Evaluating behavioural change interventions for climate change adaptation in the field: implementation, barriers, and opportunities

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CLIMATE CAMPUS

1. Introduction

Climate change will increase the frequency and severity of natural hazards such as heatwaves, floods, and droughts. To reduce the impacts of such hazards, societies need to adapt to the consequences of climate change. Adapting to climate change is a key objective for governments, from the international to the local level. Business also need to take measures to protect their operations against climate disruptions. An often overlooked player in climate change adaptation are individuals and households. Yet, individuals and households also have a key role to play in making societies climate-resilient. For example, individual homeowners can reduce urban heat island effects by installing green roofs and reducing the amount of stone or concrete in their garden.

Despite the urgency of climate change, many individuals are not yet implementing climate-adaptive measures. Governments are therefore looking for ways to motivate individuals and households to adapt. While information-based campaigns that emphasize the risks of climate change are easy to design and distribute, they are often insufficient to motivate large scale behavioural change amongst citizens. Even if such communications are received by the target groups as intended, there can be many other barriers that hinder people from taking adaptive measures. For example, people may not know which adaptive behaviours they can implement, or they may think the measures are too expensive.

Governments are also exploring alternative ways to motivate adaptation behaviour amongst individuals and households. For example, many local governments offer subsidies to reimburse the financial costs of adaptation measures such as green roofs. To ensure that such campaigns are actually effective in promoting adaptation, it is important that they are properly evaluated. Yet, designing and implementing procedures to evaluate behavioural change campaigns can be difficult. For example, which behavioural barriers are addressed by the campaign? How do we know if the campaign had its intended effect? How can we measure the psychological effects of the campaign? What kind of data and how much data do we need to make a reliable assessment?

The aim of this report is to demonstrate how the evaluate of behavioural change campaigns to promote adaptation behaviour can be implemented in practice. Moreover, we will also demonstrate the difficulties of performing a successful evaluation. This report describes the evaluation of two campaigns implemented by the municipality of Zwolle to promote adaptation behaviour amongst its citizens. Both of these interventions were based on the strategy of ‘gamification’: promoting engagement and behavioural change via games. The interventions consisted of an escape room and an online virtual gardening game.

These interventions are developed by the municipality of Zwolle, co-financed by CATCH (Water sensitive Cities: the Answer To CHallenges of extreme weather events), an Interreg North Sea Region project funded by the European Union. CATCH is a collaboration of 7 European cities that pilot innovations for climate change adaptation. These pilots are aimed at generating key insights for European

partners in Belgium, England, Denmark, Sweden, Germany, and other interested parties.

The evaluation of these interventions was conducted in collaboration with Anne van Valkengoed, an environmental psychologists at the University of Groningen. She is researching the psychological factors that motivate people to adapt to climate change. More details of her research can be found here and here.

This report is structured as follows. We first describe the escape room intervention, its evaluation procedure, and preliminary results. We repeat this structure for the online virtual gardening game. We then reflect on the implications and lessons learned from both interventions, and end this report with a conclusion and recommendations for evaluating behaviour change interventions in practice.

2. Intervention 1: Escape Room (“Adapt or BTrapped”)

2.1. The intervention

This intervention consisted of a physical escape room built into a trailer (see Figure 1). Players step into the world of 2050. The effects of climate change are unprecedented. Players watch a video, in which they receive the instructions from the mayor of Zwolle Peter Snijders to escape to the ‘Safe-zones’. Players can achieve this goal by solving the puzzles in the escape room within 20 minutes. The puzzles show possible consequences of climate change in the city of Zwolle, what the city may look like in the future, and examples of adaptation behaviours that people could also implement in real life. A full description of the escape room can be read here.

Figure 1.The Adapt or BTrapped escape room.

2.2. The evaluation procedure

The aim of this intervention is that during the game, players are confronted in a visceral way with the possible future consequences of climate change, which should increase their awareness of the negative consequences of climate change in general, but should also make them aware of their own risk of being affected by extreme weather events. Moreover, players are also shown different ways of adapting to climate change, which should increase their knowledge about adaptation, their sense of self-efficacy (i.e., whether they feel capable of adapting to climate change), and the perceived effectiveness of adaptation measures. Ultimately, participating in the escape room should motivate participants to take measures themselves to adapt to climate change.

To evaluate whether this intervention was effective, participants completed a pre and a post measure. Both the pre and the post measure consisted of the same 12 questions about the perceived consequences of climate change (4 items), risk perception of extreme weather events (4 items), knowledge about adaptation (1 item), perceived self-efficacy of adaptation (1 item), perceived effectiveness of

adaptation actions (1 item), and finally intentions to take adaptation measures (1 item). For the full list of items, see Appendix A.

The pre-measure was completed online when participants signed up to participate in the escape room. The post measure was completed directly after participants completed the escape room using an iPad. We expected that respondents would score higher on the questions on the post measure (i.e., after participating in the escape room).

2.3. The results

A total of 19 respondents completed both the pre- and the post measure. Most participants completed the pre-measure at home when they signed up for the escape room, but five of the respondents completed the pre-measure immediately before participating in the escape room. We examined whether participants indeed scored higher on the questions after they completed the escape room by comparing their pre and post scores.

For the four questions about the perceived consequences of climate change, there was little difference between the pre- and post-measure. Most respondents did not change their view of the consequences of climate change after participating in the escape room.

With regard to the perception of risks, participants generally saw a higher perceived *likelihood* of being affected by extreme weather events after participating in the escape room (See Figure 1). Specifically, 11 out of 19 participants reported a higher likelihood of experiencing negative health consequences due to extreme weather events, while just 2 participants reported a lower likelihood (Figure 2).

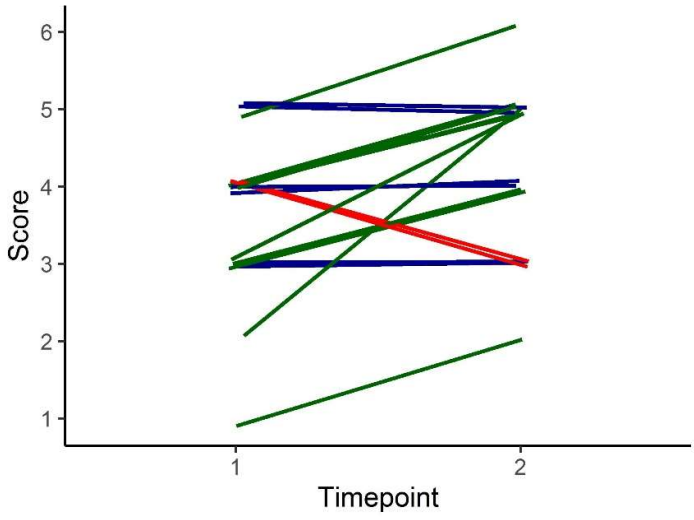

Figure 2. Changes in score for individual respondents (each represented by one line) on the item on the perceived likelihood of experiencing negative health impacts caused by extreme weather events. Timepoint 1 indicates the respondents' answers before participating in the escape room. Timepoint 2 indicates the respondents' answers after participating in the escape room. A higher score indicates a higher perceived likelihood of experiencing negative health impacts due to extreme weather.

A green line indicates a higher perceived likelihood after playing the escape room, a red line indicates a lower perceived likelihood, a blue line indicates no change.

Similarly, 10 participants reported a higher likelihood of experiencing damages to their private property by extreme weather events after participating in the escape room, while 6 participants reported a lower likely. There was no clear change in the perceived *severity* of extreme weather events.

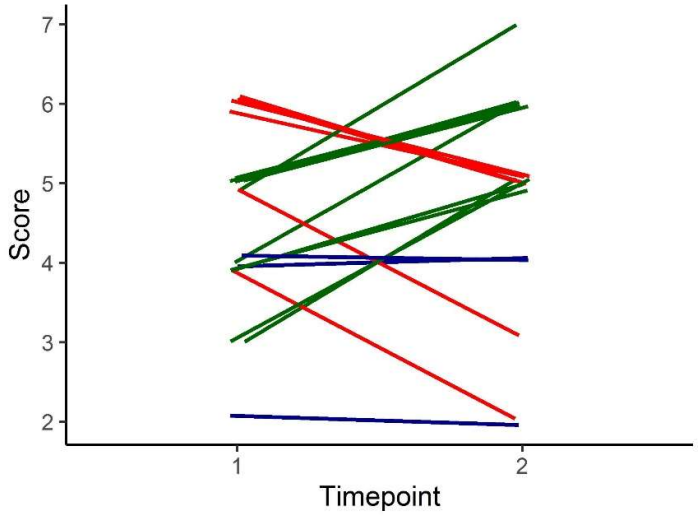

Figure 3. Changes in score for individual respondents (each represented by one line) on the item on the perceived likelihood of experiencing damages to their private property by extreme weather events. Timepoint 1 indicates the respondents' answers before participating in the escape room. Timepoint 2 indicates the respondents' answers after participating in the escape room. A higher score indicates a higher perceived likelihood of experiencing damages to their private property by extreme weather events. A green line indicates a higher perceived likelihood after playing the escape room, a red line indicates a lower perceived likelihood, a blue line indicates no change.

Half of the respondents (9 out of 18, 1 participant did not fill out this item), reported that they had more knowledge about which measures to take after participating in the escape room, while just 2 participants reported a decrease in knowledge. We did not see a clear change in the perceived effectiveness of measures, the perceived sense of self-efficacy to implement measures, nor the intentions to take measures, after playing the escape room.

3. Intervention 2: Virtual gardening game (“Garden Battle”

3.1. The intervention

This interventions consists of a ‘serious game’ that is played online on a computer via a web browser, which is similar to ‘SIM City’ and takes place in a virtual version of the city of Zwolle (see Figure 2). The game challenges citizens to make their garden, neighbourhoods, and city greener and to make more space for (rain)water. In the game, players can ‘claim’ their garden and virtually fill in the land plot with garden elements, such as shrubs, grass, stones, rain barrels, or ponds. Players are challenged to design their ‘dream garden’, or to experiment with how different elements may look during different extreme weather events (heavy rainfall, heat, and drought). Players can also claim parts of the public space in the city and design a new layout for these areas. The game will calculate how climate adaptive the designed garden is, taking into account elements such as rainwater retention and percentage of shade. The players with the highest score on their dream gardens were rewarded with prizes. For the design for public spaces, prizes could be won by gathering the most “likes” on a curated Facebook page. A full description of the Garden Battle can be read here.

Figure 4. An example of a garden designed in the Garden Battle Game.

3.2. The evaluation procedure

The aim of this game is to show respondents in an intuitive fashion how their garden can be made more climate adaptive. Because the program calculates and

communicates a ‘climate adaptation’ score, players can learn how adaptive (or not) their garden currently is. Moreover, respondents can also learn how they can make their gardens more climate adaptive, as they can experiment with removing or adding different elements to their garden and seeing how this affects the climate adaptation score. This should help players to determine which actions they can best take to make their garden more adaptive.

The evaluation plan again consists of two measurements. Respondents complete the same questionnaire as used in for the escape room evaluation (see section 2.2.) before they played the garden battle for the first time. After a period of a few weeks, they again filled in both the questionnaire and recreate the layout of their garden at two time points (April 2021 and the current moment, June 2021) This would allow us to examine whether 1) how the garden changed over time 2) whether this was accompanied by a change in different psychological variables. We expect that, after playing the game for the first time, respondents will be motivated to change their garden in real life. We expect to see this change when respondents play the game for the second time and upload the new layout of their garden, which should be more climate adaptive than before.

Additionally, we also compared the questionnaire scores of the participants who played the game to a control group who were not exposed to the intervention. By doing so, we can test whether people who chose to play the game may already have been strongly interested in the topic of climate change adaptation, or whether this group is more representative of the general public. The control group consists of 300 respondents that were contacted by the municipality of Zwolle and who filled out the questionnaire online.

3.3. The results

There was an insufficient number of players who filled in the questionnaire at both time points. It was therefore not possible to compare whether participants who played the game actually changed their opinion on any of the items we included over time. There were 16 players who completed the game twice, once showing the layout of their garden at the start of the spring season (April 2021) and once showing the layout of their garden at the end of spring (June 2021). The results showed that the garden layouts in June generally had a higher climate adaptation score than the garden layouts from April. The gardens significantly improved on all separate aspects that together make up the overall climate adaptation score (such as amount of shadow), except for water retention capabilities (see Figure 5). Out of 16 players, 10 players increased their climate adaptation score in the second measurement, while 4 players had the same score across both measurements, and 2 respondents had a lower score at the second measurement.

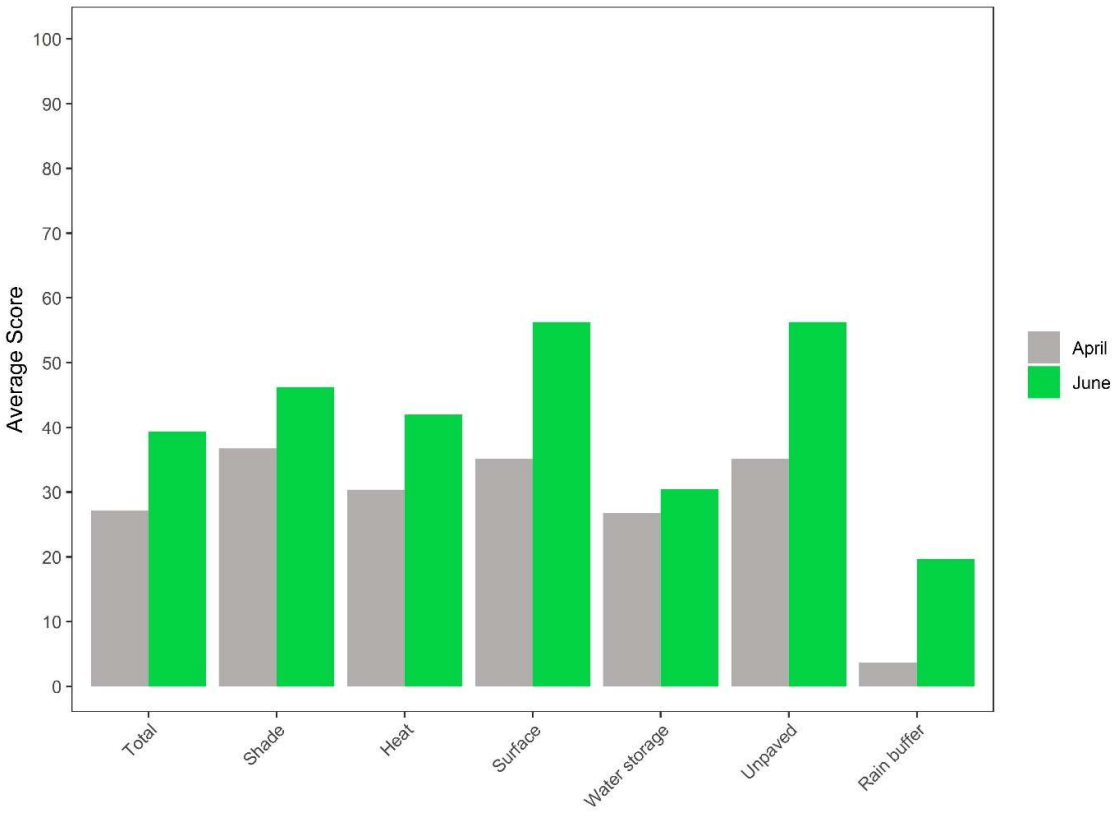

Figure 5. Differences in the total climate adaptation scores and separate elements between the garden layout in April and the garden layout in June.

The players of the game generally scored higher on all items included in the survey compared to the control group consisting of members of the general public, who did not participate in the intervention. The players agreed more that climate change would have negative consequences, that it would occur locally, and that they are worried about climate change. The players perceived a higher likelihood and severity of the risks of extreme weather event. The players also generally indicated that they perceived measures to adapt to climate change as more effective, that they perceived themselves as more capable of implementing these measures, and that they possessed the required knowledge to implement these measures. Lastly, they were also more motivated to take measures to adapt to climate change (see Figure 6).

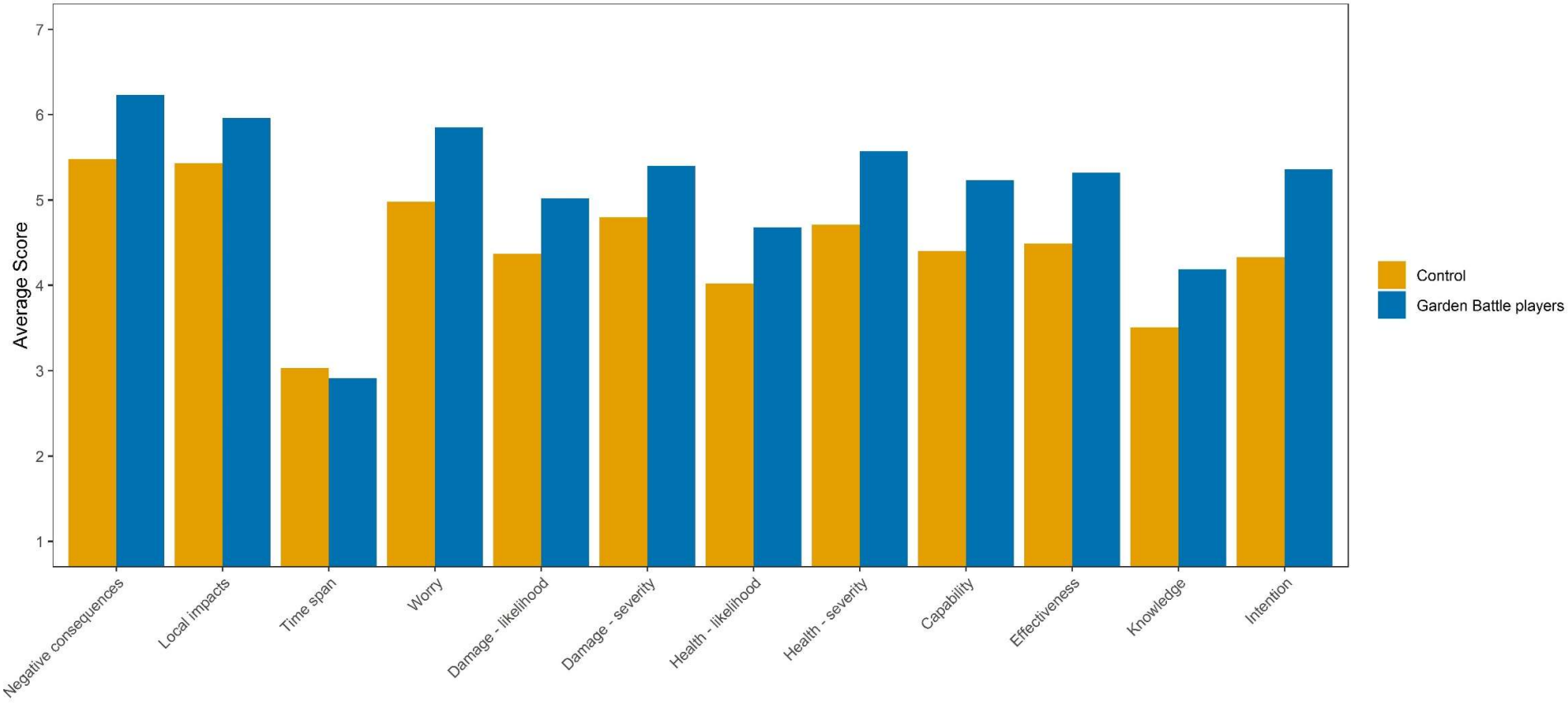

Figure 6. Comparison between Garden Battle players and participants from a control group who did not participate in the Garden Battle game, on the 12 items on climate change, risk perception, and climate change adaptation (see Appendix 1 for the exact items).

Importantly, this is based primarily on data gathered from the players during the first measurement. This indicates that the game primarily attracted players who were already interested in the topic of climate change and adaptation, and were therefore not representative of the general public. Because we did not have enough players who completed the questionnaire before and after playing the game, we cannot say whether the game also directly increased perceptions of climate change, extreme weather, or adaptation measures.

Players could also fill out their ‘dream garden’ in the game. A total of 251 dream gardens were recorded in the game. The results showed that the dream gardens were mostly similar in their climate adaptation score compared to the real gardens entered into the game by players. There was however a big difference on the “water storage” variable; players’ dream gardens had a significantly higher capability of storing excess rainwater compared to real gardens entered into the game (see Figure 7)

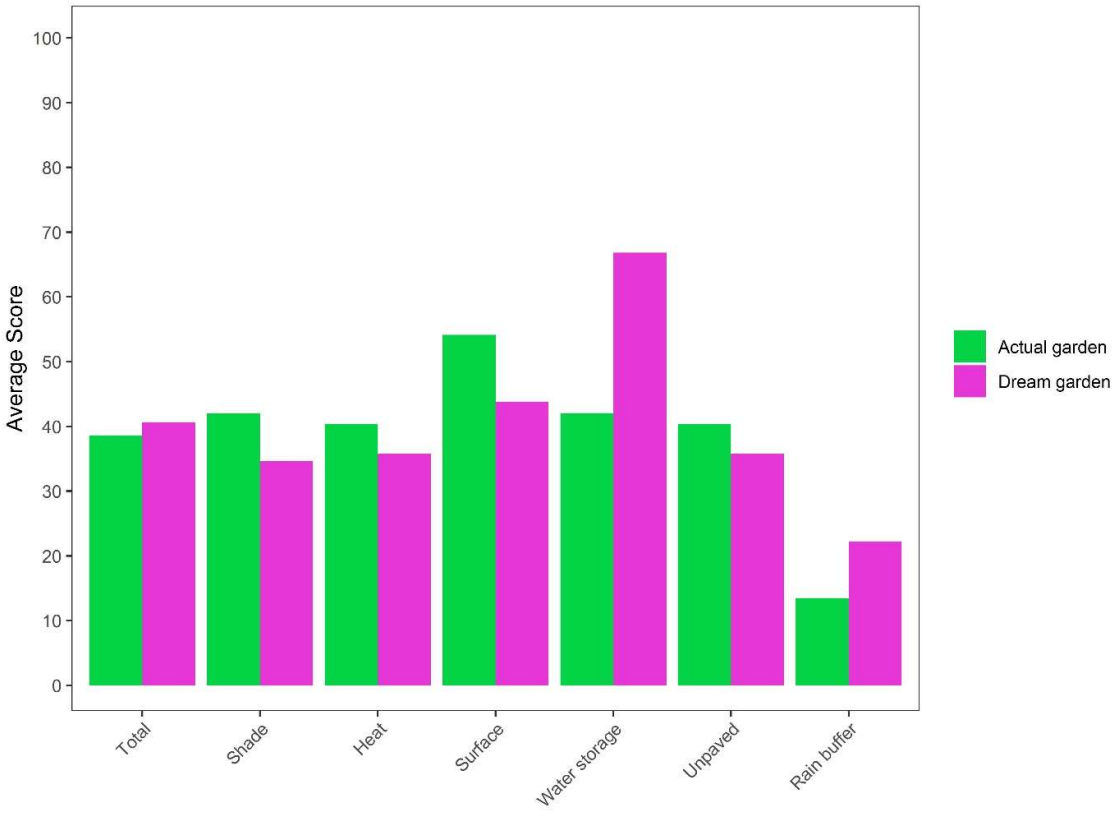

Figure 7. Differences in the total climate adaptation scores and separate elements between actual gardens entered into the game and players’ dream garden designs.

4. Reflection and conclusion

In this report, we have described two attempts to evaluate the effectiveness of interventions to motivate adaptation behaviour. These attempts showcase the steps that are involved in designing an effective evaluation. First, it must be determined what the outcomes are that the intervention aims to address. These outcomes are often not only behavioural, but also psychological. Next, it needs to be determined how these outcomes can be reliably assessed. In the current case, we for example used questionnaire studies to examine different psychological outcomes. The interventions itself can then be implemented, and it is important to ensure that a sufficient amount of data is collected. This usually involves a pre- and post-test (before and after the interventions), but a control group is sometimes also necessary to rule out alternative explanations. Lastly, statistical analyses can be performed to analyse the data and see if intervention had its intended effect.

In both cases, some preliminary insights about the effect of the interventions could be gleaned from the results. However, neither evaluation could offer conclusive evidence about whether the interventions were successful in reaching their goals. The primary barrier to drawing more substantive conclusions was in both cases the number of respondents that participated in the evaluation. In order to examine whether there are statistically significant differences on any questionnaire scores before and after people participate in an intervention, it is necessary that a relatively large group of people complete the evaluation.

The number of people that is required to conduct an evaluation varies from intervention to intervention, depending on whether a big or small effect is expected. In general, between 100 to 300 people may be required to participate in the intervention and complete the evaluation to be able to conduct reliable statistical analyses. If a control condition is also required, this may require again between 100 and 300 people. Yet, motivating people to participate in the evaluate can be a challenge, especially if respondents have to complete a questionnaire twice or more. Offering respondents incentives for participating may be one way to overcome this challenge.

Overall, we have shown that conducting an evaluation of a behavioural intervention is an involved processes akin to how scientific studies are conducted. There are many different decisions that need to be considered in order to implement an evaluation (e.g. How do I measure my outcomes? How can I reach participants? How many people need to participate? and many more). Each intervention is also unique, and will therefore require a custom evaluation plan. A collaboration with experts in (environmental) psychology is therefore highly recommended when designing and performing an evaluation of an intervention. In general, practitioners should keep in mind that performing a successful evaluation of a behavioural change intervention is a challenging task that can demand substantial resources in terms of time, expertise, and finances.

Even though evaluations can be difficult and time consuming, they can simultaneously be tremendously valuable for practitioners and scientists alike.

practitioners want to know whether the interventions they are implementing are indeed effective at achieving the goals for which it was initially design. If evaluations of existing interventions are carefully documented, this can also be an invaluable sources of information for other practitioners that may want to implement a similar type of intervention. Limited budgets for climate change adaptation campaigns can in this way be used most efficiently, without practitioners having to reinvent the wheel. At the same time, field interventions often offer a unique opportunity for behavioural scientists to tests theories or hypotheses in the field in an experimental setting. This can offer valuable data on the causality of certain relationships, and can test whether research findings also hold outside of the lab.

In conclusion, properly evaluating behaviour change interventions is a challenging endeavour that requires both expertise and considerable resources. Yet, evaluations also offer practical and scientific knowledge, and is critical to designing effective interventions to accelerate adaptation behaviour across societies. Scaling up knowledge on effective evaluations is therefore of critical importance, as well as encouraging further collaborations between practitioners and scientists to maximize the effectiveness of evaluations and behavioural change interventions to promote adaptation behaviour. In the future, we therefore hope to continue the data collection on the interventions presented here, in order to reach more definitive conclusions on the effectiveness of these interventions.

Appendix A

Questionnaire used to evaluate both interventions

Climate change perceptions (4 items)

1. Climate change will have serious negative consequences
2. Climate change will influence my local area
3. It will be a long time before the consequences of climate change are felt
4. I am worried about climate change

Response scale: 1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = neither agree nor disagree, 5 = somewhat agree 6 = agree, 7 = strongly agree.

Risk perception (4 items)

1. I think damage to my home, garden, possesions, and direct environment caused by extreme weather is …

Extremely unlikely	1	2	3	4	5	6	7	*Extremely likely*
Not at all severe	1	2	3	4	5	6	7	*Very severe*

2. I think negative consequences for my health and wellbeing, or the health and wellbeing of my familymember caused by extreme weather is …

Extremely unlikely	1	2	3	4	5	6	7	*Extremely likely*
Not at all severe	1	2	3	4	5	6	7	*Very severe*

Climate change adaptation (4 items)

1. I think I am capable of taking measures to avoid or reduce the impacts of extreme weather
2. If I take measures, this will be effective in avoiding or reduce the impacts of extreme weather
3. I have the required knowledge to take measures to avoid or reduce the impacts of extreme weather
4. I am planning to take measures to avoid or reduce the impacts of extreme weather.

Response scale: 1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = neither agree nor disagree, 5 = somewhat agree 6 = agree, 7 = strongly agree.