# Greening gardens in Leiden: The influence of attitudes towards greening and perceived individual impact on residents' garden greening behavior

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## Abstract

The municipality of Leiden aims to stimulate the greening behavior of residents with a private garden, which for example reduces CO2-emissions. Previous research implicates that the extent to which people feel that their garden makes a difference (i.e., perceived individual impact) could influence garden greening behavior. This effect was expected to be mediated by attitudes towards greening, which is defined as a settled way of thinking or feeling about greening. An online survey amongst residents of Leiden ($N$ = 142) indicated an indirect positive influence of perceived individual impact on garden greening behavior, through attitudes towards greening. People who perceive their greening behavior as impactful did not perform more garden greening behavior, which indicates the absence of a direct effect. Nonetheless, this study provides insights in ways to influence garden greening behavior, directly through attitudes towards greening and indirectly through perceived individual impact.

## Introduction

The municipality of Leiden has the goal to make Leiden more green. Greening urban areas in Leiden can have many advantages, such as the reduction of CO2-emissions (Thornbush, 2015; Kuronuma et al., 2018). Urban agriculture namely provides a buffer for pollution and improves environmental health and well-being (Thornbush, 2015). Furthermore, greening urban areas, such as roofs, contribute because of their ability to reduce energy consumption of buildings and sequester carbon in plants and substrates (Kuronuma et al., 2018). Greening therefore contributes to the reduction of climate change. However, greening the public areas of Leiden is not enough to reach the goal of the municipality, because about 50% of Leiden is private property (Gemeente Leiden, personal communication, November 23, 2020). The municipality of Leiden is thus wondering how the residents of Leiden can be stimulated to actively contribute by greening their gardens. To explore what could make the residents of Leiden contribute by greening their gardens, it can be helpful to investigate in what is behind the choices of residents regarding their gardens.

Little research exists on individual garden greening behavior. However, a lot of previous research can be found on several other forms of sustainable behavior. Various psychological factors, such as knowledge, motivation, and attitudes, have appeared to influence sustainable behavior (Joshi & Rahman, 2019). Attitudes, defined as a settled way of thinking or feeling about something, are often included in research about sustainable behavioral intentions (Robinson & Smith, 2002; Vermeir & Verbeke, 2006; Wang, 2016) and sustainable behavior (Joshi & Rahman, 2019). Attitudes have appeared to have a positive effect on sustainable behavioral intentions (Wang, 2016), sustainable purchase intentions (Robinson & Smith, 2002), sustainable food consumption intentions (Vermeir & Verbeke, 2006), and sustainable purchasing behavior (Joshi & Rahman, 2019). Moreover, attitudes are

suggested to be an important driver for garden greening behavior in specific (van Heezik et al., 2012; Stobbelaar et al., 2021).

However, findings of other studies on sustainable behavior imply that attitudes alone are not always a good predictor of sustainable behavior (Valkila & Saari, 2013; Nguyen et al., 2018; Park & Lin, 2020). Often mentioned in studies about the relationship between attitudes and sustainable behavior is the perceived individual impact, which is the extent to which people feel that their own behavior makes a difference (Vermeir & Verbeke, 2006; Nguyen et al., 2018; Park & Lin, 2020). The findings of these studies imply that perceived individual impact predicts an additional part of sustainable behavior that attitudes alone cannot predict. Other research also suggests a possible negative effect, namely that a lack of awareness about the individual impact that people can have on climate change could be a barrier in sustainable behavior (Lorenzoni et al., 2007). Moreover, the perceived impact that people individually can have with their own garden might help to stimulate garden greening behavior in specific (Stobbelaar et al., 2021). The perceived individual impact thus also seems to predict the extent to which people perform sustainable behavior and garden greening behavior, which why both attitudes and perceived individual impact are included in the current study.

**Attitudes**

Attitudes might help the stimulation of sustainable behavior, because they have appeared to have a positive effect on sustainable behavioral intentions (Wang, 2016), sustainable purchase intentions (Robinson & Smith, 2002) and sustainable food consumption intentions (Vermeir & Verbeke, 2006). The positive effect of attitudes has not only been found in research about sustainable behavioral intentions, but also in research regarding actual sustainable behavior, particularly about sustainable purchasing (Joshi & Rahman, 2019). According to this research, having a positive evaluation of sustainable purchasing is positively related to performing sustainable purchasing behavior. This finding can be explained by the

suggestion that attitudes are formed by cognitive and rational assessment of the concerned sustainable behavior, which are probably used while performing the behavior (Joshi & Rahman, 2019). These implications about the relationship between attitudes and sustainable behavioral intentions has shown that attitudes might be important to take into account when studying sustainable behavior.

Other research specifically focusses on gardening behavior and aimed to change the attitudes of garden-owners, in order to stimulate biodiversity and greening (van Heezik et al., 2012). The attitudes towards garden greening of the participants were attempted to improve through an interactive dialogue and feedback, during a process of biodiversity documentation of their gardens. The researchers found that the self-reported shift in attitudes resulted in the intended gardening practices (van Heezik et al., 2012), which is in line with the indication for a direct effect of attitudes on garden greening behavior.

Although several studies have found a positive effect of attitudes on sustainable behavioral intentions and different forms of sustainable behavior, other studies have found a discrepancy in the prediction of sustainable behavior through attitudes (Valkila & Saari, 2013; Nguyen et al., 2018; Park & Lin, 2020). These studies conclude that attitudes alone are not always a good predictor of actual sustainable behavior when it comes to actual green purchasing behavior (Park & Lin, 2020) and energy use (Valkila & Saari, 2013). A discrepancy was found between the participants' attitudes towards energy use, such as climate concerns and their perceptions on their own energy behavior, and their actual energy behavior (Valkila & Saari, 2013). The researchers suggest that a possible explanation for this discrepancy is that many of the participants feel that they individually have a limited impact on climate change. The same conclusion is drawn in research on green consumption, which includes buying and using sustainable products (Nguyen et al., 2018). Because some studies found a discrepancy in different forms of sustainable behavior that other studies did not find,

it might be helpful to explore other factors that possibly, together with attitudes, predict garden greening behavior.

**Perceived individual impact**

As mentioned previously, a variable that is often mentioned in studies about this attitude-behavior gap is perceived individual impact (Vermeir & Verbeke, 2006; Nguyen et al., 2018; Park & Lin, 2020). Perceived individual impact has appeared to be a significant predictor of sustainable behavioral intentions (Vermeir & Verbeke, 2006) and actual sustainable behavior (Roberts, 1996). The significant positive influence of perceived individual impact is also found when it comes to more specific forms of sustainable behavior, such as sustainable purchases (Joshi & Rahman, 2019; Park & Lin, 2020). These findings imply that consumers who perceive sustainable behavior as impactful have an increased likelihood to actually purchase sustainable products. Additionally, previous research suggests that when consumers who believe that their own behavior has a positive impact on the environment, their intention to consume sustainable products would be more likely to result in actual sustainable consumption (Nguyen et al., 2018). People who believe that their own sustainable behavior is impactful, thus appear to be more likely to perform sustainable behavior. One study about barriers in sustainable purchasing behavior addresses the 'Drop in the ocean' feeling, which refers to the feeling of individual helplessness due to the scale of the problem (Lorenzoni et al., 2007). The effect of perceived individual impact also seems to work the other way around, in a way that the feeling that individual behavior cannot make a difference for climate change seems to withhold people from performing sustainable behavior. Other findings suggest that informing people about their possible effectiveness could directly promote sustainable purchase intentions (Vermeir & Verbeke). The impact that people perceive they individually can make, thus seems to be an important predictor of sustainable behavior. Moreover, previous research specifically about garden greening

behavior suggests that perceived individual impact could help to stimulate greening gardens (Stobbelaar et al., 2021). The article implies that people who perceive more responsibility for adapting sustainable solutions are more likely to engage in adaptive behavior, which is in line with the predicted influence of perceived individual impact.

Previous scientific research has also found other effects of perceived individual impact that are relevant for the current research. These studies have found that people with a high perceived individual impact have more positive environmental attitudes towards sustainable behavior (Vermeir & Verbeke, 2006; Trivedi et al., 2018), which implicates a positive effect of perceived individual impact on attitudes. The perceived impact that people individually think they have, appeared to have a strong influence on attitudes regarding sustainable behavior of individual consumers (Trivedi et al., 2018). In line, attitudes had a positive effect on sustainable purchase intentions and, in turn, on sustainable purchasing behavior. These findings implicate a direct effect of perceived individual impact on attitudes towards sustainable behavior.

**Hypotheses**

The suggested direct effect of perceived individual impact on attitudes and on sustainable behavior, combined with the direct effect of attitudes on sustainable behavior, implicate that there might be a mediating effect of attitudes on the relationship between perceived individual impact and sustainable behavior. To find out what is behind the choice of residents to make their garden more green, it could thus be interesting to look into the suggested relationships between perceived individual impact, attitudes, and garden greening behavior.

Hypothesis 1 follows from the previous findings that implicate a positive relationship between perceived individual impact and sustainable behavior (Roberts, 1996; Vermeir & Verbeke, 2006; Nguyen et al., 2018; Joshi & Rahman, 2019; Park & Lin, 2020), and more

specifically, garden greening behavior (Stobbelaar et al., 2021). The current study focusses on actual garden greening behavior that people have performed instead of behavioral intentions, because the correlation between behavioral intention for sustainable behavior can vary considerably with actual behavior (Ajzen, 2011; Nguyen et al., 2018; Park & Lin, 2020).

**H1**: Residents of Leiden with a high perceived individual impact have performed more garden greening behavior than residents with a low perceived individual impact.

Hypothesis 2 follows from literature that suggests a mediating effect of attitudes on the relationship between perceived individual impact and sustainable behavior (Trivedi et al., 2018). The predicted direct influence of perceived individual impact on attitudes towards greening follows from previous findings of perceived impact of individuals on attitudes towards sustainable behavior (Vermeir & Verbeke, 2006; Trivedi et al., 2018). The predicted direct effect of attitudes towards greening on garden greening behavior follows from literature that suggests a positive relationship between attitudes and sustainable behavior (Vermeir & Verbeke, 2006; Wang, 2016), and more specifically, garden greening behavior (van Heezik et al., 2012; Stobbelaar et al., 2021).

**H2**: The effect of perceived individual impact on greening gardens is mediated by attitudes towards greening, such that the direct effect of perceived individual impact on garden greening behavior can partially be explained by attitudes, when those are taken into account.

**Current research**

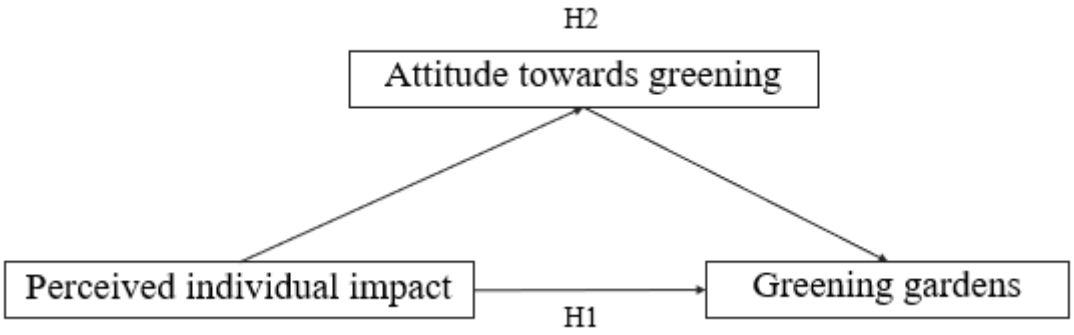
The aim of the current research is to explore the relationships are between attitudes towards greening, perceived individual impact and garden greening behavior in the past year. The dependent variable in this research is garden greening behavior. Previous research on sustainable behavior has often focussed on behavioral intention. However, this research focusses on actual behavior in the past year, to come closest to exploring what is behind the

actual garden greening behavior. The independent variable is perceived individual impact. The direct effect of perceived individual impact will be examined first, to investigate whether people who believe that greening their garden can make a difference, have performed more garden greening behavior than people with a lower perceived individual impact. Next, the mediating effect of attitudes towards greening on this relationship between perceived individual impact and garden greening behavior will be investigated. To examine this mediating effect, the relationship between perceived individual impact and attitudes towards greening will be studied, followed by the relationship between these attitudes and garden greening behavior. The mediating effect of attitudes can be confirmed when the relationship between perceived individual impact and garden greening behavior is weakened when attitudes are included in the analysis.

The hypotheses will be tested through an online survey among citizens of Leiden. This study contributes to previous literature on sustainable behavior, because of the specific outcome variable garden greening behavior, which has not been studied much in the past. The outcomes of this study can give municipalities insights in what is behind the choices of residents concerning their gardens, which could help them stimulate residents to make their gardens more green.

**Figure 1**

*Process model*




## Method

### Design

The design of this research is a descriptive design with a quantitative survey. This study was part of a bigger project, called ‘Meer Groen’, which makes this study a sub-project. The variables in this study were measured between subjects and consisted of the dependent variable garden greening behavior, the independent variable perceived individual impact and the mediator attitudes towards greening. These variables are continuous measures. To evaluate the relationships between these variables, an online survey was conducted in March 2021.

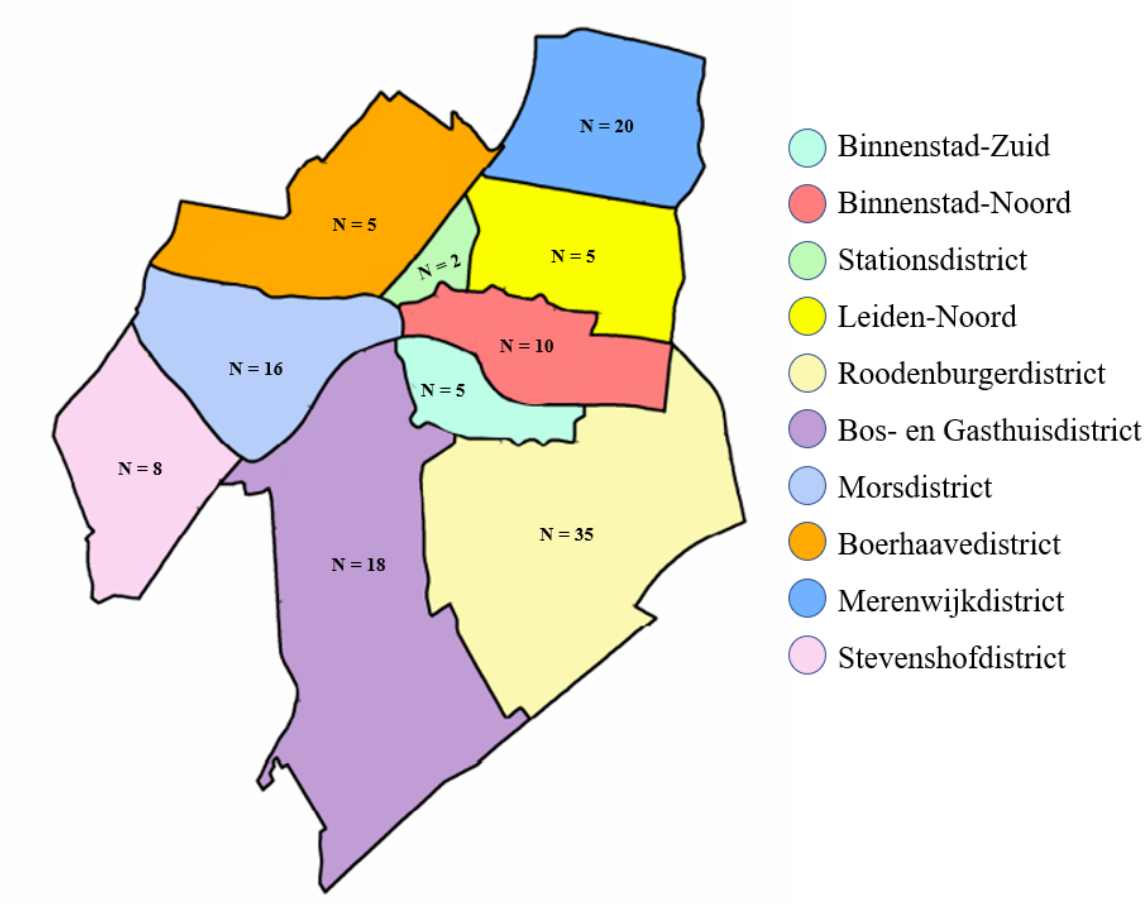
### Respondents

299 residents of Leiden voluntarily took part in the current study by filling in the online survey. The respondents that did not completely fill in the items for the current study, were excluded from the dataset, which resulted in 142 respondents. Fifteen respondents dropped out of the survey at different points after answering the questions that are used in the current study. More specifically, some respondents skipped the demographic items, which is why the demographic information is based on a lower number of respondents (N = 127) than in the analyses (N = 142). The dataset consisted of 96 females, 30 males, and 1 other than female or male. The respondents were inhabitants of Leiden of ages between 23 and 100 years old who own a garden ($M_{age}$ = 57.44, *SD* = 14.67). The most common level of education is a

university degree (N = 57), followed by a higher vocational degree (N = 48), a secondary vocational degree (N = 12), and secondary school (N = 6). When it comes to gross annual income in 2020, the most respondents have a modal income (N = 43) or an above modal income (N = 42), followed by beneath modal income (N = 19) and more than two times modal income (N = 19). Neighbourhoods that most respondents are currently living in are Roodenburgerdistrict (N = 35), Merenwijkdistrict (N = 20), Bos- en Gasthuisdistrict (N = 18) and Morsdistrict (N = 16), as can be seen in Figure 2. The respondents were recruited through the Leiden Panel (N = 54), the local newspaper (N = 28), and different social media platforms, such as LinkedIn and Facebook.

**Figure 2**

*Number of respondents per neighbourhood of Leiden*




**Ethics**

This study has been approved by the Psychology Research Ethics Committee. The questionnaire has been filled in confidentially, which has been addressed to the participants before partaking. The data has been saved in a coded way. Participants had to give their explicit consent for using their answers in our research by filling in the 'informed consent form', which can be found in Appendix B. The informed consent form consisted of some general information about the research, such as the approximate duration, the ethics and contact information for questions. The survey ended with a debriefing, which can be found in Appendix D and contained additional information about the background and the final goal of the study.

**Procedure**

The study was an online survey, due to the corona crisis. The same introduction text, which can be found in Appendix A, was used for all platforms that were used for the recruitment of respondents. In this short text, the participants were informed about the topic of the survey and the inclusion and exclusion criteria. At the beginning of the survey, respondents had to choose the language that they preferred for the survey. The respondents had to give consent before continuing to the survey questions. After that, a short introduction of the content of the survey was given. The survey started with a set of questions about the current garden and the ideal garden of the respondents, and the barriers that keep them from realising their ideal garden, which all belong to another study. Next, a few questions for another study about the intention of the respondents to green their garden were asked. These were followed by a set of questions about their garden greening behavior of the past year, which are part of the current study. These questions were followed by a set of questions for the current study about attitudes towards greening and a set of questions for another study about motivation towards greening. A few questions about the perceived individual impact of the respondents were asked next, which belong to the current study. Next, a set of questions

about knowledge about greening was asked, followed by questions about biodiversity in individual gardens. After that, a set of questions was asked about groups that the respondents belong to and their group norms. Finally, there were some questions asked about the demographics of the respondents.

**Measures**

This survey consisted of 111 items in total, of which 12 items belong to the current study. The items that were used in the current study can be found in Appendix C. A reliability check has been done for each variable based on Cronbach's Alpha. In this research, Cronbach's Alpha for each set of items had a determined lower limit ($\alpha > .65$), which is based on the small number of items per variable. Normally, a Cronbach's Alpha of .70 is used as a limit for considering a set of questions as reliable (Bland & Altman, 1997). However, Cronbach's Alpha is affected by the length of the scale (Streiner, 2003), which is why a smaller Alpha of .65 is used as a limit for the question sets in the current study.

***Attitudes towards greening***

First, the four items on attitudes towards greening were based on the survey of Tan et al. (2017) and an adjustment of Bhutto et al. (2020), and were adjusted for attitudes towards greening gardens. The items were measured with a four points Likert scale, ranging from 1 (*strongly disagree*) to 4 (*strongly agree*). An example of an item for attitudes towards greening was ''It is important to me whether my garden has vegetation''. One variable in this set that was recoded, because of the negative formulation. The Cronbach's alpha for attitudes towards greening, based on the four items that measure attitudes, is high enough ($\alpha = .725$). As can be seen in Table 1, the average score on attitudes towards greening is on the high end ($M = 3.65$, $SD = .52$).

***Perceived individual impact***

Second, the four items on perceived individual impact were based on a survey of Roberts (1996) and were measured on a seven points Likert scale, ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). An example of an item for perceived individual impact was ‘’When I buy things for my garden, I try to consider how the products will affect climate change’’. Two variables in this set were recoded. The Cronbach’s alpha for the four items that measure the perceived individual impact is high enough (α = .675). As shown in Table 1, the residents of Leiden had a slightly high perceived individual impact when it comes to greening their garden (*M* = 5.48, *SD* = 1.03).

***Garden greening behavior***

Third, the four items on past garden greening behavior were based on a previous survey from Leiden University (van Heezik et al., 2020). The items were measured on a seven points Likert scale, ranging from 1 (*not at all*) to 7 (*very much*). An example of an item for garden greening behavior was ‘’I have added vegetation to my garden’’. Garden greening behavior has four items that measure different sorts of behavior that add up to each other. Two items in this set were positively formulated and two were negatively formulated. The first positively formulated item measured the addition of vegetation to one’s garden, and the second positively formulated item measured the removal of surface coverage from one’s garden. The first negatively formulated item measured the addition of surface coverage in one’s garden, and the second negatively formulated item measured the removal of vegetation from one’s garden. The scores for garden greening behavior are calculated by adding up the scores on the two positive items, and subtracting the two negative scores from that. This calculation created a score range of -12 to +12. Table 1 shows that the average score for the sample on garden greening behavior in the past year was slightly high (*M* = 2.43, *SD* = 3.44).

**Table 1**

*Descriptive overview of the variables perceived individual impact, attitudes towards greening and garden greening behavior*

| Variable | *M* | *SD* | *Min.* | *Max.* |
|---|---|---|---|---|
| Perceived individual impact | 5.48 | 1.03 | 2 | 7 |
| Attitudes towards greening | 3.65 | .52 | 1 | 4 |
| Garden greening behavior | 2.43 | 3.44 | -6 | 12 |

**Statistical analyses**

The hypotheses were tested by analysing the dataset of the online survey in the Statistical Package for the Social Sciences 27 (SPSS 27, 2020). The analysis is done with model 4 of Hayes (2013), which has an independent variable (perceived individual impact), a mediator (attitudes towards greening) and a dependent variable (garden greening behavior). The model performs a multiple regression analysis. The steps of the mediation effect were analysed in the following order. The first step of the multiple regression analysis showed whether the variable perceived individual impact was regressed with the variable garden greening behavior (H1). Next, the effect of perceived individual impact was checked through the regression on the variable attitudes towards greening. After that, the regression for the variable attitudes towards greening on the variable garden greening behavior was checked, to measure the direct effect of attitudes. The mediating effect of attitudes is confirmed when the direct effect of perceived individual impact on garden greening behavior would weaken substantially when the mediator, attitudes towards greening, was added (H2). A regression analysis was conducted to test this mediating effect, of which the outcomes are described in the Results.

## Results

Before analysing the data, the assumptions for the multiple regression analysis were checked to see if the data fits this analysis. The data was checked for the linearity assumption, the normality assumption, the homoscedasticity assumption, multicollinearity, and outliers. All assumptions are met, except for the homoscedasticity assumption. Because of the violation of the homoscedasticity assumption, p-values are estimated too small, which made it more likely for results to be significant. To correct for the smaller p-values, this study will use a smaller significance level ($p < .01$) than usual ($p < .05$). Additionally, the data was checked for outliers on the dependent variable, the independent variable and for influential datapoints. One outlier was found on the independent variables (Centered Leverage = .225), which had very low scores on the attitudes towards greening and perceived individual impact, and average scores for garden greening behavior. However, the scores of this outlier could be due to other reasons for performing garden greening behavior that were not included in this study. Because these scores seem theoretically possible, there is no clear reason to remove this outlier from the dataset. The dataset has also been checked on unreliable respondents, that had finished the survey extremely quickly or had similar scores on regular items as on reverse-coded items. There were no clear signs found for unreliable respondents.

The hypotheses were tested with model 4 of the PROCESS Macro (Hayes, 2013). The results of the multiple regression analysis showed that perceived individual impact and attitudes towards greening explain 7.9% of the variance in garden greening behavior and together significantly predict garden greening behavior ($F$ (2, 139) = 5.95, $p = .003$, $R^2 = .079$). The results are further analysed for each step of the mediation and shown in Figure 3.

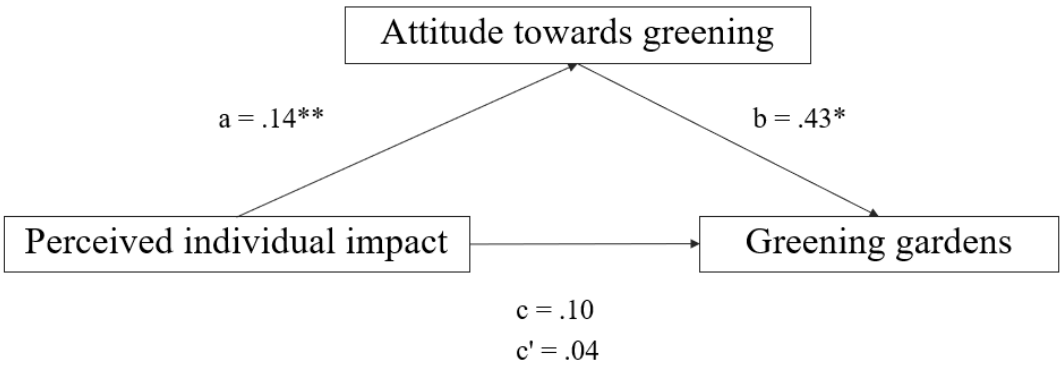
In contrast to Hypothesis 1, the regression analysis showed that perceived individual impact was not a significant predictor of garden greening behavior ($b = .10$, $t = 1.44$, $p =$

.153). This means that the direct effect of the mediation is not significant and that hypothesis 1 can be rejected.

In line with Hypothesis 2, perceived individual impact has appeared to be a significant positive predictor of attitudes towards greening ($b$ = .14, $t$ = 3.43, $p$ < .001), which confirms that the second step of the mediating effect is significant. The analysis for the third step of the mediating effect showed that attitudes towards greening is a significant predictor of garden greening behavior ($b$ = .43; $t$ = 3.11, $p$ = .002). The third step of the mediating effect is therefore also significant. The fourth step of the mediating effect showed that the direct effect of perceived individual impact on garden greening behavior ($b$ = .10; $t$ = 1.44, $p$ = .153) has decreased when adding the mediator attitudes towards greening into the model ($b$ = .04; $t$ = .55, $p$ = .580). This decrease of the direct effect has appeared to be significant, because zero does not occur within the confidence intervals ($b$ = .25; *99% C.I.* [.001, .777]). Attitudes towards greening thus had a mediating effect on the direct effect of perceived individual impact on garden greening behavior. Although the direct effect of perceived individual impact on garden greening behavior was not significant, no significant direct effect is needed to speak of a mediating effect (Rucker et al., 2011). Therefore, Hypothesis 2 can be confirmed.

**Figure 3**

*Effects of the mediation*




*Note.* *$p$ < .01. **$p$ < .001.

## Discussion

Greening the private gardens of Leiden is an important goal of the municipality of Leiden, for example to improve the environmental health and well-being, and contribute to the reduction of climate change. To reach this goal, the municipality of Leiden is wondering what is behind the choices of residents regarding their gardens. This study has investigated the direct effect of perceived individual impact on garden greening behavior of the residents, and the mediating effect of attitudes towards greening on this direct effect.

Although several studies suggested that people who perceive their own sustainable behavior as impactful show more sustainable behavior (Roberts, 1996; Vermeir & Verbeke, 2006; Nguyen et al., 2018; Joshi & Rahman, 2019; Park & Lin, 2020) and garden greening behavior (Stobbelaar et al., 2021), a direct effect of perceived individual impact on garden greening behavior amongst residents of Leiden was not found. Residents of Leiden with a higher perceived individual impact have not performed significantly more garden greening behavior than residents with a lower perceived individual impact, which is contrary to the hypotheses of the current study.

The absence of a direct effect was contrary to findings of previous research on other forms of sustainable behavior (Roberts, 1996; Vermeir & Verbeke, 2006; Nguyen et al., 2018; Joshi & Rahman, 2019; Park & Lin, 2020) and garden greening behavior (Stobbelaar et al., 2021). This absence could potentially be explained by the fact that garden greening behavior is a specific form of sustainable behavior. Garden greening behavior differs from other forms of sustainable behavior that have often been studied, because greening a garden is likely to take more time and effort than, for example, purchasing a sustainable product. Furthermore, garden greening behavior requires certain gardening skills or money to hire gardeners, in contrast to sustainable purchasing and most forms of sustainable consumption. The more time, money and gardening skills the target group has, the more abilities they might have to

perform garden greening behavior if they perceive greening their garden as impactful. In the current study, most respondents have a modal or above modal income, which implies that money should not be a barrier for changing the garden, perhaps into a more green garden. However, the gross annual income of the respondents and the fact that most respondents are highly educated, could suggest that most respondents have a time consuming job. When respondents perceive their garden as impactful, a lack of time for greening or maintaining the green garden could be a barrier to perform actual garden greening behavior. The discrepancy between garden greening behavior and previously studied forms of sustainable behavior, for example in time and effort, could thus be part of the explanation of why the perceived individual impact was not a direct significant predictor of garden greening behavior.

In line with the hypotheses, perceived individual impact had an indirect positive effect on garden greening behavior, through attitudes towards greening. More specifically, residents with a higher perceived individual impact have more positive attitudes towards greening than residents with a low perceived individual impact. The current study also found that the more positive the attitude of a resident is, the more garden greening behavior they have performed. Attitudes towards greening thus have a mediating effect on the relationship between perceived individual impact and garden greening behavior. These findings are in line with the expectations based on previous research, which suggested that attitudes have a mediating effect on the relationship between perceived individual impact and sustainable behavior (Vermeir & Verbeke, 2006; Wang, 2016; Trivedi et al., 2018), and in specific, greening garden behavior (van Heezik et al., 2012; Stobbelaar et al., 2021).

**Strengths and limitations**

The current study has several strengths and limitations that are relevant to address. First, the current study provides a reliable set of items for measuring attitudes in the context of garden greening. The survey contained items that were initially used to measure sustainable

energy-use (Tan et al., 2017; Bhutto et al., 2020), and were adjusted for the context of garden greening. The items for attitudes towards greening had a Cronbach's Alpha of .725 and are thus statistically reliable to use in future studies on attitudes towards garden greening.

Second, a strength of the current study is that the sample was to some extent specific in comparison to other studies on sustainable behavior. The average age of the sample was 57 years old and most people had a higher vocational degree or a university degree. Furthermore, most participants have a modal or above modal income. These characteristics make the survey representative for comparable target groups. However, the specificity of the sample also means that the results of this survey could differ from other target groups, that for instance are relatively young or more diverse. The sample is relatively highly educated, which could possibly have had an influence on knowledge about the individual impact of a private garden. Additionally, the fact that most respondents have a modal or above modal income could increase the possibilities for respondents to realise their ideal garden. Compared to several existing studies on sustainable behavior (Vermeir & Verbeke, 2006; Nguyen et al., 2018; Trivedi et al., 2018; Joshi & Rahman, 2019), the respondents of the current study have a relatively higher age. The high age of the sample could be related to both a higher income, which can be used to perform sustainable behavior, and more knowledge about the impact of sustainable behavior. The specificity of the sample in this research could thus be advantageous for the representativeness of similar target groups, but also disadvantageous when it comes to representativeness of different or more diverse samples.

Next, the items that were included in the survey to measure attitudes, were measured on a 4-point scale. For the items that measured the perceived individual impact, a 7-point scale was used. However, the original items for attitudes (Tan et al., 2017; Bhutto et al., 2020) were measured on a 7-point scale, and the original items for perceived individual impact (Roberts, 1996) were measured on a 4-point scale. These scales accidentally have gotten

mixed up in the online survey. Research on the use of different Likert scales in psychological research suggests that using a 7-point scale can affect the tendency to choose an answer on both ends of the scales (Wakita et al., 2012). However, the previous research suggests that the mix-up is unlikely to affect the reliability of the survey and the descriptive statistics, which indicates that the mix-up did not affect the results of the current study. Nevertheless, the original choice for the 7-point scale was based on the validated use of the scale in previous studies with attitudes, which is why it would by recommended to use the original measures in future research.

Last, another factor that possibly had an influence on this study is the global pandemic COVID-19. Most people are at home more than they were before the pandemic, which could have had an influence on how people perceive or use their gardens. Perhaps the residents have had more time to realise plans for their gardens and therefore have done more, or rather less greening than they would have done before the pandemic. The fact that people have spent more time at home than they did before the pandemic could also have an influence on attitudes towards greening, because people have spent more time in their garden or had a view of their garden. Spending more time in or around the garden could possibly strengthen attitudes or desires to change the garden in a more ideal garden. This could mean that spending more time at home increases the chance that people change their gardens to their ideal garden, and thus act more in line with their attitudes. Because the pandemic has been here for over one year and being at home more has been normalized, this study has not explored the influence of COVID-19 on the variables in the study. However, the influence of COVID-19 cannot completely be ruled out. The influence of the pandemic on the relationship between attitudes towards greening and garden greening behavior could be studied by adding items to the survey regarding the influence of COVID-19, for example on time spent at home.

**Theoretical and practical implications**

Previous literature has focused on several forms of sustainable behavior and factors that predict these forms of behavior. The current study not only gives suggestions for practical purposes aiming to influencing garden greening behavior, but also contributes to existing literature by applying findings of previous studies on garden greening behavior of residents of Leiden, which is a very specific form of sustainable behavior in a specific sample. Not a lot of research has been done on garden greening behavior specifically, which is why this study is valuable for theoretical insights on garden greening behavior. The contribution of the current study to existing literature lies in the previously described differences between garden greening behavior and other forms of sustainable behavior, such as time and effort. The results of the current study provide insights in how variables as attitudes towards greening and perceived individual impact influence garden greening behavior and other comparable forms of sustainable behavior.

Overall, the current study found that perceived individual impact has a positive influence on attitudes towards greening, and that attitudes towards greening have a positive effect on garden greening behavior. These findings provide a suggestion for a step-by-step plan to influence garden greening behavior. When residents of Leiden perceive their own gardens and greening behavior as impactful, their attitudes towards greening could become more positive, which could lead to more garden greening behavior. In research about the 'Steenbeek' Program (Stobbelaar et al., 2021), the researchers suggest to use a specific message for influencing the perceived individual impact, focused on the impact of private gardens. They suggest that simply explaining to people to what extent their garden has an impact, could increase the perceived individual impact. Concludingly, the municipality of Leiden could influence garden greening behavior by communicating the perceived individual impact of private gardens to the residents of Leiden, to increase their positive attitudes

towards greening. More positive attitudes of residents should, in turn, result in more garden greening.

Another existing research on garden greening behavior (van Heezik et al., 2012) provides an intervention to positively influence attitudes towards greening. The researchers used a process of biodiversity assessment, dialog, and feedback, which stimulated a shift in attitudes towards greening (van Heezik et al., 2012). This shift in attitudes, in turn, resulted in garden greening practices, which makes this strategy very relevant to explore for the municipality of Leiden. Directly influencing attitudes towards greening could be more influential than the previous suggestion for influencing perceived individual impact (Stobbelaar et al., 2021), because attitudes have a direct effect on garden greening behavior, whereas perceived individual impact has an indirect effect. However, a disadvantage of this intervention for stimulating a shift in attitudes is that it would be relatively time consuming and likely to be more expensive to arrange than the previous suggestion for influencing perceived individual impact.

**Directions for future research**

The current research gives certain directions for future research focussing on exploring garden greening behavior. First, this study explores a specific form of sustainable behavior, using a specific target group that is, for example, generally highly educated and has a modal or above modal income. The sample was limited for this research, because of the conditions that the respondents had to live in Leiden and own a garden. In the sample of the current study, the respondents generally have an modal or above modal income, and therefore are expected to have a time consuming job, and thus not to have much spare time. This expected lack of spare time is likely to have had a negative effect on the influence of perceived individual impact and attitudes on garden greening behavior, whereas money is likely to have had a positive effect. To make future research more applicable to different target groups, such

as target groups with a below modal income or more spare time, the focus could use a more diverse sample, in terms of more variation in education level and gross annual income. Expected would be that target groups that generally have more time and money could have more of a discrepancy between their perceived individual impact or attitudes, and the amount of garden greening behavior they have performed. Time and money could help realising the ideal garden of participants, which is likely to be influenced by the attitudes towards greening their gardens and the impact that they perceive to make with this behavior. Including possible moderators, such as time, money, required skills or money into future research, could not only expand the representativeness of the findings of the current study, but also give a more concrete comparison of garden greening behavior with other forms of sustainable behavior. Because garden greening behavior is expected to, for instance, cost more time and skills than some other forms of sustainable behavior, these differences could be interesting to take into consideration.

Second, influence of COVID-19 on attitudes and greening behavior is not studied in this research, because the pandemic has been normalized and present for over a year. The influence of COVID-19 could be taken into account in future research, because of the fact that people are at home more often, which might influence the way that people perceive their garden or the extent to which people perform garden greening behavior. However, a lack of memory from how their attitudes and gardening behavior were exactly before the pandemic occurred, could make this harder to include in a future study. Therefore, recommended would be to replicate the current study when the pandemic has ended or no longer affects the daily lives of residents. Expected is that people would spend less time at home, which could increase the discrepancy between perceived individual impact, attitudes and garden greening behavior. Time spent at home could be included in such future research, to explore if this

factor indeed influences the effect of perceived individual impact and attitudes towards greening on garden greening behavior.

**General conclusion**

In summary, this study gives an insight on how perceived individual impact and attitudes towards greening influence actual garden greening behavior. The findings of this study provide insights in how the municipality of Leiden can stimulate garden greening behavior amongst residents. Attitudes towards greening have appeared to have a positive influence on garden greening behavior, which suggests that influencing attitudes could be a way to reach the goal of the municipality of Leiden. The results of this study also suggest that attitudes towards greening might become more positive if people perceive their garden and their choices regarding their garden as impactful. Perceived individual impact could thus have an indirect effect on garden greening behavior. These findings provide a potential guide for the municipality of Leiden to reach their goal by stimulating residents to make their garden more green. Future research on garden greening behavior or similar sustainable behavior could include time spent at home, income, and gardening skills as moderators, to get a broader perspective on garden greening behavior and the possible influences of these characteristics of the sample.

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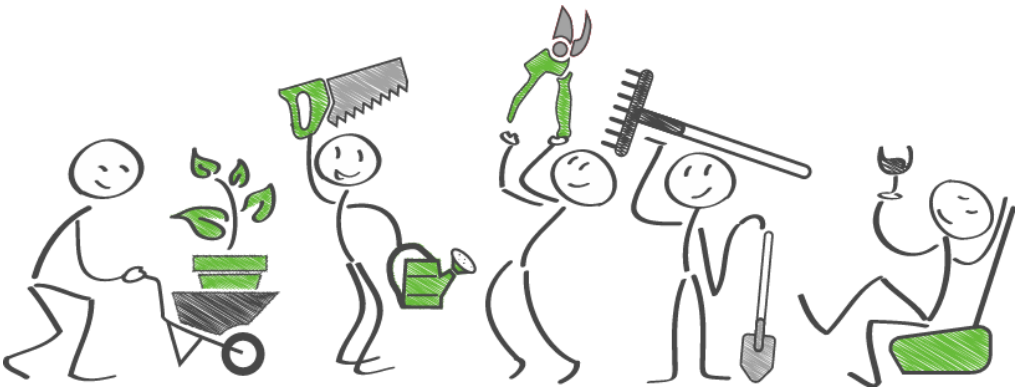
## Appendix A

## Text used for the recruitment of respondents

**Hoe gebruikt u uw tuin?**



Veel Leidenaren hebben een tuin, die op een verschillende manier wordt gebruikt en er bij iedereen weer anders uit ziet. In samenwerking met gemeente Leiden onderzoekt de Universiteit Leiden de tuinen van Leidenaren. Dit onderzoek is gericht op uw tuingebruik en wat uw doelen en voorkeuren zijn. Wij horen graag uw mening!

Wilt u bijdragen aan het onderzoek? Vul dan deze vragenlijst in. Deelname zal ongeveer 20 minuten van uw tijd in beslag nemen.

Door op onderstaande link te klikken komt u direct bij de vragenlijst uit.

https://leidenuniv.eu.qualtrics.com/jfe/form/SV_cIp7EKGVIXGZpEq

## Appendix B

## Informed consent form

**NL**

Beste Leidenaar,

Woont u in Leiden, heeft u een tuin op de begane grond én bent u 18 jaar of ouder? Dan komen we graag meer te weten over hoe u deze heeft ingericht en welke overwegingen daarbij een rol hebben gespeeld. We zouden u daarom willen vragen om onze vragenlijst (van

ongeveer 20 minuten) in te vullen. Het maakt niet uit hoe uw tuin er uit ziet, elke tuin draagt bij aan ons onderzoek!

**Meer informatie:**

Dit onderzoek is goedgekeurd door de Psychologie Ethiek Commissie van de Universiteit Leiden. Deelname aan dit onderzoek is geheel vrijwillig. Als u van uw deelname af wilt zien, kunt u dat op ieder moment doen. Hiervoor hoeft u geen reden op te geven.

**Wat gebeurt er met mijn gegevens?** Uw antwoorden zullen worden gekoppeld aan een unieke code. Uit onderzoeksverslagen kan dus niet worden herleid op wie de gegevens betrekking hebben.

**Heeft u nog vragen?** Als u verdere vragen heeft over dit onderzoek of uw rechten, of een klacht of zorg wilt uiten over dit onderzoek, dan kunt u contact opnemen via a.van.der.weiden@fsw.leidenuniv.nl. Heeft u vragen over uw privacy? Dan kunt u contact opnemen met onze privacy officer via privacy@fsw.leidenuniv.nl.

Met vriendelijke groet,

Anouk van der Weiden

Hoofdonderzoeker “Buitenruimtes in Leiden”

Afdeling Sociale, Economische en Organisatiepsychologie

**Ik verklaar dat:**

*(alle antwoord opties moeten worden aangevinkt om deel te nemen aan het onderzoek)*

- Ik de informatie over dit onderzoek begrijp, en dat ik de mogelijkheid heb gehad om vragen te stellen over het onderzoek (per e-mail);
- Ik begrijp dat mijn gegevens gecodeerd zullen worden verzameld en verwerkt;

- Ik begrijp dat ik mijn deelname op elk moment kan stoppen, zonder daarvoor een reden te hoeven geven;
- Ik een tuin heb;
- Ik 18 jaar of ouder ben;
- Ik toestemming verleen om mee te doen aan dit onderzoek.

**EN**

Dear Leidenaar,

Do you live in Leiden? Do you have an outdoor area on the ground floor? And are you at least 18 years of age? Then we would like to know more about how you have arranged your garden and the considerations that played a role in this arrangement. We would like to ask you to fill in our questionnaire (of approximately 20 minutes). It does not matter what your garden looks like. Every garden is valuable to our research!

**More information:**

This study has been approved by the Psychology Ethics Committee of Leiden University. Participation in this study is completely voluntary. You can renounce your participation at any given time, without having to give any explanation.

**What will happen with my data?** Your answers will be linked to a unique code. Our research reports will not allow anyone to trace the data back to whom they relate.

**Do you have any further questions?** If you have further questions regarding this research, your rights, or if you want to express any complaints or worries regarding this study, you can contact a.van.der.weiden@fsw.leidenuniv.nl. Do you have any questions regarding your privacy? Then you can contact our privacy officer at privacy@fsw.leidenuniv.nl.

Kind regards,

Anouk van der Weiden

*Principal invesitagor "Outdoor spaces in Leiden"*

*Department of Social, Economic, and Organisational Psychology*

**I declare that:**

*(all answer options must be checked to participate in this research)*

- I understand the given information regarding the research, and I have been given the opportunity to ask questions (by e-mail);
- I understand that my answers will be collected and processed in a coded manner;
- I am aware that I can renounce my participation at any given time without having to give any explanation;
- I possess an outdoor area on the ground floor;
- I am at least 18 years old;
- I consent to participate in this research.

## Appendix C

## Questionnaire in NL and EN

**NL**

**Garden greening behavior (GGBeh)**

De volgende vragen gaan over de indeling van uw tuin en hoe u deze gebruikt. In deze vragen wordt gesproken over de soorten oppervlakten **grondbedekking** en **begroeiing**. Hiervoor worden de volgende definities gehanteerd:

**1. Grondbedekking (verstening)**

Bijvoorbeeld: tegels, grind, stenen, kiezels, kunstgras, hout, cement, vlonders, etc.

**2. Begroeiing**

*Bijvoorbeeld: planten, bloemen, gras, bomen, onkruid, klimop, paddenstoelen, mos, heg, etc.*

Mogelijk heeft u **het afgelopen jaar** aanpassingen gemaakt aan uw tuin. Geef aan in welke mate u de volgende activiteiten uitgevoerd heeft. Schaal: 1 (Helemaal niet), 2, 3, 4, 5, 6, 7 (Heel veel).

- Ik heb begroeiing aan mijn tuin toegevoegd.
- Ik heb begroeiing uit mijn tuin weggehaald.
- Ik heb grondbedekking aan mijn tuin toegevoegd.
- Ik heb grondbedekking uit mijn tuin weggehaald.

**Attitudes towards greening (Attitu)**

De volgende stellingen gaan over uw kijk op de indeling van uw tuin. In deze vragen wordt gesproken over de soorten oppervlakten **grondbedekking** en **begroeiing**. Hiervoor worden de volgende definities gehanteerd:

**1. Grondbedekking (verstening)**

*Bijvoorbeeld: tegels, grind, stenen, kiezels, kunstgras, hout, cement, vlonders, etc.*

**2. Begroeiing**

*Bijvoorbeeld: planten, bloemen, gras, bomen, onkruid, klimop, paddenstoelen, mos, heg, etc.*

Geef aan in hoeverre u het eens bent met de volgende stellingen. Schaal: Helemaal mee oneens, Beetje mee oneens, Beetje mee eens, Helemaal mee oneens.

- Het hebben van begroeiing in mijn tuin is belangrijk voor mij.
- Het toevoegen van begroeiing in mijn tuin is belangrijk voor mij wanneer ik beslissingen neem met betrekking tot mijn tuin.
- Wanneer ik kan kiezen tussen het hebben van begroeiing of grondbedekking in mijn tuin, gaat mijn voorkeur uit naar grondbedekking.
- Ik heb een positieve houding ten aanzien van tuinen met begroeiing.

**Perceived individual impact (PercII)**

De volgende stellingen gaan over uw tuin met betrekking tot klimaatverandering. Geef aan in hoeverre u het eens bent met de volgende stellingen. Schaal: Helemaal mee oneens, Mee oneens, Beetje mee oneens, Niet mee oneens/eens, Beetje mee eens, Mee eens, Helemaal mee eens.

- Het heeft geen zin om als individu iets aan jouw tuin te doen om klimaatverandering tegen te gaan.
- Wanneer ik dingen koop voor mijn tuin, probeer ik te overwegen in hoeverre deze het klimaat beïnvloeden.
- Omdat één persoon de klimaatverandering niet kan tegengaan, maakt het niet uit wat ik aan mijn tuin doe.
- Het gedrag van elke tuineigenaar kan een positief effect hebben op klimaatverandering, door het hebben van een tuin met begroeiing.

**EN**

**Garden greening behavior (GGBeh)**

The following questions concern the layout of your garden and how you use it. In these questions, there will be spoken about two kinds of surfaces: **surface coverage** and **vegetation,** which will have the following definitions:

**1. Surface coverage**

For example: tiles, gravel, stones, pebbles, artificial grass, wood, cement, decking, etc.

**2. Vegetation**

For example: plants, flowers, grass, trees, weeds, ivy, mushrooms, moss, hedges, etc.

You have potentially made some adjustements to your garden **in the past year**. Please indicate to what extent you have performed the following activities. Scale: 1 (Not at all), 2, 3, 4, 5, 6, 7 (Very much).

- I have added vegetation to my garden.
- I have removed vegetation from my garden.
- I have added surface coverage to my garden.
- I have removed surface coverage from my garden.

**Attitudes towards greening (Attitu)**

The following statements are about your view on the layout of your garden. In these questions, there will be spoken about two kinds of surfaces: **surface coverage** and **vegetation,** which will have the following definitions:

**1. Surface coverage**

*For example: tiles, gravel, stones, pebbles, artificial grass, wood, cement, decking, etc.*

**2. Vegetation**

*For example: plants, flowers, grass, trees, weeds, ivy, mushrooms, moss, hedges, etc.*

Please choose to what extent you agree with the following statements. Scale: Strongly disagree, Somewhat disagree, Somewhat agree, Strongly agree.

- It is important to me whether my garden has vegetation.
- Adding vegetation to my garden is important to me when making decisions regarding my garden.
- If I can choose between having a garden with vegetation or surface coverage, I prefer to have surface coverage.
- I have a favourable attitude towards gardens with vegetation.

**Perceived individual impact (PercII)**

The following statements are about your garden with regard to climate change. Please choose to what extent you agree with the following statements. Scale: Strongly disagree, Disagree, Somewhat disagree, Neither agree nor disagree, Somewhat agree, Agree, Strongly agree.

- It is worthless for the individual garden owner to do anything about climate change.
- When I buy things for my garden, I try to consider how the products will affect climate change.
- Since one person cannot have any effect upon climate change, it doesn't make any difference what I do.
- Each consumer's behavior can have a positive effect on climate change by having a garden with vegetation.

## Appendix D

## Debriefing in NL and EN

**NL**

Beste Leidenaar,

Ten eerste willen we u van harte bedanken voor het meedoen aan ons onderzoek. In deze brief zullen we u iets meer uitleg geven over waarom we dit onderzoek doen.
Leiden bestaat voor ongeveer 40% uit tuinen. Met dit onderzoek hopen we er achter te komen waarom Leidenaren hun buitenruimte hebben ingericht zoals die is. Uit onderzoek blijkt namelijk dat tuinen een grote rol kunnen spelen bij het oplossen van een aantal (klimaat)problemen:

- Een van die problemen is de afvoer van regenwater. Bij grote hoeveelheden regen raken de riolen overbelast en kunnen er waterproblemen ontstaan. Een belangrijke oplossing voor dit probleem is meer natuurlijke ondergrond (zoals gras, planten, bomen, aarde, of water). Via een natuurlijke ondergrond kan het water beter worden opgenomen en ontstaan er minder problemen in het riool (zie bijv.: Galderisi & Treccozzi, 2017; Offermans, 2012).
- Een ander voordeel van een tuin met veel natuurlijke ondergrond is dat dieren meer kansen hebben om te overleven (zie bijv.: Goddard and colleagues., 2013; Smith, 2006).
- Ook inwoners van Leiden zelf kunnen voordelen ervaren van groenere tuinen. In de stad is het over het algemeen een aantal graden warmer dan in omliggende gebieden. Dit wordt het hitte-eiland effect genoemd. Hoe meer natuurlijke bodem, hoe minder hitte er wordt opgenomen door bijvoorbeeld stenen terrassen. Groenere tuinen kunnen dus voor verkoeling zorgen in warme zomers (zie bijv.: Bowler, 2010; Zwaagstra, 2014).

Daarnaast heeft onderzoek laten zien dat natuur goed is voor gezondheid en welzijn (zie bijv.: Twohig-Bennett & Jones, 2018).

De resultaten van dit onderzoek zullen alleen in gecodeerde vorm (dus nooit in relatie tot uw persoonsgegevens) worden gedeeld. We zijn onder andere van plan de resultaten (dus niet uw gegevens) te delen met de gemeente Leiden. Mocht u hier bezwaar tegen hebben, dan kunt u dit aan ons laten weten en zullen wij uw gegevens niet meenemen in onze analyses.

Heeft u nog meer vragen of wilt u op de hoogte worden gehouden van het onderzoek, dan kunt u contact opnemen via a.van.der.weiden@fsw.leidenuniv.nl.

Als u uw eigen gegevens wilt inzien, dan kan dat onder vermelding van uw deelnemerscode**:**

**${e://Field/Random%20ID}**.

We kunnen uw persoonlijke gegevens niet achterhalen zonder deze code. Bewaar deze code daarom goed!

We hopen dat u het leuk vond om mee te doen. Uw bijdrage aan ons onderzoek wordt zeer gewaardeerd. Nogmaals bedankt voor uw deelname!

Met vriendelijke groet,

Anouk van der Weiden

*Hoofdonderzoeker "Buitenruimtes in Leiden"*

*Afdeling Sociale, Economische en Organisatiepsychologie*

**EN**

Dear Leidenaar,

First of all, we would like to thank you for participating in our study. In this letter we will give you some more information about why we are doing this research.

Approximately 40% of the outdoor space in Leiden consists of private gardens. With this research we hope to find out why Leiden citizens have arranged their gardens the way they have. This is because research has shown that gardens can play a major role in solving a number of (climate) issues:

- One of these issues is the drainage of rainwater. In case of heavy rainfall, the sewers become overloaded and water problems can occur. An important solution to this problem is more natural surfaces (such as grass, plants, trees, soil or water). With a

natural surface, water can be absorbed better and there are fewer problems in the sewers (see e.g.: Galderisi & Treccozzi, 2017; Offermans, 2012).

- Another advantage of a garden with a lot of natural surface is that animals have more chances to survive (see e.g.: Goddard and colleagues., 2013; Smith, 2006).
- Leiden residents themselves can also experience benefits from greener gardens. In the city it is generally several degrees warmer than in surrounding areas. This is also called the 'heat island' effect. The more natural surface there is, the less heat is absorbed by stone terraces, for example. Greener gardens can therefore provide cooling in hot summers (see for example: Bowler, 2010; Zwaagstra, 2014).

In addition, research has shown that nature is good for health and well-being (see e.g.: Twohig-Bennett & Jones, 2018).

The results of this research will only be shared in coded form (i.e. never in relation to your personal data). Among other things, we intend to share the results (i.e. not your data) with the municipality of Leiden. If you object to this, please let us know and we will not include your data in our analyses.

If you have any further questions or would like to be kept informed about the research, please contact us via a.van.der.weiden@fsw.leidenuniv.nl.

If you would like to view your own data, you can do so by stating your participant code: **${e://Field/Random%20ID}**.

We cannot find your personal data without this code. Therefore, please save this code well!

We hope you enjoyed participating. Your contribution to our survey is highly appreciated.

Thanks again for your participation!

Kind regards,

Anouk van der Weiden

Principal investigator "Outdoor spaces in Leiden

Department of Social, Economic and Organisational Psychology