspective. The players are the main character, a girl that returns to her family home and finds everyone gone. She explores what happened in the lives of family members while she was gone. In the simulated 90s style house, the players are met with a high degree of freedom. They can open almost every drawer, turn on and off lights, and even flush the toilet. *Gone Home* could implement an environmental trophy option. Actions like flushing the toilet when unnecessary or leaving lights on when leaving a room will decide whether the users receives the trophy, and the players will constantly be reminded of its existence.

**Stakeholders:** Direct stakeholders are the players, who can choose how sustainable their gaming style is. Indirect stakeholders are the developers.

**Persuasiveness:** This scenario uses the persuasive strategy of giving a Reward when the desired behaviour is performed.

**Long- and short-term effects:** Players will be made aware of the existence of the trophy. If they decide to act sustainably in order to receive a reward, some players might maintain the behaviour throughout the game. Some players might get annoyed by turning off lights each time they leave a room and will lose interest. This reflects on their attitude towards sustainability in real life.

**Systemic effects:** The best case would be that players translate the sustainable behaviour from the game into the out-of-game world. The behaviour learned in the game might form new procedural constructs (e.g. it becomes a habit to turn off lights when leaving a room). Sustainable behaviour might further be perceived as advantageous, leading to later rewards.

**Value implications:** The implementation of this option will cause additional time and money costs for the creators, which will not be reciprocated by higher monetary profit. Players might feel annoyed by the requirements for getting the trophy and even more disappointed once they give up. These negative emotions might be directed towards the game.

### Scenario 3

**Description:** In BioShock, the protagonist and private investigator, Booker DeWitt, has to save 19 to 20-year-old Elizabeth who has been held captive in Columbia. Elizabeth is the protagonist's AI-based companion for a certain amount of time. She is guarded by her only friend, Songbird, a monstrous, winged creature. Being smart and close to non-human creatures, Elizabeth could be used as a role model for sustainable behaviour, making the players aware of undesired behaviour and using dialogue to state her point of view.

**Stakeholder:** The players and the developers.

**Persuasiveness:** Elizabeth, as the companion of the players, cooperates with them and sends persuasive messages through direct dialogue.

**Long- and short-term effects:** The player may initially ignore comments on sustainability but might remember them for a longer period of time and take them into account.

**Systemic effects:** Implementing eco-focused characters in games might create a new, positive image of certain groups that are stereotyped in the real world (e.g. vegetarians).

**Value implications:** The opinions will be forced on the players even if they do not want to hear them. Elizabeth might be perceived as annoying.

## Scenario 4

**Description:** Dirt Rally 2.0 is a car racing game where the players race through natural terrain. A tree, when destroyed in a car crash, can cause an estimated 15.000€ fine for the driver<sup>41</sup>, even if he ends up dead. In Dirt Rally 2.0, trees and other plants do not matter to this extent. To change this, the players could receive penalties (e.g. having their best race cars taken away temporarily) for damaging nature.

**Stakeholder:** The players being punished as well as the developers adding this option.

**Persuasiveness:** Taking away the players best race cars will cause them to fall behind their competitors. Their competitiveness will lead to more careful driving in order to protect the environment.

**Long- and short-term effects:** In the long term, the users might become better at driving and more careful than before.

**Systemic effects:** The users might value trees and other plants more and tend to protect them in the out-of-game world.

**Value implications:** The players could get annoyed by these rules. Some players enjoy crashing into trees and making compilations of it.



**Figure 8** Dirt Rally 2.0 car crash<sup>42</sup>

<sup>41</sup> <https://www.zeit.de/1978/45/was-kostet-ein-zerstoerter-baum> (2020-04-05)

<sup>42</sup> <https://www.youtube.com/watch?v=TWyTr63QVSY> (2020-04-05)

## Scenario 5

**Description:** GTA offers players the option to buy coffee in one of the coffee shop's chains (e.g. Cool Beans). These are usually purchased to-go because the player is always on the go. Offering players the option to buy a reusable cup and add it to their inventory is an option.

**Stakeholder:** The players who can decide whether to get a reusable cup or dispense coffee completely and the developers.

**Persuasiveness:** This implementation is referred to as subliminal priming. The next time the players are about to purchase a to-go coffee, they might have the situation in mind.

**Long- and short-term effects:** At first, the users might perceive it as a joke but, in the long term, become used to this standard and carry their reusable cups in the game.

**Systemic effects:** Due to the fact that GTA gamers will communicate about this change and the issue of non-reusable cups, the image of reusable cups will improve. Even video game protagonists use reusable cups now.

**Value implications:** The players might just shoot the owner of the coffee shop or perceive this change as annoying.



**Figure 9** GTA coffee shop<sup>43</sup>

---

<sup>43</sup> <https://www.gta5-mods.com/scripts/coffee-shops> (2020-04-05)

## Scenario 6

**Description:** GTA is already promoting BMX bike riding. Bikes are indestructible and the player can do stunts as well as improve after practice. For short distances, the use of bikes can be advantageous when taking shortcuts through the parks. Biking could be more actively promoted by equipping bikes with radios and by having bike riding improve the players health status.

**Stakeholder:** The players already accept bikes and will like the improvements.

**Persuasiveness:** Bikes have advantages that cars do not have. Cars might have a cool image, but bikes can become the new subject of desire.

**Long- and short-term effects:** In the long term, improvements to bikes might lead to higher use.

**Systemic effects:** The image of bikes will be improved. This could cause younger people to relate bikes with stereotypes initially related to cars.

**Value implications:** The players will not care more about the bikes, because they will not match their need.

## Scenario 7

**Description:** inFAMOUS Second Son is an adventure game where the gamer plays as a boy born with superhuman abilities. Superhumans are hunted in this world. The players can take actions and can observe the consequences of their actions. A hidden environmental trophy could be implemented in the game (e.g. kicking over a trashcan causes negative points). The users do know that there is a trophy and will not be made aware of actions that have an impact on the score.

**Stakeholder:** The players who need to be aware of their actions and the creators of the game.

**Persuasiveness:** The players must constantly be aware of acting sustainably. This will form new procedural and cognitive constructs over time.

**Long- and short-term effects:** In the short term, the users might forget to act desirably. If more games implemented hidden environmental trophies, gamers might unconsciously start to act sustainably.

**Systemic effects:** Over time, users are conditioned to behave sustainably. Performing certain behaviours in games will become new standards. This change in behaviour might be

translated into the real world. Further, users will have to make assumptions about what they consider to be sustainable. A higher cognitive effort leads to higher maintenance of new behaviour patterns.

**Value implications:** The users might not care about the trophy or take any consequences into account. Furthermore, players might not know how to perform sustainably and will not have a chance to receive the trophy.

## 6 Discussion

As can be seen from the various scenarios, there are ways to implement strategies for behaviour change in well-known video games. The games do not necessarily need to focus on the topic of sustainability, but small integrations of functions can support behaviour changes in all stages of the TTM. On the contrary, the implementation of these features generates extra costs as well as design and development time. While the game production industry is already facing harsh critiques on wages and working conditions, expecting the integration of altruistic strategies that lead to no monetary profit is hopeful. Further, it would have to be assumed that game producers feel responsible or have the motivation to implement these solutions in order to change their customers environmental behaviour. On the market this is barely an ethical concern, but more of an economic decision.

The question then becomes whether the industry forms the players or the players form the industry. When presented with sustainable strategies, whether proactive or passive, gamers might turn against them and gravitate to different games. The addressed target group is vital in the fight against GCC. On one hand, they are one of the main factors causing GCC but also the ones who bear the consequences. Experiencing every day, real-life problems through media might make gamers reject an otherwise perfect game. Forcing them to deal with these problems in their safe zone might turn some away. The goal is not only to demonstrate that the problem exists, as is done with existing games (e.g. *Eco*) that just simulate the world as it is, but to offer them help through conscious or unconscious guidance. The presented technologies can help people perform their desired behaviours, as shown previously in other areas (e.g. physical exercise, healthy eating, quit smoking). Implementing solutions to help users face GCC, their role in it, and ways to tackle it are more complex in the field of sustainable behaviour because the problem is not an individual issue. The effects of one individual's effort can barely be detected, especially not immediately. Sticking to principles and theories discussed in this paper, it might be possible to help a defined group of people

change. There will be an estimated 2725 million video gamers worldwide in 2021<sup>44</sup>. If the implementation of behaviour-changing strategies concerning plastic cups as shown in scenario 5 could change the behaviours of merely 1% of all gamers (27.250.000 gamers), this would have a significant impact. Here, an example<sup>45</sup>:

*16 billion cups used annually / 7.8 billion people on earth<sup>46</sup> = 2 cups per person annually*

*6.5 million trees used for paper cups every year / 16 billion cups used annually = 4.0625e-7 trees per cup*

*27.250.000 gamers (1% of total) \* 2 cups annually per person = 54500000 cups saved total*

*54500000 cups saved \* 4.0625e-7 trees used per cup = 20.1896 trees that can be saved*

These, of course, are hypothetical numbers. The effectiveness of a game regarding behaviour change can be measured by how successfully it educates its users and how likely it is to trigger a behaviour change and raises awareness (Buschet al., 2015, as cited in Orji, et al., 2017). Future research could attempt to implement the suggested solutions into games and measure their effectiveness. Still, the presented numbers give hope and provide a new approach for a solution in the fight against GCC.

## 7 Conclusion

This paper gave an overview regarding solutions for the implementation of behaviour change towards a more sustainable market through Educational and Simulation Games. Further, it explained the TTM and vital underlying theories that should be kept in mind when implementing these strategies. There is not yet proof that these strategies will have a positive impact, but with millions of gamers operating their gaming PCs for several hours a day, it is crucial to realize that this is a fundamental target group that contributes to ongoing GCC and its consequences. Video games as persuasive technology could provide a solution to motivate consumers to act more environmentally friendly. As shown changing peoples' behaviours or even attitudes is a process and not a simple one. To get from the point of ignorance to little changes in every day actions takes more than just statistics on temperature changes on the news. As can be reflected in how the world deals with ongoing GCC the message of what is to come has not settled yet. There are people being aware of GCC and there are people that are ready to change. Still, they are either overwhelmed or just do not know how to act appropriately.

---

<sup>44</sup> <https://www.statista.com/statistics/748044/number-video-gamers-world/> (2020-04-05)

<sup>45</sup> Numbers retrieved from <https://www.greenmatch.co.uk/blog/2015/06/the-effects-of-paper-coffee-cups-on-the-environment> (2020-04-05)

<sup>46</sup> <https://www.worldometers.info/world-population/> (2020-04-05)

Video games have the power unlike other forms of media to pick us up from any state of change and provide the solutions and guidance we need in a way we understand. Video games are fun and educational. They do not necessarily confront us with a problem but make it possible to play with it and have fun while we cope with it.

This paper showed that it is justifiable to assume that video games are a powerful tool that can be used to trigger a behaviour change towards more sustainability. To confirm this assumption, however, further research is required. Further studies could implement some of the here presented scenarios in the mentioned game titles and use quantitative methods to measure the effect. E.g. one could measure the use of non-reusable coffee cups before and after playing scenario 5. How do the different scenarios affect the gamer? In what stage of the TTM is which scenario most effective? This will also show whether the strategies as presented in this paper were placed in the right phase of the TTM. Additionally, the current state of the gaming world in regards of GCC could be examined. Are people who play video games either the same, more or less environmentally friendly than the average person? What are the reasons? Research could take a closer look at ongoing developments in the gaming industry. Another interesting question would be to lay focus on different types of gamers and research how various gamer types will respond to different implemented strategies. Furthermore, the market and its openness towards solutions regarding GCC could be examined.

All in all, these scenarios are just a drop in the ocean of what is possible in the gaming world in order to use video games for behaviour change towards a sustainable lifestyle. It could be shown that video games have an impact on the gamers' behaviours a long time ago. We now must use this fact as an advantage. Video games can make the world a better place and this paper provides first underlying theories, design principles and ideas on how to fight GCC by using them.

## Bibliography and list of primary sources

- Adams, A. T., Costa, J., Jung, M. F., & Choudhury, T. (2015). Mindless computing: Designing technologies to subtly influence behavior. *UbiComp 2015 - Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing*, (September), 719–730. <https://doi.org/10.1145/2750858.2805843>
- Bargh, J. A., Chen, M., & Burrows, L. (1996). Automaticity of social behavior: Direct effects of trait construct and stereotype activation on action. *Journal of Personality and Social Psychology*, 71(2), 230–244. <https://doi.org/10.1037/0022-3514.71.2.230>
- Bhattacharya, A., Kolovson, S., Sung, Y. C., Eacker, M., Chen, M., Munson, S. A., & Kientz, J. A. (2018). Understanding pivotal experiences in behavior change for the design of technologies for personal wellbeing. *Journal of Biomedical Informatics*, 79(January), 129–142. <https://doi.org/10.1016/j.jbi.2018.01.002>
- Boykoff, M. T. (2008). Lost in translation? United States television news coverage of anthropogenic climate change, 1995-2004. *Climatic Change*, 86(1–2), 1–11. <https://doi.org/10.1007/s10584-007-9299-3>
- Campbell, T., Ngo, B., & Fogarty, J. (2008). Game design principles in everyday fitness applications. *Proceedings of the ACM Conference on Computer Supported Cooperative Work, CSCW*, 249–252. <https://doi.org/10.1145/1460563.1460603>
- Caraban, A., Karapanos, E., Teixeira, V., Munson, S., & Campos, P. (2017). On the Design of Subly: Instilling Behavior Change During Web Surfing Through Subliminal Priming. 163-174. 10.1007/978-3-319-55134-0\_13.
- Chaubey, D., & Kandpal, B. (2017). A Study of Impression Management Techniques Applied By Academicians In Select Educational Institutions Of Dehradun. *Uttaranchal Business Review*, 7(August), 9–20. Retrieved from [https://www.researchgate.net/publication/319164392\\_A\\_STUDY\\_OF\\_IMPRESSION\\_MANAGEMENT\\_TECHNIQUES\\_APPLIED\\_BY\\_ACADEMICIANS\\_IN\\_SELECT\\_EDUCATIONAL\\_INSTITUTIONS\\_OF\\_DEHRADUN](https://www.researchgate.net/publication/319164392_A_STUDY_OF_IMPRESSION_MANAGEMENT_TECHNIQUES_APPLIED_BY_ACADEMICIANS_IN_SELECT_EDUCATIONAL_INSTITUTIONS_OF_DEHRADUN)
- Consolvo, S., McDonald, D. W., & Landay, J. A. (2009). Theory-driven design strategies for technologies that support behavior change in everyday life. *Conference on Human Factors in Computing Systems - Proceedings*, 405–414. <https://doi.org/10.1145/1518701.1518766>
- Coyne, S. M., Warburton, W. A., Essig, L. W., & Stockdale, L. A. (2018). Violent video games, externalizing behavior, and prosocial behavior: A five-year longitudinal study during adolescence. *Developmental Psychology*, 54(10), 1868–1880. <https://doi.org/10.1037/dev0000574>
- Davis, J. (2009). Design methods for ethical persuasive computing. *ACM International Conference Proceeding Series*, 350. <https://doi.org/10.1145/1541948.1541957>
- de Kort, Y., IJsselstein, W., Midden, C. J. H., Eggen, B., & Fogg, B. J. (2007). Persuasive Technology - Second International Conference on Persuasive Technology, PERSUASIVE 2007 Palo Alto, CA, USA, April 26-27, 2007 Revised Selected Papers. *New York*, 3962(2), 1–10. <https://doi.org/10.1007/11755494>

- De Marchi, E., Cavaliere, A., Bacenetti, J., Milani, F., Pigliafreddo, S., & Banterle, A. (2019). Can consumer food choices contribute to reduce environmental impact? The case of cisgenic apples. *Science of the Total Environment*, 681, 155–162. <https://doi.org/10.1016/j.scitotenv.2019.05.119>
- Dijksterhuis, A.: Unconscious relaxation: the influence of subliminal priming on heart rate (2001)
- Dijksterhuis, A., Aarts, H., & Smith, P. K. (2005). The power of the subliminal: Subliminal perception and possible applications. In R. Hassin, J. Uleman, & J. A. Bargh (Eds.), *The new unconscious* (pp. 77–106). New York, NY: Oxford University Press.
- Epstein, D. A., Kang, J. H., Pina, L. R., Fogarty, J., & Munson, S. A. (2016). Reconsidering the Device in the Drawer: Lapses as a Design Opportunity in Personal Informatics. *Proceedings of the ... ACM International Conference on Ubiquitous Computing . UbiComp (Conference), 2016*, 829–840. <https://doi.org/10.1145/2971648.2971656>
- Evans, G. W. (2019). Projected Behavioral Impacts of Global Climate Change. *Annual Review of Psychology*, 70(1), 449–474. <https://doi.org/10.1146/annurev-psych-010418-103023>
- Fabricatore, C., & López, X. (2012). Sustainability Learning through Gaming, an exploratory study, Fabricatore & Lopez, 2012. *Journal of E-Learning*, 10, 209–222.
- Figueiredo, R., & Paiva, A. (2011). Persu - An architecture to apply persuasion in interactive storytelling. *ACM International Conference Proceeding Series*. <https://doi.org/10.1145/2071423.2071468>
- Flannery, T. (2006) *The weathermakers: how man is changing the climate and what it means for life on earth*. Atlantic Monthly Press, New York
- Fogg, B. (2009). A behavior model for persuasive design. *ACM International Conference Proceeding Series*, 350. <https://doi.org/10.1145/1541948.1541999>
- Galea, S., Nandi, A., & Vlahov, D. (2005). The epidemiology of post-traumatic stress disorder after disasters. *Epidemiologic Reviews*, 27, 78–91. <https://doi.org/10.1093/epi-rev/mxi003>
- Greitemeyer, T., & Mügge, D. O. (2014). Video Games Do Affect Social Outcomes: A Meta-Analytic Review of the Effects of Violent and Prosocial Video Game Play. *Personality and Social Psychology Bulletin*, 40(5), 578–589. <https://doi.org/10.1177/0146167213520459>
- Grimes, A., Bednar, M., Bolter, J.D., Grinter, R.E., EatWell: sharing nutrition-related memories in a low-income community, in: *Proceedings of the 2008 ACM Conference on Computer Supported Cooperative Work*, 2008 November 8, ACM, 2008, pp. 87–96.
- Goos, G., Hartmanis, J., Van, J., Board, L. E., Hutchison, D., Kanade, T., Weikum, G. (2013). *Persuasion Technology*. (April). <https://doi.org/10.1007/978-3-642-37157-8>

- Groce, D. E. (1999). A Phenomenological Study of Pivotal Moments in Guided Imagery and Music (GIM) Therapy. Retrieved from [https://pdfs.semanticscholar.org/2c01/c350654fe3bda45f019c708bc89dc2ced8a9.pdf?\\_ga=2.56676258.906246032.1585320117-1295024746.1580636957](https://pdfs.semanticscholar.org/2c01/c350654fe3bda45f019c708bc89dc2ced8a9.pdf?_ga=2.56676258.906246032.1585320117-1295024746.1580636957)
- Greeuw, S. C. H. et al. (2000). *Cloudy Crystal Balls: An assessment of recent European and global Scenario studies and Models*, Copenhagen: European Environment Agency (Environmental issues series 17)
- Jraidi, I. & Frasson, C.: Subliminally enhancing self-esteem: impact on learner performance and affective state. In: Alevén, V., Kay, J., Mostow, J. (eds.) ITS 2010. LNCS, vol. 6095, pp. 11–20. Springer, Heidelberg (2010). doi:10.1007/978-3-642-13437-1\_2
- Kahneman, D. (2011). *Thinking, Fast and Slow*. London: Macmillan.
- Karapanos, E. (2015). Sustaining user engagement with behavior-change tools. *Interactions*, 22(4), 48–52. <https://doi.org/10.1145/2775388>
- Karl, T. R., & Trenberth, K. E. (2003). Modern Global Climate Change. *Science*, 302(5651), 1719–1723. <https://doi.org/10.1126/science.1090228>
- Kelly, S., & Nardi, B. (2014). Playing with sustainability: Using video games to simulate futures of scarcity. *First Monday*, 19(5). <https://doi.org/10.5210/fm.v19i5.5259>
- Kosow, H., & Gaßner, R. (2008). *Methods of Future and Scenario Analysis - Overview, assessment, and selection criteria*. [https://doi.org/ISBN 978-3-88985-375-2](https://doi.org/ISBN%20978-3-88985-375-2)
- Joongsup Lee. (2016). A study for increasing reusable and personal cup consumption in the coffee industry - Focused on behavior change with motivation -. *Journal of Korea Design Forum*, null(53), 327–340. <https://doi.org/10.21326/ksdt.2016>
- Légal, J. B., Chappé, J., Coiffard, V., & Villard-Forest, A. (2012). Don't you know that you want to trust me? Subliminal goal priming and persuasion. *Journal of Experimental Social Psychology*, 48(1), 358–360. <https://doi.org/10.1016/j.jesp.2011.06.006>
- Lenhart, B. Y. A., Smith, A., Anderson, M., Duggan, M., & Perrin, A. (2015). Teens, Technology & Friendships: Video games, social media and mobile phones play an integral role in how teens meet and interact with friends. *Pew Research Center's Internet & American Life Project*, 1–76. Retrieved from <http://www.pewinternet.org/2015/08/06/teens-technology-and-friendships/>
- Locke, E. A., & Latham, G. P. (2002). Building a practically useful theory of goal setting and task motivation: A 35-year odyssey. *American Psychologist*, 57(9), 705–717. <https://doi.org/10.1037/0003-066X.57.9.705>
- Miller, M., & Jehle, A. (2012). Cognitive Dissonance Theory. *Encyclopedia of Human Behavior: Second Edition*, (January), 543–549. <https://doi.org/10.1016/B978-0-12-375000-6.00097-5>
- Nathan, L. P., Klasnja, P. V., & Friedman, B. (2007). Value scenarios: A technique for envisioning systemic effects of new technologies. *Conference on Human Factors in Computing Systems - Proceedings*, 2585–2590. <https://doi.org/10.1145/1240866.1241046>

- Oakley, I., Chen, M., Nisi, v. (2008). Motivating Sustainable Behavior. *Workshop Proceedings of UbiComp 2008*, (January). Retrieved from [http://www.whereveriam.org/work/UMa/MotivatingSustainableBehaviour\\_Oakley\\_Nisi\\_Chen\\_v1.2.pdf](http://www.whereveriam.org/work/UMa/MotivatingSustainableBehaviour_Oakley_Nisi_Chen_v1.2.pdf)
- Oinas-Kukkonen, H., & Harjumaa, M. (2008). A systematic framework for designing and evaluating persuasive systems. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, 5033 LNCS, 164–176. <https://doi.org/10.1007/978-3-540-68504-3-15>
- Oinas-Kukkonen, H., & Harjumaa, M. (2009). Persuasive systems design: Key issues, process model, and system features. *Communications of the Association for Information Systems*, 24(1), 485–500. <https://doi.org/10.17705/1CAIS.02428>
- Orji, R., Mandryk, R. L., & Vassileva, J. (2017). Improving the Efficacy of Games for Change Using. *ACM Transactions on Computer-Human Interaction*, 24(5). <https://doi.org/10.1145/3119929>
- Postmes, T., Rabinovich, A., Morton, T., & van Zomeren, M. (2013). Toward sustainable social identities: Including our collective future into the self-concept. *Encouraging Sustainable Behavior: Psychology and the Environment*, (May 2014), 185–202. <https://doi.org/10.4324/9780203141182>
- Prochaska, J. O., & Velicer, W. F. (1997). The transtheoretical model of health behavior change. *American Journal of Health Promotion*, 12(1), 38–48. <https://doi.org/10.4278/0890-1171-12.1.38>
- Ramirez, R., Mukherjee, M., Vezzoli, S., & Kramer, A. M. (2015). Scenarios as a scholarly methodology to produce “interesting research.” *Futures*, 71, 70–87. <https://doi.org/10.1016/j.futures.2015.06.006>
- Richter, A. (2010). *Klassifikation von Computerspielen*. Retrieved from <https://publishup.uni-portsdam.de/opus4-ubp/frontdoor/deliver/index/docId/4662/file/digarec05.pdf>
- Saad L. 2017. Global warming concern at three-decade high in U.S. Gallup, March 14. <http://news.gallup.com/poll/206030/global-warming-concern-three-decade-high.aspx>
- Saleem, M., & Anderson, C. A. (2013). Arabs as terrorists: Effects of stereotypes within violent contexts on attitudes, perceptions, and affect. *Psychology of Violence*, 3, 84-99.
- Sipos, Y., Battisti, B., & Grimm, K. (2008). Achieving transformative sustainability learning: Engaging head, hands and heart. *International Journal of Sustainability in Higher Education*, 9(1), 68–86. <https://doi.org/10.1108/14676370810842193>
- Soon, W., Baliunas, S., Idso, C., Idso, S., & Legates, D. R. (2003). Reconstructing Climatic and Environmental Changes of the Past 1000 Years: A Reappraisal. *Energy & Environment*, 14(2–3), 233–296. <https://doi.org/10.1260/095830503765184619>
- Staniford, A. K., Dollard, M. F., & Guerin, B. (2009). Stress and help-seeking for drought-stricken citrus growers in the Riverland of South Australia. *Australian Journal of Rural Health*, 17(3), 147–154. <https://doi.org/10.1111/j.1440-1584.2009.01059.x>

- Tosi, H. L., Locke, E. A., & Latham, G. P. (1991). A Theory of Goal Setting and Task Performance. *The Academy of Management Review*, 16(2), 480. <https://doi.org/10.2307/258875>
- Verheijen, G. P., Burk, W. J., Stoltz, S. E. M. J., Van Den Berg, Y. H. M., & Cillessen, A. H. N. (2019). Associations between Different Aspects of Video Game Play Behavior and Adolescent Adjustment. *Journal of Media Psychology*. <https://doi.org/10.1027/1864-1105/a000253>
- Whirley Drink Works (2002). Did you know?. *Dayton State College Education Files*. Retrieved from [https://www.daytonastate.edu/green/files/ChoosetoReusePresentation\\_1512430.pdf](https://www.daytonastate.edu/green/files/ChoosetoReusePresentation_1512430.pdf)
- Williamson, K., Satre-Meloy, A., Velasco, K., & Green, K. (2018). Climate Change Needs Behavior Change. *Yale Program on Climate Change Communication*. Retrieved from <http://climatecommunication.yale.edu/news-events/climate-change-needs-behavior-change/>
- Wu, J. S., & Lee, J. J. (2015). Climate change games as tools for education and engagement. *Nature Climate Change*, 5(5), 413–418. <https://doi.org/10.1038/nclimate2566>

## Appendix



Posted by u/MilenaClara 1 day ago

### Games for Sustainability

Looking for games that changed your attitude and/or behavior to live more sustainable. Not Educational Games that are all about sustainability, just common fun games that do that on the side. Any recommendations? (e.g. Raft)

6 Comments Share Edit Post Save Hide ...

76% Upvoted



LunaNouveau 1 point · 1 day ago

Can you explain more about your paper?

Reply Give Award Share Report Save



MilenaClara 1 point · 9 minutes ago



Sure! I am studying Game Design and did psychology before. I am now doing research on how one could implement triggers for behavior change in common games. There are educational games, but they are very boring. It is more about small details, that won't distract the user but form her/his attitude. E.g. in GTA you can get plastic cups from the coffeshop. One could replace them by a reusable ones, the player has to carry. Players could get climate trophees etc. I am now trying to find out if games already came up with solutions for this.

Reply Share Save Edit ...

#### Antwort auf Post: Games for Sustainability



von /u/jackrobertwillamson über /r/EnvironmentalEngineer gesendet um vor 1 Tag

Can't say I had anything that changed my opinion personally, as I came to be interested in sustainability on my own, but here are some games that I know do have themes of sustainability in them. Keep in mind some of these may be early access and still a work in progress:

Any sim game:

- Sim city - pollution and treatment are a big part of some newer versions
- The Universim - allows you to expand sustainably, with certain benefits, or not

Any tycoon game:

- Theme park tycoon, zoo tycoon, etc - requires resource management and placement of certain components in order to successfully expand and keep customers/animals happy

Any survival game:

- Eco - the whole concept of the game is sustainability
- Empyrion galactic survival - has a neat solar system generator, complete with planetary ecosystem construction tools, based on temperature and humidity, and overall requires you to wisely manage your resources as a player, advancing technology as you go. Resources also don't regenerate, so once you deplete an area, you need to keep exploring to find more.

Kontext Vollständige Kommentare (6) Melden User Blockieren Als Ungelesen Markieren Antworten

**Antwort auf Post: Games for Sustainability**

von [/u/LunaNouveau](#) über [/r/EnvironmentalEngineer](#) gesendet um vor 1 Monat

Stardew Valley is a big one, you live on a farm and transform the entire town by growing crops, appeasing the spirits of the forest, gathering materials to make tools and clothing, etc. The life you live is wholesome and fulfilling, and like most people who play it makes me want to grow my own food and live more simply.

A deeper cut would be Sim Park, a Maxis game from the 90s. You play as a park ranger and work to make your park biodiverse so that the food chain runs efficiently. When introducing people to make more money for the park, you have to do so in a way that keeps the animals safe, as well as having enough trash cans around that the park isn't full of litter. There is some educational component, where you learn how to identify plants and animals, but the overall goal is to transform the land into a beautiful and self-sustaining system.

The Sims 4 has a mode to go off-the grid, and a lot of people enjoy building a life away from electricity and with very little resources, often by farming their own food and crafting their own furniture and other necessities. There is also a 'conservationist' career where you work to preserve and maintain the ocean and and wildlife of Sulani Island.

Kontext [Vollständige Kommentare \(9\)](#) [Melden](#) [User Blockieren](#) [Als Ungelesen Markieren](#) [Antworten](#)

**Antwort auf Post: Games for Sustainability**

von [/u/JaxRayne](#) über [/r/EnvironmentalEngineer](#) gesendet um vor 1 Tag

Cities: Skylines has a good amount of sustainability like water pollution, air pollution, recycling, etc. It's a city building game. Once you add the DLC/Mods they can really expand the green/sustainability part.

Also, to some degree, Minecraft. Your resources are limited (In the sense of staying in one area). For renewable items like wood, crops, etc, you have to make sure you're sustainable with your consumption and renewal.

Kontext [Vollständige Kommentare \(6\)](#) [Melden](#) [User Blockieren](#) [Als Ungelesen Markieren](#) [Antworten](#)

**Antwort auf Post: Games for Sustainability**

von [/u/Smartville](#) über [/r/Eco](#) gesendet um vor 1 Tag

Don't step on the lava. j/k j/k

I already had it but Settlers of Catan has been fun but you need 4 people to play.

Kontext [Vollständige Kommentare \(1\)](#) [Melden](#) [User Blockieren](#) [Als Ungelesen Markieren](#) [Antworten](#)

**Antwort auf Post: Games for Sustainability**

von [/u/LunaNouveau](#) über [/r/EnvironmentalEngineer](#) gesendet um vor 10 Stunden

Hey! I just wanted to add that the Sims 4 is coming out with a new "Eco Lifestyle" pack that is all about recycling, composting, windmills, solar panels, etc. The goal is to start off with a smoggy dirty trash town and convince everyone to be more eco-conscious and green. It could be relevant down the line for your research :)

Kontext [Vollständige Kommentare \(9\)](#) [Melden](#) [User Blockieren](#) [Antworten](#)

**Antwort auf Post: Games for Sustainability**

von [/u/NomNomMeatballBanned](#) über [/r/Eco](#) gesendet um vor 21 Tagen

The game eco

Kontext [Vollständige Kommentare \(2\)](#) [Melden](#) [User Blockieren](#) [Antworten](#)