Journal of Environmental Economics and Management 119 (2023) 102798

Contents lists available at ScienceDirect

Journal of Environmental Economics and Management

journal homepage: www.elsevier.com/locate/jeem

Information processing in stated preference surveys A case study on urban gardens

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ARTICLE INFO

Dataset link: https://github.com/sagebiej/info processing

Keywords:
Discrete choice experiment
Environmental valuation
Information effects
Information recall
Survey engagement
Urban ecosystem services

ABSTRACT

For valid preference elicitation, stated preference surveys must provide information on the good to be valued, and respondents must process and recall the information. Previous studies show that the amount and type of information can affect stated preferences and the validity of value estimates, but how respondents process this information has been less researched. Some studies find correlations between preferences and respondent engagement with the information, but our study is the first to randomly and exogenously manipulate factors of engagement in a stated preference survey. Drawing on stated preference guidance and psychological concepts, we estimate the effect of quiz questions (asking about the content of the information) and self-reference questions (asking how the information personally relates to the respondent) on (i) engagement, (ii) information recall, and (iii) stated preferences in a discrete choice experiment survey valuing the ecosystem services of urban gardens in the German cities of Berlin and Stuttgart. Our results indicate that respondents spend more time on the information page when confronted with quiz rather than self-reference questions. For both question types, we do not find effects on recall or stated preferences. The results suggest that questions which increase engagement offer no simple fix to enhance information processing. Thus, alternative ways of reinforcing engagement, comprehension, and information recall in stated preference surveys should be developed and applied.

1. Introduction

Stated preference surveys are frequently used in environmental economics to value non-market goods. However, the validity of their estimates is debated. For example, it matters for stated preferences and the validity of value estimates how information about the good to be valued is provided to survey respondents (Blomquist and Whitehead, 1998; Johnston et al., 2017). Several studies show that more information about the good can increase value estimates (e.g., Bateman and Mawby, 2004; Hoevenagel and van der Linden, 1993; Vanermen et al., 2021; Rambonilaza and Brahic, 2016; Hoehn and Randall, 2002) and that different types of information can lead to differing stated preferences (e.g., Ajzen et al., 1996; Czajkowski et al., 2016; Yang and Hobbs, 2020). Munro and Hanley (2001), and similarly Bergstrom et al. (1990), suggest that such effects on value estimates can be explained by expected utility theory if the provided information changes respondents' beliefs about the benefits or the probability of provision of the environmental good.

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https://doi.org/10.1016/j.jeem.2023.102798
Received 24 March 2022
Available online 24 February 2023
0095-0696/

For the provided information to affect beliefs and consequently stated preferences, the information needs to be processed by the respondents and recalled during preference elicitation. Long-standing psychological literature concludes that the depth of information processing matters for how well information is retained and later recalled (Craik and Lockhart, 1972; Van Raaij, 1988). In the context of stated preferences, a small number of studies open this black box, investigating how respondents engage with information and how this matters for stated preferences. Balcombe et al. (2017) and Ballco et al. (2019) use eye-tracking devices to show that respondents with higher visual attendance to the information have larger value estimates. Others find that stated preferences differ between respondents who spend less or more time reading the information (Holmes et al., 1998; Vista et al., 2009; Tienhaara et al., 2021). Berrens et al. (2004) and Tienhaara et al. (2021) show that respondents who access optional links to additional information in online experiments state a higher willingness-to-pay. Similarly, Hu et al. (2009) find that respondents who voluntarily access additional information choose different alternatives in a choice experiment than those who do not access this information. These previous studies on respondent engagement compare stated preferences between groups of respondents who differ in their engagement with the information according to observed indicators. However, due to potential endogeneity, this correlation does not necessarily imply a causal relationship between engagement and stated preferences. In particular, stated preferences and survey engagement are likely co-determined by underlying preferences. For example, respondents with strong preferences for the good to be valued could plausibly engage more with the information provided to them. At the same time, they could also exhibit a higher willingness-to-pay for this good. Our study is, to the best of our knowledge, the first to investigate a potential causal effect of respondents' engagement with the information on stated preferences, which we explore by employing random exogenous manipulations as a causal identification strategy.

We insert two types of questions about the information directly after information provision and before preference elicitation to manipulate survey engagement and information processing. First, we follow Mathews et al. (2006) who suggest incorporating quiz questions that ask respondents about the content of the information into stated preference questionnaires to reinforce respondent comprehension. Similarly, Johnston et al. (2017) recommend supporting questions to engage respondents while they process presented information. However, we are unaware of any previous empirical investigation of the effects of quiz questions in stated preference surveys. Second, psychology literature finds that self-reference questions lead to higher engagement with, and deeper processing of, the information compared to semantic questions, such as quizzes (Rogers et al., 1977; Van Raaij, 1988). Self-reference questions are questions that ask how the information personally relates to the respondent, such as her previous experience, preferences or identity. By inducing deeper processing, self-reference questions can lead to a better recall of the information than quiz questions. In the experiments by Rogers et al. (1977), subjects are twice as likely to correctly recall information when asked self-reference compared to semantic questions. In the context of stated preference surveys, deeper processing of information about the good to be valued, such as being potentially induced by quiz and self-reference questions, may strengthen respondents' adaptation of beliefs in response to the information and, consequently, affect stated preferences. If respondents cannot recall the provided information about the good at the time of preference elicitation, this information would less likely affect the beliefs underlying their responses.

This paper investigates whether integrating quiz and self-reference questions in stated preference surveys (i) improves engagement with the information, (ii) increases recall of the information, and (iii) affects stated preferences. We analyze the extent to which these effects differ between quiz (recommended in the stated preferences literature) and self-reference (recommended in the psychology literature) questions. We use data from a discrete choice experiment survey that elicits preferences towards new urban gardens in the two German cities of Berlin and Stuttgart. The study was conducted in September and October 2020 with a sample of 1686 respondents. In the preregistered study design,[1] respondents are randomly assigned to one of six versions of a questionnaire. The questionnaires differ in the amount of information provided and whether quiz, self-reference, or no questions related to the information were posed.

Using ordinary least squares regressions, we investigate the effect of the manipulations on three outcomes: (i) time spent on relevant survey pages, (ii) correctly evaluated recall statements about the information after preference elicitation, and (iii) opt-out choices in the choice experiment. To analyze the effects of the manipulations on the willingness-to-pay estimates, we estimate a mixed logit model with treatment interaction terms. Additionally, we estimate a mixed logit model allowing willingness-to-pay to correlate with the time spent on the information page. This enables us to investigate whether the finding from previous studies that engagement and stated preferences are correlated can be replicated with our data. It also allows us to compare these potential correlations with the causal relations identified in the first mixed logit model with experimental manipulations.

We find that respondents confronted with quiz questions spend more time on the information page than those in the information-only and self-reference questions treatment. For both question types, we do not find large or statistically significant effects on recall or stated preferences, suggesting that questions about the provided information cannot easily reinforce the processing and recall of information. However, in accordance with previous studies (Holmes et al., 1998; Vista et al., 2009; Tienhaara et al., 2021), we find statistically significant correlations between time spent on the information page and stated preferences. The two results indicate that the previously found correlations might reflect heterogeneity in respondent characteristics rather than a causal effect of engagement on stated preferences.

This study contributes to the stated preference literature in two ways: It is the first study to test empirically the recommendation to reinforce respondent engagement in stated preference surveys with quiz questions and the first to investigate how self-reference

[1] The research question, study design and empirical strategy were pre-registered in September 2020 before the start of data collection. We report all pre-registered analyses in this paper, but also engage in additional explorative analyses. The pre-registration is available under this link: https://aspredicted.org/blind.php?x=2aq63r. More details are provided at the end of the methods section.

questions affect engagement and value estimates in stated preferences. Hence, our results inform recommendations concerning whether practitioners should include such questions when designing valuation surveys. Furthermore, our study is the first to use random exogenous manipulations of engagement with the information in stated preferences. This allows us to test whether the findings from previous research, namely that engagement with survey information correlates with stated preferences, is causal. The results can shed light on how survey information affects stated preferences as well as to what extent heterogeneity in engagement can explain preference heterogeneity among respondents.

2. Data and experimental design

The first part of the questionnaire provided respondents with information on the two types of gardens studied and their attributes. This part included the treatments used to answer this paper's research question. In the following part, respondents participated in a discrete choice experiment with eight choice sets. Afterwards, respondents answered follow-up questions and evaluated eight recall statements testing their recall of the information provided before the choice experiment. The questionnaire ended with questions on socio-demographic characteristics. We included a back button on each survey page so that respondents had the option to go back to previous pages.

2.1. Information provision and treatments

We used six different questionnaire versions to implement the two-by-three between-subject experimental design. Respondents were randomly assigned to one of the six versions. The versions only differed on one survey page before the discrete choice experiment. This page first provided information about two types of urban gardens, allotment garden areas (*Kleingartenanlagen*) and community gardens (*Gemeinschaftsgärten*). This information was seen by all respondents, independent of the treatment to which they were assigned:[2]

In Berlin/Stuttgart there are different types of gardens. This survey is about gardens which are not only private, but where many people can garden in.

Allotment garden areas are managed by an allotment garden association. Members of the association cultivate private parcels individually. There are public paths and spaces that can also be used by visitors. There is often a community house.

Community gardens are managed jointly by a group of people. They may be organized as an association, as a non-profit organization, or not formally organized at all. The group together cultivates shared or private patches. There is a shared garden area that is open to visitors.

As part of our experimental manipulations, half of the respondents received an additional paragraph on the same page providing information about the benefits of urban gardens for the neighborhood:

Allotment garden areas and community gardens not only provide benefits for the gardeners, they also impact the neighborhood. They can be used as a place for relaxation, meeting people, or enjoying nature. Some allotment garden areas and community gardens have a public café or a beer garden open to visitors. When it is hot, the green area cools the surroundings, because it evaporates water and heats up less than concrete or asphalt. Some plants in the gardens can retain pollutants like nitrogen oxides and particulate matter. This improves air quality. The gardens also promote urban biodiversity, as they are habitats for animals and plants, and connect adjacent habitats.

The additional information paragraph was designed to mimic commonly used information scripts which have a strong effect on stated preferences: The paragraph describes the impact of urban gardens, but only covers their benefits. A non-use value, unfamiliarity and new information have been related to strong information effects (Hoehn and Randall, 2002; Bateman and Mawby, 2004; Hasselström and Håkansson, 2014) – all these factors apply to some degree: The described benefits for biodiversity likely have non-use value for respondents. Community gardens are rather unfamiliar to respondents, as only 24% of our respondents stated they had ever visited one. Most probably the information concerning the impact of gardens on cooling and pollutant retention is also new for many respondents.

At the bottom of the same survey page, we included the second experimental manipulation with three different versions. For a third of the respondents, the page ended after the information. A further third of the respondents were asked three quiz questions with yes and no as possible answers, as recommended by Mathews et al. (2006) to reinforce comprehension. Finally, another third of the respondents were asked three self-reference questions with yes and no as possible answers. They were designed to be similar to the quiz questions in structure and content to allow us to attribute any difference to the type of question rather than the content.

The quiz questions read as follows:

Can visitors also use allotment garden areas? yes/no

Can new gardeners participate in community gardens? yes/no

Is it only gardeners who benefit from allotment garden areas and community gardens? yes/no

The self-reference questions read as follows:

Would you use a new allotment garden area in your neighborhood? yes/no

Would you participate in a new community garden in your neighborhood? yes/no

Would you personally benefit from a new allotment garden area or community garden in your neighborhood? yes/no

Fig. 1 summarizes the experimental design and sample sizes per treatment. On the following pages, the survey provided respondents with detailed information on six attributes of the gardens.[3] These pages and the remaining part of the questionnaire were identical for all respondents.

[2] The questionnaire was presented to respondents in German. All text described in this paper is translated to English by the authors.

[3] An English translation of the information on attributes can be found in Appendix G.

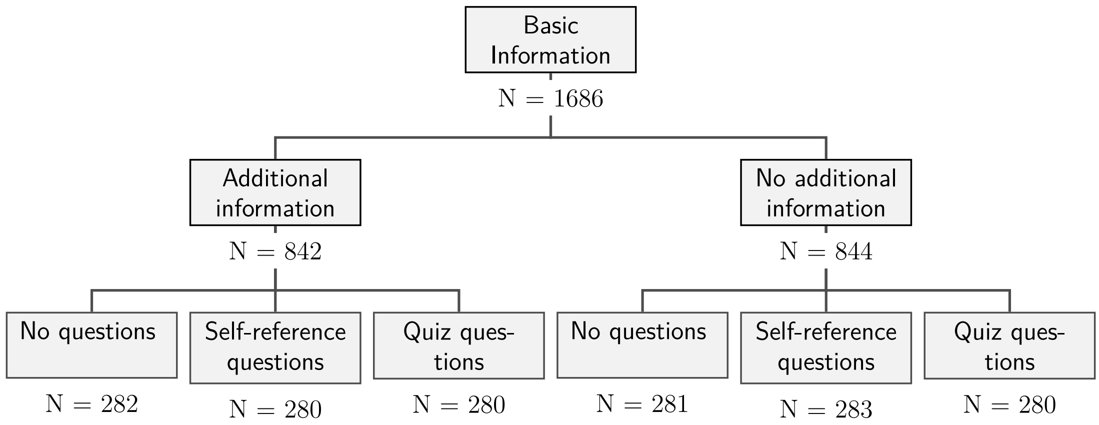

Fig. 1. Flowchart of experimental manipulations.

Table 1
Discrete choice experiment attributes and their levels.

Attribute	Description	Levels
Size of garden	Area of the allotment garden site or community garden	500 m^2, 1000 m^2, 2000 m^2, 5000 m^2 10,000 m^2, 20,000 m^2
Distance from residence	Distance from the place of residence of the respondent to the garden site	300 m (5 min walk) 600 m (10 min walk) 1 km (15 min walk) 2 km (30 min walk) 3 km (45 min walk)
Neighborhood events	Organization of social events for gardeners and visitors from the neighborhood	None Community activities Cultural events Environmental education
Access for visitors	Number of days a week that the garden is open for visitors	2 days a week 5 days a week 7 days a week
Garden style	Aim of garden layout and maintenance: orderly aesthetic or natural dynamic	Rather orderly Rather natural
Yearly fee	Compulsory yearly payment per individual	6 Euro, 12 Euro, 36 Euro, 60 Euro, 90 Euro, 120 Euro

2.2. Discrete choice experiment

In the choice tasks, respondents could choose whether they preferred an allotment garden area or a community garden to be created in their neighborhood. Each garden was characterized by a combination of levels of the same six attributes, as presented in Table 1. The attributes included the size of the garden; its distance from the place of residence of the respondent; the hosting of community activities, cultural events and environmental education; the number of days it is accessible for visitors; and its garden style. The monetary attribute was defined as a compulsory yearly payment to a garden fund for every adult resident of the city district. Respondents were informed that the money would be exclusively used to subsidize the creation and maintenance of new gardens.

The selection of attributes, their levels, and definitions were guided by expert consultations with the city administrations of Berlin and Stuttgart in a workshop in January 2020 and bilateral follow-up meetings with selected experts. In addition, four live chat focus groups with a total of 35 participants from the general population of Berlin and Stuttgart were conducted in June 2020 to assess the relevance and understanding of potential attributes. The selected attributes were tested in an online pretest with 100 respondents from Berlin in August 2020. Based on the results, some attribute descriptions were refined and the maximum level of the size and cost attribute reduced.

The discrete choice experiment consisted of a sequence of eight choice tasks. Each choice task included one alternative labeled as an allotment garden area and one alternative labeled as a community garden. Respondents were asked to choose their most preferred option. Respondents could also indicate that they did not want to create either of the two gardens (opt-out). Fig. 2 shows an example choice task.

The design includes 32 choice tasks split into four blocks. Each respondent was randomly assigned to one block of eight choice tasks. The order of the choice tasks from the respective block was randomized within subjects, and each respondent received attributes in a random (but constant for the respondent) order. The design was created with the Stata module dcreate, using the

	Community garden	Allotment garden site
Distance from your residence	2 kilometres (30 minutes walking)	600 metres (10 minutes walking)
Neighbourhood events	Community activities	Cultural events Environmental education
Garden style	Rather orderly	Rather natural
Access for visitors	5 days a week open	7 days a week open
Size of garden	2,000 m²	1,000 m²
Annual fee to garden fund	€60	€120
	☐	☐

☐ None of the gardens should be implemented.

Note: The tasks were originally displayed in German.

Fig. 2. An example choice task.

Fedorov algorithm to maximize the D-efficiency for dummy coded attributes in a multinomial logit model with priors taken from the pretest (Hole, 2017). The pretest design was an orthogonal array with the same number of choice sets and blocks.

2.3. Follow-up questions and recall statements

After the discrete choice experiment, respondents answered questions on choice certainty, perceptions of survey consequentiality and credibility, and their reasons for choosing the opt-out option. This was followed by eight statements about the information provided on the page, including the treatments. For each statement, respondents could choose between the options "correct", "false", or "don't know".

There were two statements on the paragraph about allotment garden areas:

Allotment garden areas can only be entered by members.

Only members of the allotment garden association can have a parcel in allotment garden areas.

Moreover, there were two statements on the paragraph about community gardens:

Community gardens can only be entered by members.

Community gardens are always managed by an association.

Finally, there were four statements on the additional information about the impact of the gardens on the neighborhood:

Cafés and beer gardens in allotment garden areas and community gardens are only for members.

Allotment garden areas and community gardens connect adjacent habitats for animals and plants.

The plants in allotment gardens and community gardens retain nitrogen oxides.

When it is hot, gardens warm the surroundings because they heat up more than concrete or asphalt.

We use the respondents' number of correctly evaluated statements as an indicator to assess the extent to which respondents after the choice experiment recall the information that was provided before the choice experiment.

2.4. Survey implementation

The survey was implemented online and administered by a professional public opinion polling agency from September to October 2020. A total of 1,084 respondents from Stuttgart and 602 respondents from Berlin completed the questionnaire. Participants were recruited via two modes, where 507 respondents from Stuttgart and all 602 respondents from Berlin were drawn from a panel that the polling agency recruited offline without the possibility of self-enrollment. To increase the sample size in Stuttgart, letters

Table 2
Socio-demographic characteristics.

Characteristic	No additional info or questions	Quiz	Self-reference	Information	Info × quiz	Info × self-reference
Age	**49.4 (15.2)**	**49.4 (15.7)**	**49.9 (15.9)**	**49.1 (15.7)**	**49 (16.5)**	**49.4 (16.3)**
Gender						
Female*	44.1%	49.6%	51.9%	44.7%	47.1%	47.1%
Male	55.2%	50%	47.3%	53.2%	52.5%	51.4%
Household size	**2.2 (1.2)**	**2.1 (1.1)**	**2.3 (1.2)**	**2.2 (1.3)**	**2.3 (1.1)**	**2.3 (1.2)**
Number of children under 14	**0.4 (0.8)**	**0.4 (0.8)**	**0.4 (0.8)**	**0.5 (0.9)**	**0.4 (0.8)**	**0.5 (0.8)**
Household monthly income [EUR]						
Less than 3000	33.1%	33.6%	29.3%	34.4%	32.1%	31.4%
3000 or more	51.6%	49.3%	55.5%	50%	53.6%	52.1%
University education						
University degree	57.3%	56.4%	51.2%	53.5%	51.4%	53.6%
No university degree	40.2%	42.1%	47.7%	44%	45.7%	43.6%
Use of community gardens						
Regular use of community gardens	5.3%	4.6%	3.9%	4.3%	3.6%	3.2%
No use of community gardens	68.3%	66.1%	67.8%	58.2%	66.1%	62.9%
Use of allotment gardens						
Regular use of allotment gardens	14.6%	15.7%	15.5%	13.5%	11.4%	11.1%
No use of allotment gardens	83.3%	82.1%	82.7%	84%	87.9%	87.1%
Number of respondents	**281**	**280**	**283**	**282**	**280**	**280**

Note: For age, household size and the number of children under 14, the table shows means (and standard deviations in parentheses). For gender, household monthly income, university education, and use of allotment and community gardens, shares of participants are reported. The shares do not sum up to 100% because of missing observations. The category female* also includes two people that are diverse.

with a brief invitation to the survey and links to the online questionnaire were sent in September via mail to a sample of 11,000 home addresses selected randomly from the official registry of the city of Stuttgart, and 577 additional respondents completed the questionnaire after receiving this postal invitation.

Table 2 shows socio-demographic characteristics of the respondents, separated into the six samples of the two by three study design. Differences between the samples are not statistically significant for any socio-demographic variable in Kruskal–Wallis and Chi-squared tests (p-values between 0.26 and 0.98).

3. Methods

Our analysis is based on two different modeling approaches. First, we use ordinary least squares (OLS) regressions to regress (i) time spent on relevant survey pages, (ii) the number of correctly evaluated recall statements, and (iii) the number of opt-out choices on the treatment variables and selected control variables. These models show how the treatments and respondent characteristics affect survey engagement, information recall and stated preferences. Second, for a more nuanced picture of the effect on stated preferences, we estimate willingness-to-pay values for the attributes in the choice experiment with mixed logit models. The first mixed logit model with treatment interactions tests how our treatments affect willingness-to pay-values. The second model with time interactions tests for correlations between engagement and stated preferences to enable a comparison with the results of previous studies (in particular, Holmes et al., 1998; Vista et al., 2009; Tienhaara et al., 2021). Table 3 shows the coding of the manipulations that are used in the same fashion in all models investigating their effects.

Table 3
Coding of manipulations.

Factor	Description	Levels
INFO	The information script was shown.	0 if not shown 1 if shown
QUIZ	The quiz questions were shown.	0 if not shown 1 if shown
SELF	The self-reference questions were shown.	0 if not shown 1 if shown

3.1. Specification of OLS models

We estimate five OLS models which differ only in the dependent variable. The model takes the form

$$\begin{aligned} Y &= \alpha + \beta_1 * INFO + \beta_2 * QUIZ + \beta_3 * SELF \\ &+\beta_4 * INFO * QUIZ + \beta_5 * INFO * SELF + \boldsymbol{\gamma} * \mathbf{CONTROL} + \epsilon \end{aligned} \tag{1}$$

where Y is the dependent variable being (i) time in seconds spent on the screen with information about the two types of urban gardens, (ii) time in seconds spent for the total questionnaire excluding the screen with information, (iii) time in seconds spent on the choice experiment, (iv) the number of correctly evaluated recall statements about the information ranging from zero to eight (as indicator for information recall), and (v) the number of opt-out choices ranging from zero to eight. The variables INFO, QUIZ and SELF are the manipulations described in Table 3. $CONTROL$ is a vector of control variables, including age, gender, education, mode of recruitment as well as the usage of allotment gardens and community gardens. The latter two are included as we expect that people who use these gardens are already familiar with urban gardens and most interested in the subject. The βs are parameters to be estimated, measuring the impact of the manipulations on the dependent variable, and γ is a vector of parameters for the control variables. Finally, ϵ is a normally distributed and independent and identically distributed error term.

3.2. Mixed logit model with treatment interaction terms

We use a mixed logit model with interaction terms to estimate the effect of our manipulations on stated preferences. To understand individuals' preferences disclosed through choices in the choice experiment, we apply the random utility framework (McFadden, 1974) and represent the utility of individual i as

$$U_i = \mathbf{\beta_i'}\mathbf{X} + \mathbf{\beta_T'}\mathbf{XT} + \beta_{iC}C + \epsilon_i \tag{2}$$

where U_i is the utility of respondent i, X is a vector of the alternative-specific constants for allotment and community gardens, as well as the non-monetary attributes; C is the cost attribute; T is a vector of binary treatment variables as defined in Table 3; and ϵ_i is an independently and identically-over-all alternatives Extreme Value Type I distributed error term. The parameters β_i and β_{iC} measure the impact of a one-unit change in X and C on utility. Differences in preference parameters between the treatment groups are captured by the parameters of the interaction terms, namely by $\mathbf{\beta_T}$.

The parameters which are indexed over i are random parameters, following a predefined distribution. The mean value of the distribution reflects the mean preference while the standard deviation indicates how heterogeneous preferences are within the sample. An index for time, capturing the panel structure of the data, is omitted for readability.

The interpretation of the parameters is limited, as utility has no specified unit of measurement. Hence, we use willingness-to-pay, which is defined as the negative ratio of the parameter of attribute k, β_{ik}, and the cost parameter, β_{iC}; that is, $w_{ik} = -\frac{\beta_{ik}}{\beta_{iC}}$, where w_{ik} can be interpreted as the marginal willingness-to-pay for attribute k. To ease the interpretation of the model estimates, we estimate our model directly in willingness-to-pay space (Train and Weeks, 2005). The willingness-to-pay space model is a reparametrization of Eq. (2). Each non-monetary parameter is multiplied by $\frac{-\beta_{iC}}{-\beta_{iC}}$ so that each estimated parameter reflects the willingness-to-pay $-\frac{\beta_{ik}}{\beta_{iC}}$, rather than the effect on utility β_{ik}.

$$U_i = -\beta_{iC}(\mathbf{w_i'}\mathbf{X} + \mathbf{w_{iT}'}\mathbf{XT} - C) + \epsilon_i \tag{3}$$

All w parameters are assumed to be normally and β_c log-normally distributed. This model can be estimated with the maximum simulated likelihood method (Train and Weeks, 2005).

3.3. Mixed logit model with time interaction terms

Some empirical studies investigate the relation between stated preferences and engagement with survey information measured in time spent on relevant survey parts (Holmes et al., 1998; Vista et al., 2009; Tienhaara et al., 2021). In contrast to our approach based on experimental manipulations, these models do not reliably identify causal relationships due to potential endogeneity, such as stated preferences and survey engagement being co-determined by underlying preferences. We estimate a mixed logit model with time as an indicator for engagement. This allows us to investigate whether we can find (not necessarily causal) correlations between engagement and stated preferences, as in previous studies, and compare whether these relationships hold up in the causal model with treatment interactions described above.

Our modeling approach is borrowed from one of these studies (Vista et al., 2009).[4] We estimate a heteroscedastic mixed logit model with the alternative specific constant and each attribute interacted with the time spent on the information screen before preference elicitation. Allowing for heteroscedasticity in time shows how people who spend more or less time reading the information differ in their level of attention to the choice sets, and thus in the randomness of their choices.

For better interpretation of coefficients, we divide time by 10 (i.e., a one unit increase in time corresponds to 10 s) and estimate the model in WTP space. To avoid confounding with the treatment effects, we use as the time variable its deviation from the treatment means ($time - mean(time_{Treatment})$). Heteroscedasticity is operationalized by modeling the scale parameter λ as $\lambda = exp(\phi * Time)$, whereas ϕ is a parameter to be estimated (Hensher et al., 1998; DeShazo and Fermo, 2002), entering utility as

$$U_i = exp(\phi * Time) * -\beta_{iC}(\mathbf{w_i'}\mathbf{X} + \mathbf{w_{iTime}'}\mathbf{X} * Time - C) + \epsilon_i \tag{4}$$

The specification is similar to the mixed logit model described above with the difference that we multiply utility with λ, and that the interaction terms are formed with the time spent on the information page ($Time$), rather than the treatments. The parameters of the interaction terms indicate the relation between time spent on the information page and stated preferences, and ϕ indicates how the error variance varies with $time$.

[4] Our model differs from Vista et al. (2009) in some ways: (i) We use a continuous time variable instead of a binary cut off. (ii) We interact the time variable with all attributes and the alternative specific constants (ASC), instead of only the ASC. (iii) We estimate a mixed logit model to use the same specification as our first model, instead of a conditional logit model.

Table 4
Results of OLS predicting number of correct recall statements.

	Model 1	Model 2
Intercept	6.22 (0.10)***	6.19 (0.10)***
Information	−0.15 (0.14)	−0.13 (0.13)
Quiz questions	0.07 (0.14)	0.11 (0.14)
Self-reference questions	−0.28 (0.14)**	−0.23 (0.13)*
Information × quiz questions	0.38 (0.19)**	0.34 (0.19)*
Information × self-reference questions	0.39 (0.19)**	0.34 (0.19)*
Gender		−0.11 (0.08)
Age (10 years)		−0.07 (0.03)***
University education		0.27 (0.08)***
Use of allotment gardens		0.40 (0.08)***
Use of community gardens		0.25 (0.10)**
Recruited by mail		−0.03 (0.09)
R^2	0.01	0.06
Adj. R^2	0.01	0.05
Num. obs.	1533	1533
RMSE	1.55	1.52

Notes: ***, **, and * indicate 1%, 5%, and 10% significance levels, respectively. Standard errors are displayed in parentheses.

3.4. Pre-registered analysis and outcomes

We pre-registered key outcomes and steps of our analysis.[5] All six experimental conditions described above were part of the pre-registration. We defined the time spent on the information page, the number of correctly evaluated recall statements, the number of opt-out choices and the willingness-to-pay for the attributes as our main outcomes for engagement, recall and stated preferences, respectively. We also specified OLS regressions and mixed logit models in willingness-to-pay space. We did not, however, pre-register the mixed logit model with time interactions that we use to explore the relation between time and stated preferences found by previous studies.

4. Results

4.1. Effects on engagement

Table 8 in Appendix A presents OLS estimates predicting the time spent on the survey screen that provided information and treatments. Trivially, respondents spend more time on the screen if it contains one of the manipulations. However, it is notable that respondents who answer quiz questions spend on average statistically significantly ($p > 0.001$) more time (65 s) than those who answer self-reference questions (50 s). This is an indication that the quiz questions induce stronger engagement with the information screen than self-reference questions.

Table 9 in Appendix B presents OLS estimates predicting the total time spent on the questionnaire excluding the screen with information and treatments, and Table 10 in Appendix C presents OLS estimates predicting the time spent on the choice sets. The results reveal whether the treatments have a spill-over effect on the time spent on other parts of the questionnaire. For example, respondents may compensate for the time spent on the information page by rushing other parts in the questionnaire, or more information may lead to a generally longer engagement with the questionnaire. However, the results indicate that there is no large spill-over effect.

4.2. Effects on information recall

Table 4 presents OLS estimates of the number of correctly evaluated recall statements about the information. Model 1 includes the experimental manipulations, while Model 2 adds socio-economic covariates (vector **CONTROL** in Eq. (2) above). Respondents evaluated on average 6.2 of the eight statements correctly. Note that this implies respondents knew the correct answer in, on average, around half of the cases, because they would have guessed correctly by chance in two of the remaining four statements. In contrast to the time spent on the screen, the manipulations only have small and mostly statistically insignificant effects on correctly evaluated statements. However, socio-economic covariates play a major role in correctly evaluating statements about the information. Younger respondents, more educated respondents, and respondents who regularly use community or allotment gardens are more likely to evaluate the statements correctly. The magnitude of some of these estimates outweigh the treatment effects. Respondents who regularly use allotment gardens give on average 0.4 more correct responses which is more than what can be achieved by adding questions or information. The recruitment method had no impact on the number of correct answers. In Appendix D, we provide output from a Poisson and a Negative Binomial regression model as additional robustness tests. The models find neither large nor statistically significant treatment effects.

[5] The pre-registration is available under this link: https://aspredicted.org/blind.php?x=2aq63r.

Table 5
Results of OLS predicting number of opt-out choices.

	Model 1	Model 2
Intercept	2.53 (0.18)***	2.53 (0.18)***
Information	0.20 (0.25)	0.19 (0.25)
Quiz questions	0.09 (0.25)	0.05 (0.25)
Self-reference questions	0.01 (0.25)	0.01 (0.25)
Information × quiz questions	−0.11 (0.36)	−0.04 (0.35)
Information × self-reference questions	−0.23 (0.36)	−0.22 (0.35)
Gender		−0.10 (0.14)
Age (10 years)		0.29 (0.05)***
University education		0.28 (0.15)*
Use of allotment gardens		−0.73 (0.15)***
Use of community gardens		−0.54 (0.18)***
Recruited by mail		−0.03 (0.16)
R^2	0.00	0.06
Adj. R^2	−0.00	0.05
Num. obs.	1533	1533
RMSE	2.87	2.80

Notes: ***, **, and * indicate 1%, 5%, and 10% significance levels, respectively. Standard errors are displayed in parentheses.

4.3. Effects on stated preferences

To estimate the effect of our manipulations on stated preferences, we estimate (1) an OLS model predicting the number of opt-out choices and (2) a mixed logit model in willingness-to-pay space with the treatment variables as interaction. While the OLS model reveals the effect of our manipulations on choosing one of the gardens in general, the mixed logit model details the effects on the willingness-to-pay for specific attributes.

Table 5 reports results from an OLS model with the treatment variables (Model 1) and with additional covariates (Model 2). The models have very low predictive power as indicated by an adjusted R^2 of 0.00 and 0.05 respectively. The intercept indicates that, on average, a respondent opts out in 2.5 of eight choice situations. The effects of all treatment variables are not statistically significant and very small, ranging from 0.01 to 0.23. In contrast, some of the control variables are statistically significant. An increase in age by ten years increases the number of opt-out choices by nearly 0.3. People not using allotment gardens and community gardens opt out nearly one time more often than people who use them. Overall, the models indicate that the additional information, as well as the quiz and self-reference questions, have no effect on how often respondents opt out in the choice experiment. Appendix D shows output from four different count data regression models as robustness tests, and the models show neither large nor statistically significant treatment effects.

Table 6 presents the results of the mixed logit model in stacked form. The model was estimated in R 4.1.2, using the apollo package version 2.6 (Hess and Palma, 2019). The first two columns report the mean and standard deviations of the normally distributed random parameters of the attributes' main effects, respectively. They indicate the mean willingness-to-pay for a one unit increase and its estimated standard deviation for respondents who have received no additional information or questions, i.e., the baseline. The following columns report the interaction effects with the different treatments, expressed in additional willingness-to-pay compared to the baseline. The last two columns are three-way interactions between the attributes, the information text and the quiz or self-reference questions. A positive sign of the interaction parameters implies a higher estimated willingness-to-pay among the respondents in the respective treatment groups compared to the baseline.

The estimated mean parameters of the main effects have the expected signs, and most parameters are highly statistically significant. The willingness-to-pay for a new community garden in the neighborhood (ASC (alternative-specific constant) community garden) is twice as high as for a new allotment garden area (ASC allotment garden) at approximately 60 Euro per year compared to approximately 30 Euro per year. An increase in the distance from the respondent's residence to the garden by one kilometer reduces willingness-to-pay by 20 Euro, and the presence of cultural events or environmental events increases willingness-to-pay by almost 15 Euro. An additional day of public access increases willingness-to-pay by 5 Euro and a natural garden layout compared to an orderly layout increases it by 20 Euro. The size of the garden and the presence of community activities have no statistically significant effect. Note that all standard deviations are highly significant and larger than the means. This implies a high degree of preference heterogeneity, with a considerable share of respondents even exhibiting negative willingness-to-pay. This may be an indication of some respondents valuing the opportunity costs of using space in their neighborhood for a new garden more highly than its benefits.

There are no statistically significant interaction effects at the 5% level, i.e., we cannot confirm any shift in stated preferences caused by our manipulations. We have validated the findings by estimating various model specifications including separate models for each treatment. In all models, we obtain similar results.[6] To jointly assess explanatory power of the treatments, we use likelihood

[6] We also estimated a model with alternative-specific attribute parameters to control for potential differences in the good to be valued. While people are more familiar with allotment gardens, which have a long tradition in Germany, the concept of community gardens is rather new. Hence, additional information

Table 6
Results of the mixed logit model in willingness-to-pay space.

	Main effects (mean)	Main effects (standard deviations)	INFO	QUIZ	SELF	INFO × QUIZ	INFO × SELF
ASC community garden	59.15***	89.03***	5.64	−3.34	−2.99	−22.13	6.38
	(7.12)	(3.75)	(11.38)	(11.44)	(11.17)	(17.05)	(16.62)
ASC allotment garden	29.28***	92.36***	−1.22	0.2	11.25	−1.04	−0.37
	(8.1)	(3.6)	(13.39)	(12.11)	(11.44)	(18.8)	(17.9)
Size (per 1000 m^2)	0.04	2.43***	0.67	0.91*	1*	−0.4	−0.68
	(0.36)	(0.25)	(0.52)	(0.5)	(0.53)	(0.73)	(0.74)
Distance (per 1000 m)	−20.68***	26.96***	−5.46	−0.3	−1.98	5.32	1.4
	(2.64)	(1.57)	(4.06)	(3.84)	(4.21)	(5.8)	(5.94)
Community activities	5.53	18.97***	10.98*	9.43	9.77*	−7.22	−12.86
	(4.09)	(3.21)	(6.14)	(5.82)	(5.91)	(8.36)	(8.58)
Cultural events	13.4***	37.8***	−9.34	11.26*	−6.04	−2.27	8.21
	(4.59)	(2.78)	(6.71)	(6.83)	(6.61)	(9.49)	(9.48)
Environmental education	14.33***	25.54***	−4.69	−0.18	−6.51	−0.25	11.24
	(4.25)	(3.72)	(6.32)	(6.03)	(6.09)	(8.66)	(9.04)
Access (per open day)	5.24***	11.71***	1.55	1.89	2.73	−1.11	−2.65
	(1.17)	(0.71)	(1.79)	(1.85)	(1.8)	(2.63)	(2.6)
Near-natural garden layout	20.47***	56.52***	8.98	3.15	9.18	−10.47	−8.51
	(5.51)	(2.75)	(7.57)	(7.52)	(7.95)	(10.32)	(10.57)
Yearly fee (per 1 Euro)	1.09***	0.68***					
	(0.05)	(0.08)					
Log-likelihood at convergence	−12 428.337						
Log-likelihood at constant(s)	−11 237.026						
Rho-square	0.242						
Adj. Rho-square	0.237						
AIC	22 604.052						
BIC	23 092.173						
Number of observations	13 488						
Number of respondents	1686						
Number of parameters	65						

Note: ***, **, and * indicate 1%, 5%, and 10% significance levels, respectively. Standard errors are displayed in parentheses.

ratio tests to compare the improvements in terms of model fit over a mixed logit model in WTP space without any treatment interactions (see Table 13 in Appendix E for model results), for (i) the model with all interactions as reported in Table 6, (ii) a model with interactions indicating whether additional information was presented, and (iii) a model with interactions indicating which question type was presented. The results are presented in Table 14 in Appendix F.

The test indicates that model fit does not improve for the model with all interactions or, the model with the interaction with the additional information. An improvement in model fit is only present for the model with only question interactions (at a 1% significance level).

4.4. Correlation between engagement and stated preferences

Table 7 shows the results for the mixed logit model allowing for correlations between time spent on the information page and both willingness-to-pay and error variance. Mean willingness-to-pay values for the attributes are similar to mean willingness-to-pay in the mixed logit model without any interaction terms (see Appendix E). The small and insignificant parameter ϕ indicates no correlation between time and error variance. In contrast, some interaction terms with willingness-to-pay are significantly different from zero. Respondents who spend more time on the information page than the treatment mean are willing to pay less for a new community garden or allotment gardens (ASC), holding all other attributes constant. Staying ten seconds longer on the information page translates into a 3 to 4 Euro lower willingness-to-pay. These amounts are, however, relatively small, taking into account the large heterogeneity between respondents' willingness-to-pay for a new garden, as indicated by the standard deviations of 90 to 95 Euro. With respect to attributes, we find positive and significant correlations (5% significance level) for cultural events and near-natural garden layout. There is also a small negative correlation between time and distance (10% significance level). The remaining correlations are not statistically significant and relatively low in magnitude. A likelihood-ratio test (LR = 21.84; d.f. = 10; p = 0.02) shows that the model with time interaction terms has a better model fit than a simple mixed model without any interaction effects. These results indicate that, in our study, response time is correlated with stated preferences and value estimates, although not in a consistent direction and not throughout all attributes.

might have a particular effect on the preferences for community gardens. However, we did not find any statistically significant differences in the interaction effects between allotment garden and community garden parameters.

Table 7
Results of the mixed logit model in willingness-to-pay space with time interactions.

	Main effects (mean)	Main effects (standard deviations)	Time interactions
ASC community garden	59.31***	90.21***	−3.13***
	(3.62)	(3.92)	(1.03)
ASC allotment garden	32.09***	95.14***	−3.69***
	(3.91)	(3.99)	(0.98)
Size (per 1000 m^2)	0.82***	2.25***	−0.02
	(0.15)	(0.31)	(0.04)
Distance (per 1000 m)	−23.59***	27.92***	−0.56*
	(1.27)	(1.62)	(0.31)
Community activities	12.98***	23.62***	−0.32
	(1.82)	(3.61)	(0.45)
Cultural events	11.22***	39.75***	1.21**
	(2.12)	(2.93)	(0.58)
Environmental education	13.48***	20.24***	0.3
	(1.87)	(3.38)	(0.51)
Access (per open day)	6.94***	11.57***	−0.23
	(0.56)	(0.79)	(0.15)
Near-natural garden layout	26.44***	57.25***	1.17**
	(2.24)	(2.81)	(0.56)
Yearly fee (per 1 Euro)	1.05***	0.62***	
	(0.04)	(0.06)	
Time on error variance (Phi)	−0.01		
	(0.01)		
Log-likelihood at convergence	−13 010.053		
Log-likelihood at constant(s)	−11 240.948		
Rho-square	0.241		
Adj. Rho-square	0.239		
AIC	22 541.896		
BIC	22 767.183		
Number of observations	13 488		
Number of respondents	1686		
Number of parameters	30		

Note: ***, **, and * indicate 1%, 5%, and 10% significance levels, respectively. Standard errors are displayed in parentheses.

5. Discussion and conclusions

One precondition for valid stated preference estimates is that respondents have sufficient information on the good to be valued to make informed choices. For the provided information to have the desired effect, it is important to ensure that respondents process the information and recall it during preference elicitation. While various studies investigated how much and what type of information should be provided, there have been few stated preference studies on the processing of information and these have only identified correlations between engagement with the information and stated preferences. Despite the absence of conclusive evidence, the stated preference literature recommends the use of quiz questions to reinforce respondent engagement. Psychology literature, in contrast, concludes that self-reference questions are more effective.

In this paper, we used a two-by-three between-subject design in a choice experiment on urban gardens to investigate the effect of quiz and self-reference questions on engagement with the information, recall of the information, and stated preferences. We deployed six different questionnaire versions that differed in the amount of information and the presence of questions. Our study was the first to empirically test the recommendation to use quiz questions to reinforce information processing. Although we found that respondents confronted with quiz questions spend more time on the information page than those who are not asked any questions or are asked self-reference questions, we did not find statistically significant effects on recall and stated preferences. This suggests that including quiz questions about the provided information in stated preference questionnaires may be less helpful than generally assumed.

Although studies found self-reference questions to be more effective for enhancing information processing than semantic questions like quiz questions, in our case, respondents spend more time on the information screen when answering quiz rather than self-reference questions. We did not find statistically significant effects on recall or stated preferences, either. Different experimental settings may be a reason why we cannot replicate the effect of self-reference questions found in the original studies. The original studies tested the engagement with and recall of isolated words (e.g., Rogers et al., 1977). Our results suggest that these findings do not transfer to the setting of extensive information texts. The results do not provide evidence for recommending the inclusion of self-reference questions in stated preference surveys.

In our study, respondents seeing additional information on the benefits of urban gardens do not differ in their stated preferences. This contrasts with findings from numerous studies showing that additional information about the good to be valued increases value estimates (e.g., Hoevenagel and van der Linden, 1993; Munro and Hanley, 2001; Bateman and Mawby, 2004). The information treatment in our study fulfills characteristics that have been related to strong information effects to some degree: Additional information is found to affect stated preferences more if non-use values are important (Bateman and Mawby, 2004). Urban gardens provide non-use values by promoting urban biodiversity as well as use values. Bateman and Mawby (2004) also find information effects to be stronger for unfamiliar goods. Community gardens are rather unfamiliar to respondents, as only 24% stated they had ever visited one, while allotment gardens are familiar to most respondents. Hoehn and Randall (2002) and Hasselström and Håkansson (2014) find that additional information affects predominantly the stated preferences of those respondents for whom the information is new. This might have limited the effect of our information treatment, as even respondents without the additional information evaluated part of the recall statements correctly.

Particularly noteworthy is that the additional information does not increase the number of correctly evaluated recall statements, even though half of the statements were about the additional information. Some caution may be advised when constructing stated preference surveys that rely on information text. While information provision is a necessary precondition for informed choices, in particular for unfamiliar goods, our findings call into question whether the information is sufficiently processed and recalled in preference elicitation. Questions or statements about the information, similar to those that we employed after the choice task, could be used in pretesting to assess whether necessary information is understood and recalled. If not, alternative ways of providing important information like videos, pictures or diagrams could be considered.

While we do not find treatment effects on stated preferences, we find significant correlations between stated preferences and the time spent on the information page, similar to the findings of previous studies (Holmes et al., 1998; Vista et al., 2009; Tienhaara et al., 2021). Our results suggest that the previously found correlations might reflect heterogeneity in respondent characteristics rather than a causal effect of engagement on stated preferences. This may impede enhancing information processing by enforcing engagement with the survey design. Instead, it is important to think carefully about target populations and sampling, as respondent characteristics such as sociodemographic variables and prior information can matter more for knowledge about the good than information provided in the survey.

To advance the question how to reinforce information processing in stated preference surveys, more research is necessary. First, it would be interesting to investigate manipulations of engagement similar to ours in the context of different goods and valuation scenarios, such as goods that provide exclusively non-use values or are very unfamiliar to the respondents. Second, a more extensive investigation of quiz and self-reference questions might produce a more detailed picture of how such questions can be constructed to be most effective. For example, one could vary the number of questions, the difficulty of these questions, and their position in the questionnaire. Third, the effect of pictures, videos, animations and other information display formats may affect the engagement with the information. The combination of these formats of information provision with questions can shed some light on how information is processed in different formats and whether these questions lead to improved engagement and recall. Finally, eye-tracking can help to better understand the effect of quiz and self-reference questions. One could, for example, investigate if people cross-check their answers with the information provided.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The manuscript was produced in quarto and all files, including data and code, required to reproduce the manuscript are available on Github https://github.com/sagebiej/infoprocessing.

Acknowledgments

We gratefully acknowledge funding from the German Federal Ministry of Education and Research (FKZ: 033W107A-J, project GartenLeistungen)

Appendix A. OLS predicting time spent on information page

See Table 8.

Appendix B. OLS predicting total time spent on questionnaire

See Table 9.

Appendix C. Results of OLS predicting time spent on choice experiment

See Table 10.

Table 8
Results of OLS predicting time on information page.

	Model 1	Model 2
Intercept	24.25 (2.11)***	24.55 (2.10)***
Information	12.08 (2.98)***	12.02 (2.97)***
Quiz questions	40.38 (3.03)***	40.09 (3.02)***
Self-reference questions	25.33 (2.98)***	25.02 (2.97)***
Information × quiz questions	−3.73 (4.26)	−3.46 (4.24)
Information × self-reference questions	−5.77 (4.24)	−5.53 (4.22)
Gender		−0.10 (1.74)
Age (10 years)		−0.88 (0.58)
University education		−2.21 (1.79)
Use of allotment gardens		−0.81 (1.85)
Use of community gardens		0.79 (2.17)
Recruited by mail		6.92 (1.95)***
R^2	0.20	0.21
Adj. R^2	0.20	0.21
Num. obs.	1422	1422
RMSE	32.76	32.62

Notes: ***, **, and * indicate 1%, 5%, and 10% significance levels, respectively. Standard errors are displayed in parentheses. Outliers who spent more than one and a half standard deviations above the mean time have been removed. This definition of outliers was part of the pre-registration.

Table 9
Results of OLS predicting total time spent on questionnaire excluding information page.

	Model 1	Model 2
Intercept	929.26 (18.56)***	939.98 (17.22)***
Information	−16.12 (26.28)	−9.88 (24.34)
Quiz questions	−8.05 (26.68)	−8.73 (24.74)
Self-reference questions	−0.18 (26.23)	−9.18 (24.35)
Information × quiz questions	28.84 (37.53)	25.22 (34.77)
Information × self-reference questions	7.41 (37.35)	8.42 (34.61)
Gender		64.99 (14.29)***
Age (10 years)		61.73 (4.73)***
University education		−19.35 (14.65)
Use of allotment gardens		52.62 (15.14)***
Use of community gardens		−3.34 (17.81)
Recruited by mail		136.72 (16.01)***
R^2	0.00	0.15
Adj. R^2	−0.00	0.14
Num. obs.	1422	1422
RMSE	288.79	267.33

Notes: ***, **, and * indicate 1%, 5%, and 10% significance levels, respectively. Standard errors are displayed in parentheses.

Appendix D. Count models for quiz questions and opt-outs

Tables 11 and 12 complement the OLS models investigating the effects of the treatments on the number of correct recall statements and the number of opt out choices. For correct statements, we estimated a Poisson and a negative binomial model. For the opt-out choices we estimated additional zero inflated and hurdle count models because these models account for large frequencies of zeros (Zeileis et al., 2008), which are present in this case. All in all, the results are consistent with the OLS results. There are no significant effects of the treatments on the number of correctly evaluated recall statements nor the number of opt out choices.

Appendix E. Mixed logit model in WTP space without interactions

The model specification is equivalent to the mixed logit model in Table 6, but excluding all interaction terms with the treatments (see Table 13).

Appendix F. LR test

See Table 14.

Table 10
Results of OLS predicting time spent on choice experiment.

	Model 1	Model 2
Intercept	147.01 (4.39)***	148.78 (4.25)***
Information	−4.56 (6.22)	−3.27 (6.01)
Quiz questions	−9.58 (6.31)	−10.20 (6.10)*
Self-reference questions	−9.33 (6.20)	−10.89 (6.01)*
Information × quiz questions	8.59 (8.88)	8.17 (8.58)
Information × self-reference questions	9.34 (8.83)	9.37 (8.54)
Gender		21.08 (3.52)***
Age (10 years)		7.53 (1.17)***
University education		3.95 (3.61)
Use of allotment gardens		13.62 (3.74)***
Use of community gardens		2.37 (4.39)
Recruited by mail		21.40 (3.95)***
R^2	0.00	0.07
Adj. R^2	−0.00	0.07
Num. obs.	1422	1422
RMSE	68.30	65.95

Notes: ***, **, and * indicate 1%, 5%, and 10% significance levels, respectively. Standard errors are displayed in parentheses.

Table 11
Count regression models for number of correctly evaluated recall statements.

	Poisson	Negative binomial	OLS
Intercept	1.82***	1.82***	6.19***
	(0.03)	(0.03)	(0.10)
Information	−0.02	−0.02	−0.13
	(0.04)	(0.04)	(0.13)
Quiz questions	0.02	0.02	0.11
	(0.04)	(0.04)	(0.14)
Self-reference questions	−0.04	−0.04	−0.23*
	(0.04)	(0.04)	(0.13)
Information × quiz questions	0.05	0.05	0.34*
	(0.05)	(0.05)	(0.19)
Information × self-reference questions	0.06	0.06	0.34*
	(0.05)	(0.05)	(0.19)
Gender	−0.02	−0.02	−0.11
	(0.02)	(0.02)	(0.08)
Age (10 years)	−0.01*	−0.01*	−0.07***
	(0.01)	(0.01)	(0.03)
University education	0.04**	0.04**	0.27***
	(0.02)	(0.02)	(0.08)
Use of allotment gardens	0.07***	0.07***	0.40***
	(0.02)	(0.02)	(0.08)
Use of community gardens	0.04	0.04	0.25**
	(0.03)	(0.03)	(0.10)
Recruited by mail	−0.01	−0.01	−0.03
	(0.02)	(0.02)	(0.09)
AIC	6319.68	26.00	
BIC	6383.70	95.35	
Log likelihood	−3147.84	0.00	
Deviance	743.70	743.70	
Num. obs.	1533	1533	1533
R^2			0.06
Adj. R^2			0.05
RMSE			1.52

Notes: ***, **, and * indicate 1%, 5%, and 10% significance levels; Standard errors in parentheses.

Appendix G. Translation of the attribute descriptions

Scenario

Imagine there is unused land in your neighborhood where a new community garden or an allotment garden area could be created and consideration is being given to implementing such a new garden. It has not yet been determined what type of garden will be

Table 12
Count regression models for opt out choices.

	Poisson	Negative binomial	Zero inflated	Hurdle	OLS
Intercept	0.89***	0.90***	1.29***	1.29***	2.53***
	(0.04)	(0.08)	(0.06)	(0.06)	(0.18)
Information	0.07	0.09	0.13	0.13	0.19
	(0.05)	(0.12)	(0.08)	(0.08)	(0.25)
Quiz questions	0.03	0.00	0.06	0.06	0.05
	(0.06)	(0.12)	(0.08)	(0.08)	(0.25)
Self-reference questions	0.01	−0.00	0.08	0.08	0.01
	(0.06)	(0.12)	(0.08)	(0.08)	(0.25)
Information × quiz questions	−0.03	−0.02	−0.07	−0.07	−0.04
	(0.08)	(0.17)	(0.11)	(0.11)	(0.35)
Information × self-reference questions	−0.08	−0.11	−0.19*	−0.19*	−0.22
	(0.08)	(0.17)	(0.11)	(0.11)	(0.35)
Gender	−0.04	−0.02	−0.05	−0.06	−0.10
	(0.03)	(0.07)	(0.05)	(0.05)	(0.14)
Age (10 years)	0.11***	0.11***	0.08***	0.08***	0.29***
	(0.01)	(0.02)	(0.01)	(0.01)	(0.05)
University education	0.10***	0.12*	−0.02	−0.02	0.28*
	(0.03)	(0.07)	(0.05)	(0.05)	(0.15)
Use of allotment gardens	−0.28***	−0.28***	−0.18***	−0.18***	−0.73***
	(0.03)	(0.07)	(0.05)	(0.05)	(0.15)
Use of community gardens	−0.24***	−0.23***	−0.14**	−0.14**	−0.54***
	(0.04)	(0.09)	(0.06)	(0.06)	(0.18)
Recruited by mail	−0.01	−0.03	−0.02	−0.02	−0.03
	(0.04)	(0.08)	(0.05)	(0.05)	(0.16)
Ln(theta)			1.60***	1.60***	
			(0.14)	(0.14)	
AIC	8088.38	6451.33	6241.11	6240.70	
BIC	8152.40	6520.69			
Log likelihood	−4032.19	−3212.67	−3095.55	−3095.35	
Deviance	5127.62	1674.43			
Num. obs.	1533	1533	1533	1533	1533
R^2					0.06
Adj. R^2					0.05
RMSE					2.80

Notes: ***, **, and * indicate 1%, 5%, and 10% significance levels. Standard errors in parentheses. Coefficients for the second equation in the Hurdle and Zero Inflated model are not displayed.

created. The new garden may differ in various features, which we will present on the coming pages. Assume you can help decide which garden will be created.

Size of the garden

Some community gardens and allotment garden areas are very small and have an area of only 500 square meters, for example. Others are large and have an area of 20,000 square meters, for example. For comparison, a soccer field is about 7000 square meters.

Neighborhood activities in the garden

In some community gardens and allotment garden areas, activities are held for the gardeners and people from the neighborhood. Environmental education events allow gardeners and visitors to learn together about nature in the garden and beyond. For example, knowledge about gardening, herbs and other plants, composting or insect hotels is imparted during workshops, courses, lectures, campaigns or school project days. Cultural events in the garden can consist of, for example, concerts, films or readings for gardeners and visitors. Community activities allow gardeners and visitors to meet and spend time together. These include summer parties, harvest festivals, communal cooking or baking, flea markets and days of action.

Access for visitors

Different community gardens and allotment garden areas also differ with respect to who can enter them and when. Some are open every day for visitors from the neighborhood. The gates are always open and anyone interested can enter the community garden or allotment to take a look around, spend time or participate in activities. Others are only open to visitors from the neighborhood on certain days. On the other days, the gates are closed and only members or tenants and their friends and family can enter the community garden or allotment.

Garden style

Different community gardens and allotment garden areas are designed and maintained differently.

Some gardens are rather orderly: Beds are surrounded by flower strips or frequently mowed lawns. Other plants in the garden, such as bushes and hedges, are also often trimmed. Weeds and wild plants are quickly removed. There are no rock or deadwood piles. As a result, the garden provides little habitat for animals such as birds, insects, and small mammals. Other gardens are rather

Table 13
Results of the mixed logit model in willingness-to-pay space with no interactions.

	Main effects (mean)	Main effects (standard deviations)
ASC community garden	58.55***	89.38***
	(3.7)	(3.61)
ASC allotment garden	30.83***	96.75***
	(3.99)	(4.21)
Size (per 1000 m^2)	0.83***	2.43***
	(0.15)	(0.4)
Distance (per 1000 m)	−23.81***	27.34***
	(1.3)	(1.71)
Community activities	13.45***	24.19***
	(1.85)	(4.21)
Cultural events	11.61***	42.25***
	(2.17)	(3.09)
Environmental education	13.76***	17.82***
	(1.88)	(4.35)
Access (per open day)	6.61***	11.44***
	(0.58)	(0.75)
Near-natural garden layout	26.56***	56.06***
	(2.21)	(2.8)
Yearly fee (per 1 Euro)	1.06***	0.63***
	(0.05)	(0.08)
Log-likelihood at convergence	−12 413.286	
Log-likelihood at constant(s)	−11 251.869	
Rho-square	0.241	
Adj. Rho-square	0.239	
AIC	22 543.739	
BIC	22 693.93	
Number of observations	13 488	
Number of respondents	1686	
Number of parameters	20	

Note: ***, **, and * indicate 1%, 5%, and 10% significance levels, respectively. Standard errors are displayed in parentheses.

Table 14
Interaction models: likelihood-ratio test results.

Model	LR	df	pvalue
All interactions	29.68	45	0.96
Only info interactions	11.16	9	0.26
Only question interactions	34.48	18	0.01

natural: there are many naturally growing plants in the garden, such as meadows with grasses and wildflowers. Bushes and hedges are also cut less frequently. Weeds and wild herbs are allowed to grow to some extent. Sometimes there are rock or deadwood piles. As a result, the garden provides more habitat for animals such as birds, insects and small mammals.

Distance from residence

There are several possible sites where the new community gardens and allotment garden area could be located in your neighborhood. Some are very close to where you live, for example only 300 m away. You will only need about 5 min to walk there. Others are further away, as far as 3 km. You will need about 45 min to walk that distance.

Yearly fee

The creation and maintenance of new community gardens and allotment garden areas produce costs. A large part of these costs is borne by the gardens themselves. However, such gardens can be used not only by the gardeners, but also by the neighborhood, bringing benefits to other citizens such as a greener cityscape, neighborhood activities and a place to relax, meet people or enjoy nature.

Since all citizens can benefit from the gardens, it would be conceivable that an additional part of the costs for creation and maintenance of the garden is borne by everyone, including you. Therefore, in the following scenario, an annual contribution for a garden fund is charged, which can range from 6 euros to 120 euros and exclusively funds the creation and maintenance of the new garden. If the garden is created, this fee will be paid by all citizens over the age of 18 in your district.

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