Information use and its effects on the valuation of agricultural genetic resources

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Abstract

This paper examines the effects of information on stated preferences for an unfamiliar environmental good: agricultural genetic resources. We define two groups of respondents based on their use of additional information, and we model information use and its effect on individual preferences and scale. Our findings indicate that both sociodemographic and attitudinal variables affect the use of information. We observe individual preference heterogeneity, but no significant differences in scale between the information groups. The results highlight the importance of genetic resource conservation and controlling for the effects of information use in choice experiment models for unfamiliar goods.

Keywords*:* Agricultural genetic resources; Discrete choice experiments; Environmental valuation; Information effects

JEL codes: Q51, Q57

Appendix materials can be accessed online at:

https://uwpress.wisc.edu/journals/pdfs/LE-98-2-Tienhaara-appA.pdf

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1. Introduction

Stated preference methods, including contingent valuation (CV) and discrete choice experiments (CE), are often used to examine citizens' willingness to pay (WTP) for environmental goods, to provide policy-relevant information on environmental values (Hanley and Czajkowski 2019). Nowadays, applications are common for both goods that people are familiar with and have some experience of, such as water quality (e.g. Hanley et al. 2006; Ahtiainen et al. 2015), and goods that people may be unfamiliar with or have no practical experience of, such as specific rare species or biotopes (e.g., Christie and Gibbons 2011; Jobstvogt et al. 2014) or agricultural genetic resources (AgGR) (Pouta et al. 2014). Regardless of the good, the underlying assumption is that respondents make informed choices (e.g., Blomquist and Whitehead 1998). This is easier when the good being valued is familiar to the respondent. However, in the valuation of more unfamiliar goods, the information provided in the survey plays a more substantial role. This paper focuses on the effects of information in the valuation of genetic resources: whether respondents use the additional information provided, what characteristics are related to the use of information, and if and how this information affects respondents' preferences and WTP.

Both the amount and type of information that is presented to respondents require attention in survey design (Johnston et al. 2017). Including more information about the quality of the environmental good in a survey can have various effects on WTP: it can increase, have no impact on, or decrease the WTP (Blomquist and Whitehead 1998). It has been argued that the provision of relevant information improves respondents' understanding of environmental commodities and reduces both uncertainty and possible divergence between the true and stated WTP (Hoehn and Randall 1987). However, increased information in stated preference surveys increases the burden of information processing and the complexity of the choice process. Increased complexity, in turn, affects the consistency of respondents' choices and thereby their stated WTP (Berrens et al. 2004). When faced with difficult choice questions, respondents often tend to use heuristics. Sandorf et al.

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(2017) suggested that providing information about the environmental good in question before a valuation task is important, because the more respondents know about the environmental good in question, the less likely they are to use simplifying strategies, such as attribute non-attendance. As increasing knowledge helps to avoid, at least to some extent, the use of heuristics, providing information can be helpful in obtaining more accurate welfare estimates.

In addition to the extent of information, the nature of the information also plays a role. According to Hu et al. (2009), studies assessing the effect of information on consumers' choices have concluded that positive information tends to reduce adverse reactions, while negative information tends to reinforce negative responses. Environmental commodities can have beneficial attributes, but also attributes that can be perceived negatively. Hence, additional information describing these negative attributes can induce reductions in WTP (Bergstrom et al. 1990).

Information provision is important to an individual's decision-making, especially in situations where considerable uncertainty is involved, for example, in the valuation of unfamiliar goods. It is often assumed that once information is made available, respondents will access and process it. However, simply providing information does not imply that all the respondents will read it. The decision of respondents to access voluntary information is reliant on their previous knowledge of the topic and personal characteristics (Hu et al. 2009). Furthermore, even if the respondents access the information provided, it is difficult to assess whether they truly comprehend it. Aanesen et al. (2015) applied a valuation workshop in order to reduce the problems related to the valuation of an unfamiliar good (in their case, cold-water coral). The workshop setting allows more extensive provision of information and also helps researchers to learn how respondents understand the questions and the information. However, this method is time consuming, especially if the aim is to obtain data that are representative of the population. In addition, results can be biased by self-selection and the social desirability effect.

The CV literature contains a plethora of studies on information effects and their reasons, as well as on respondents' cognitive effort (see, e.g., Cameron and Englin 1997; Blomquist and

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Whitehead 1998; Munro and Hanley 2002; Berrens et al. 2004). Most of these CV studies have found significant information effects on preferences and values. However, only a few CE studies have examined the use of information. Hu et al. (2009) and Vista et al. (2009) focused on respondent effort, indicated by the decision to access optional information made available in the survey and the time spent on completing the survey. Hu et al. (2009) used data from a CE concerning genetically modified food to simultaneously model voluntary information access and product choices. They demonstrated that additional information was accessed rather infrequently, and that those who held critical views on genetic modification accessed the information more often. There were interlinkages between information access and choices, but they were complex and varied between individuals. Vista et al. (2009) examined the effect of time spent on attribute information, choice questions and completing the survey on preferences, finding no significant effects on parameter estimates. In turn, Curtin and Papworth (2018) sought to explore whether additional information can shift stated conservation preferences, concluding that the amount of information provided in the CE affected the conservation decisions. Emberger-Klein and Menrad (2018) studied how information provision affected consumers' use of carbon labels. Additional information about the labels encouraged the use of and preference for carbon labels among consumers and could also affect the purchase decision.

Heterogeneity of preferences and heterogeneity in scale across individuals has become an important consideration in modeling CE responses (Louviere et al. 2002; Louviere 2006; Fiebig et al. 2010; Hensher et al. 2012). Scale represents the variation in the random component of utility relative to the deterministic component, and scale heterogeneity implies that the scale of the error term varies across respondents. From the analyst's perspective, a higher mean scale infers that the respondents' choice behavior appears less random. Regarding unfamiliar goods, it may be especially important to allow for scale heterogeneity, in addition to individual preference heterogeneity (Christie and Gibbons 2011). Recent CE studies have investigated information effects and the familiarity of the environmental good while allowing for scale heterogeneity. Using CE data from a biodiversity conservation program, Czajkowski et al. (2016) demonstrated that individual-specific preferences

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and the mean of the scale parameter and its variance in the sample are sensitive to the information given to the respondents. Christie and Gibbons (2011) interpreted scale heterogeneity as the ability of respondents to choose, and concluded that accounting for scale heterogeneity can improve the reliability of the results when valuing unfamiliar or complex goods. Related to AgGR, Pallante et al. (2016) and Zander et al. (2013), for example, examined both preference and scale heterogeneity. However, there have been no studies examining the effect of information use in the valuation of AgGR.

Here, we contribute to the stated preference literature on the effect of information use on respondents' choices and WTP for an unfamiliar good, i.e., AgGR. Our CE survey offered the respondents an opportunity to access additional information on the environmental good being valued, similarly to Hu et al. (2009). We examine the determinants of voluntary information acquisition and the effect of accessing the information on respondents' preferences and scale, allowing for individual preference and scale heterogeneity. The data come from a CE survey on AgGR, which include all animal and plant species and varieties of interest in agriculture. Although the public is likely to be aware of agricultural production and its impacts on the environment, specific aspects, such as the conservation of genetic resources, are likely to be unfamiliar to at least some of the respondents. This setting provides an excellent prospect for examining the influence of information on preferences for unfamiliar environmental goods in a CE (Pouta et al. 2014).

The paper is organized as follows: Section 2 discusses genetic resource conservation in Finland and introduces the survey and data, section 3 describes the statistical approach, section 4 presents the results, and section 5 discusses and concludes the analysis.

2. Survey and data

Conservation of agricultural genetic resources in Finland

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Agricultural intensification has caused significant changes in the utilization of AgGR in recent decades. Consequently, many previously common animal breeds and crop varieties are currently on the verge of extinction worldwide. In Finland, the majority of old, indigenous crop varieties and the Finnish landrace pig are already extinct. Furthermore, Northern Finncattle and Kainuu Grey sheep are endangered, and the populations of Finnhorse, native chicken, Åland sheep, native goat and Western and Eastern Finncattle are described as vulnerable according to the FAO classification (MMM 2018).

International agreements, such as the Convention on Biological Diversity (1992), the Global Plan of Action for Animal Genetic Resources (FAO 2007), and the United Nations strategic plan for biodiversity (CDB 2011), guide the conservation policies for AgGR. National programs to support the conservation of genetic resources in Finland were initiated in 2003 for plants and in 2005 for farm animals. There has been some progress in actioning the conservation programs, but they have not been fully implemented due to a lack of resources and political interest in conservation. In addition, the economic benefits of such programs are poorly known. Thus, the present study aims to estimate citizen's use and non-use benefits from the conservation of AgGR, for policy-making support, especially focusing on the effects of information in the context of valuing unfamiliar goods.

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Data collection

The CE survey was carried out during the summer of 2011 using a probability-based Internet panel of a private survey company, Taloustutkimus. The survey questions, and especially the choice experiment, were tested with a pilot study (n = 138). For the final survey, a random sample of 6200 respondents was selected and 2426 responses were obtained. Out of these, 1495 completed the whole survey. The response rate for the final survey was therefore 39% and 24%, respectively. Based on the sociodemographic information, in comparison with the statistics for the general Finnish population

(Table 1), the data were an adequate representation of the population. The proportions of females, people with a higher educational level, and people living in Southern Finland were similar in the data and population. However, the respondents were somewhat older, had a higher income, and were less likely to have children compared with the population.

Survey design

The survey had five sections, with questions on environmental issues in agriculture, familiarity with and attitudes toward AgGR, environmental values (the CE), willingness to purchase products made from traditional varieties and breeds and, finally, the respondent's background. The survey began with a question on the respondents' perceived importance of different agri-environmental measures. This was followed by a short description of the most common Finnish AgGR (native animal breeds and plant varieties), for which the respondents evaluated their familiarity. Next, the conservation of AgGR in Finland was briefly highlighted, and the respondents were then presented with two Internet links that allowed access to additional information on animal and plant genetic resources, respectively (see Appendix A). This voluntary additional information package included the motivation for conservation, descriptions of different conservation methods, and information on the sustainable use of genetic resources. We recorded the time respondents used to read this additional information. The provision of voluntary information enabled the identification of respondents who accessed the links, as well as documenting how much time they spent on these information pages. This approach was similar to Hu et al. (2009), who provided voluntary access to additional information. In our case, however, the choice tasks and information acquisition were not simultaneous, but instead, the information was provided before the CE. The information page with the links was followed by questions about the perceived importance of animal and plant genetic resources. The survey then presented the current state of conservation (the status quo) and proceeded to the CE.

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The CE was framed by explaining that many of the Finnish native animal breeds and plant varieties are endangered and their preservation requires special measures. After familiarizing the respondents with the current level of preservation, they were presented with a program that would increase the conservation of breeds and varieties on farms (*in situ*) and in gene banks (*ex situ*). The conservation program included five attributes, each containing three levels, with first level always presenting the status quo level (Table 2). Native animal breeds in gene banks and on farms were presented to the respondent as single attributes, instead of having separate attributes for each animal breed, in order to avoid choice tasks that were too taxing. However, in the analyses, individual animal breeds were treated as separate attributes. The number of traditional ornamental plant varieties was given as verbal expressions, as the total number of varieties was unknown and mapping of the varieties is still ongoing. The cost attribute was specified as an increase in income tax over a 10-year period (2012–2021).

In the CE, the respondents faced six choice tasks (see Table 3 for an example), each containing two policy alternatives and the status quo option. After each choice task, the respondents evaluated the certainty of their choice on a scale from 1 to 10 (1 = completely uncertain; 10 = completely certain).

The experimental design was created with Ngene software (v. 1.0.2), employing a Bayesian D-efficient design (ChoiceMetrics 2010). Efficient designs aim to capture the maximum amount of information from each choice situation. This is done by finding the design with minimal standard error values, thereby producing more reliable parameter estimates (see, e.g., Rose and Bliemer 2009). To generate efficient designs, it is necessary to specify priors for the parameter estimates. Zero priors were used in the pilot design, but the final design utilized the parameter estimates obtained from the pilot study. The final design consisted of 180 choice tasks blocked into 30 subsets, which resulted in six choice situations for each respondent. A more detailed description of the experimental design is presented in Pouta et al. (2014).

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3. Statistical models

In the statistical modeling, we examined the use of information and its effects on scale, preferences, and WTP. First, a logistic regression model (e.g., Greene 2007) was estimated to examine the use of information. The dependent variable in the logit model was a binary variable describing information use, defined according to the time the respondent spent on the additional information pages for the native animal breeds and plant varieties. Since only a small proportion of respondents read only one of the two information pages and the effects of accessing information about animals and plants had very similar effects on preferences in preliminary tests, we combined animal and plant information into one variable[1]. The respondents were considered to have perused the information if they had spent 30 s (close to the median time) or more on either of the information pages. A robustness check was conducted for the choice of cut-off time using (1) a linear function, (2) a logarithmic function, and (3) by defining alternative discrete thresholds, based on other quartiles of time distribution. The results of the sensitivity analysis were consistent and robustness was confirmed. In addition to socio-demographic variables, independent variables included the perceived responsibilities for the conservation of AgGR, the respondent's familiarity with native breeds and varieties, and the perceived importance of preserving AgGR relative to other environmental protection measures. The descriptive statistics for the variables included in the logit model are presented in Table 4.

Second, respondents' utility function parameters were modeled using the stated choices they made in the CE component of the survey. We utilized the random parameters mixed logit (RP-MXL) model (McFadden and Train 2000; Hensher and Greene 2003), which allows for incorporation of unobserved preference and scale heterogeneity (Hess and Train 2017). Following Czajkowski et al. (2014), we controlled for scale or preference differences between respondents who did/did not access additional information while modeling their choices jointly.

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Modelling discrete choice data follows the random utility theory (McFadden 1974). In the random utility framework, an individual is assumed to maximize the utility by choosing the alternative with the highest utility from a given choice set. An individual i's utility from selecting alternative j in situation t can be expressed as:

$$U_{ijt} = \mathbf{x}_{ijt}\boldsymbol{\beta}_i + \varepsilon_{ijt}. \quad [1]$$

The utility can be divided into two parts: the observed characteristics (i.e., choice attributes), $\mathbf{x}_{ijt}$, and the random component, ε_{ijt}, which includes unobservable factors that affect individuals' choices. Individual-specific taste parameters ($\boldsymbol{\beta}_i$) allow differences in preferences among the respondents. To account for preference differences associated with accessing the voluntary information, a binary indicator z for accessing information and a vector $\boldsymbol{\delta}$ of its estimated attribute-specific effects can be added to the multivariate distribution of these parameters $\boldsymbol{\beta}_i = f(\mathbf{b} + z_i\boldsymbol{\delta}, \sum)$, where $\mathbf{b}$ is a vector of sample means and $\sum$ is a variance-covariance matrix.[2]

The random component of the utility function (ε_{ijt}) is usually assumed to identically and independently have an extreme value type-1 distribution with a constant variance $var(\varepsilon_{ijt}) = \pi^2/6$, leading to the following specification:

$$U_{ijt} = \sigma_i \mathbf{x}_{ijt}\boldsymbol{\beta}_i + \varepsilon_{ijt}, \quad [2]$$

where σ_i is the 'scale' parameter. As the utilities are ordinal, the absolute value of utility has no meaning and only differences in utilities matter (Hensher, Rose & Greene 2015). Hence, this specification still represents the same preferences for individual i. Note that since the scale and preference parameters enter the model as a multiplication, they are not separately identifiable. However, this does not restrict model applicability, because utility function parameters do not have an absolute scale and can only be interpreted in relation to zero and each other.

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Accessing information is likely to influence the variance of the random component of the utility function (scale), that is, the level of randomness of choices from the modeler's perspective. As a result, since the variance of the error term is normalized in the model, parameter estimates of all the utility function parameters would increase or decrease relative to those who have not accessed information and whose scale is used as a baseline. Scale differences associated with accessing information can be controlled by defining $\sigma_i = \sigma\big(exp(\lambda z_i)\big)$, where z is a binary indicator for accessing information and λ is a parameter capturing its effect for scale, relative to the baseline group of individuals (e.g., Czajkowski et al. 2015; Ruokamo et al. 2016).

As we were interested in the marginal rates of substitution with respect to the monetary attribute p, we estimated the models in WTP space (Train and Weeks 2005), in addition to preference space. The money-metric utility function can be obtained as follows:

$$U_{ijt} = \big(\alpha p_{ijt} + \mathbf{Y}_{ijt}\mathbf{b}\big) + \varepsilon_{ijt} = \alpha\big(p_{ijt} + \mathbf{Y}_{ijt}\boldsymbol{\beta}\big) + \varepsilon_{ijt}. \qquad [3]$$

In this specification, the vector of parameters $\boldsymbol{\beta} = \mathbf{b}/\alpha$ can be directly interpreted as a vector of marginal WTPs for the non-monetary attributes $\mathbf{Y}_{ijt}$, making the interpretation of the results easier. Here, we can also define $\boldsymbol{\beta}_i = f(\mathbf{b} + z_i\boldsymbol{\delta}, \sum)$, which conveniently allows us to interpret $\boldsymbol{b}$ as the mean WTP for a base treatment and $\boldsymbol{b} + z_i\boldsymbol{\delta}$ as the mean WTP for other treatments (accessing information).

The model is estimated using maximum likelihood techniques. An individual will choose alternative j if $U_{ijt} > U_{ikt}$, for all $k \neq j$, and the probability (P) that alternative j is chosen from a set of J alternatives is given by:

$$P(j|\,J) = \frac{exp(\sigma_i \mathbf{x}_{ijt}\boldsymbol{\beta}_i)}{\sum_{k=1}^{J} exp(\sigma_i \mathbf{x}_{ikt}\boldsymbol{\beta}_i)}\,. \qquad [4]$$

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There exists no closed form expression of Eq. (4), but it can be simulated by averaging over D draws from the assumed distributions (Revelt and Train 1998). Maximizing the log-likelihood function gives estimates for the parameters.[3]

In the modeling, attributes were dummy-coded, except for the cost attribute, which was specified as continuous. All parameters were modeled as random and they were assumed to follow normal distributions, except cost, which was assumed to be negative log-normally distributed. Sensitivity analysis using different specifications for the time used to access information confirmed the robustness regarding the effect on preferences.[4]

4. Results

Familiarity and use of information

As hypothesized, the responses demonstrated that many respondents were unfamiliar with several native animal breeds and plant varieties. In general, people had heard about or had experience of native animal breeds more often than plant varieties. Over 30% of respondents had never heard of about 5 of the 10 animal breeds and plant varieties presented in the survey. Between 5 and 47% of respondents had no prior knowledge, depending on the breed or variety.

Out of the 1,495 respondents, 64% spent over 30 s reading at least one of the two additional information pages. The median response time for completing the whole survey was approximately 15 minutes. The results of the logit model that explained the use of information are presented in Table 5. According to these results, female and older respondents preferentially read additional information. The likelihood of reading the information also increased if the respondent considered the conservation of genetic resources to be the responsibility of taxpayers, but decreased if s/he considered the conservation as the responsibility of farmers. In our case, the importance of preserving native breeds and varieties did not play a role in information acquisition. Instead, the respondent’s familiarity with

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the native breeds and varieties negatively impacted on the use of the information. This behavior could suggest that those who had the least knowledge and experience at the outset were more likely to obtain additional information in the course of the survey. The educational and income level of the respondents did not affect their use of information.

Effects of information on respondents' preferences, scale, and willingness to pay (WTP)

We first examined whether the use of information affected the frequency of choosing the status quo alternative or bid acceptance. There was a noticeable difference (p = 0.000) in choosing the status quo alternative between the information groups. Respondents who read/did not read the additional information chose the status quo in 19% and 33% of the choice sets, respectively. The group that read the information had a larger share of respondents accepting the smaller bids, but there appeared to be no difference between the groups for higher bids (Appendix B).

Next, we examined the effects of accessing additional information on the respondents' preferences and scale. Table 6 presents the results of the RP-MXL models in the preference space, with correlated parameters[5] in three specifications: assuming that accessing information only causes differences in scale (Model 1), assuming that accessing information can influence the means of the preference parameters and scale (Model 2), and allowing for the independent effect for means and standard deviations of preference parameters (Model 3). The models included 9484 observations from 1608 respondents.

The RP-MXL Model 1 (Table 6) included all respondents (both those who read the additional information and those who did not), and there were no assumed differences in preferences between the information groups. However, the mean of the scale parameter was allowed to differ between groups. Most of the conservation parameters in Model 1 were significant and of the expected sign, with increases in the protection of native breeds and varieties increasing utility. The respondents tended to choose policy alternatives instead of the status quo. An increase in the program cost was

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associated with negative utility, as expected. The highest utility changes resulted from the conservation of plants in gene banks and on farms, as well as cattle breeds on farms. Only the attributes for preserving food plant varieties, native chickens in gene banks, and the lower level of change for increasing the number of sheep breeds on farms were nonsignificant.

Model 1 indicates that accessing information increases scale, namely it reduces the error term variance. In other words, respondents' choices appear less random from the modeler's perspective. However, the comparison with Model 2, in which parameters of the means of each attribute can depend on whether the information was accessed or not, indicates that Model 1 is overly restrictive. Since the models are nested, one can use the likelihood ratio test to confirm this (see Table 6 for details). As a result, we concluded that the scale results observed in Model 1 are driven by the effect of accessing information on selected mean parameters, as indicated by significant interactions with 'information accessed' in Model 2 (Table 6). In particular, respondents who accessed information were, on average, less likely to choose the status quo, had stronger preferences for increasing the number of food plants and native cattle breeds on farms, as well as goats in gene banks, and had a significantly lower marginal utility of money (and, hence, an expected higher WTP). Accessing information did not appear to affect the mean preference parameters for other attributes. In addition, once differences in means were controlled, the interaction of scale with a dummy variable for accessing information was no longer significant. Namely, there was no consistent statistical difference in the variances of preference parameters between those who did/did not access the additional information.

Model 3, with two information groups, allows for the independent effect of accessing information on the means and standard deviations. A comparison of the parameter estimates between the information groups revealed that not only were many of the attribute coefficients higher, but there were also more significant variables for the group that had accessed the additional information relative to those who did not. Moreover, these respondents were less willing to choose the status quo alternative and derived higher utility from improvements related to preserving native food varieties

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on farms, ornamental varieties in gene banks, and native horse and sheep breeds. The results indicate that those who had familiarized themselves with the information obtained more utility from the improvements compared with those who had not accessed the information[6]. However, based on the likelihood ratio test, there was no significant difference in the model fit between Model 3 and Model 2 (p = 0.999).

Next, we compared the differences in the respondents' WTP resulting from accessing additional information. Even though we have established that additional information can influence respondents' preference parameters, this is not necessarily equivalent to causing significant differences in their mean WTP, especially if the effects of preferences for attributes and cost are not proportional. Therefore, we estimated the same three specifications of the RP-MXL model with correlations in the WTP space. The results, presented in Table 7, can readily be interpreted as marginal WTP (€/year), and show that differences in WTP were fairly consistent with the differences in respondents' preferences. Table 7 summarizes the WTP measures for Model 2 and Model 3. Model 2 shows that in this study, accessing information could be associated with significant differences in the mean WTP for selected attributes, but not necessarily with significant differences in the scale or standard deviations of the WTP.

Based on Model 3, we can see that compared to the respondents who did not access the information, those who accessed the information were, on average, willing to pay €6 more for increasing the number of food plants on farms (from 7 to 2000), approximately €9 more for banking ornamental plants, and €20 and €5 more for banking native goats and horses, respectively. Furthermore, they were willing to pay about €25 more for increasing the number of native cattle breeds on farms, as well as €12–24 more for increasing the number of native sheep breeds on farms. At the same time, their implied WTP for the status quo policy was about €44 lower, indicating that they were generally willing to pay more for implementing the new policy than respondents who did not access the additional information.

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The WTP for the conservation program with a low level of improvements was €63.38 for those respondents who did not access the information, whereas the corresponding value for the respondents who used the information was nearly twice as much (€120.26). When a conservation program with high levels of improvement was considered, the WTP for the group not accessing the additional information barely changed (€67.17), while for those who accessed the information, the WTP further increased to €169.97.

Overall, the group that accessed the information had a higher WTP for all attributes when compared with the group that did not access the information, except for the lower improvement of food plants on farms. All other WTP measures were of the expected sign, but the group that did not access the information had a significant and negative WTP for the high improvement level of food plants banked and the low improvement level of native sheep breeds on farms.

5. Discussion and conclusions

This study investigated the voluntary use of additional information and information effects in a CE setting. The empirical application concerned the conservation of AgGR (native breeds and varieties) in Finland, an environmental good that is unfamiliar to many people. Respondents were divided into two groups based on the time they spent reading the additional information in the Internet survey. We examined the determinants explaining the use of information with the logit model and the effect of information use on respondents' preferences and scale with the RP-MXL models.

The logit model results suggested that respondents who had read the additional information were more likely to be female, older, and perceived the conservation of genetic resources to be the responsibility of taxpayers. The respondents who were more familiar with native animal breeds and plant varieties, and those who felt that conservation was the responsibility of farmers, were less likely to read the additional information. These results are, in part, similar to those of Hu et al. (2009), who modeled information access in a CE concerning genetically modified food. In that study, male

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respondents and those who were employed or had a higher income were less likely to access the information, and the more children the household had, the lower was the likelihood of information access. Conversely, being a member of a consumer group or a rural resident increased the likelihood of accessing the information.

Altogether, in our study, the respondents showed support for the conservation of native breeds and varieties. However, the results of the RP-MXL models indicate that there was heterogeneity in preferences and WTP between those who accessed/did not access the additional information, with voluntary information access being associated with higher welfare estimates. The respondents who had read the additional information chose the status quo alternative less frequently, and their choices could be explained by several environmental attributes characterizing the conservation program of AgGR. The choices of the respondents who did not read the information were associated with fewer significant conservation attributes, and the attribute coefficients were lower than for those having read the information.

This finding could indicate that those who have more information on AgGR obtain greater benefits from their conservation, and that providing the public with additional information on policies to conserve AgGR may increase the support for such policies. As our findings pertain to this specific case, their wider applicability to other unfamiliar goods should be investigated. Another possible explanation could be that those respondents who had read the additional information were already more interested in the environmental good and so would be more likely to support the conservation programs, regardless of the information. However, our results do not corroborate this alternative explanation, as information acquisition was not significantly explained by the attitudes toward the importance of conserving AgGR.

The findings concerning significant information effects are consistent with several previous studies (e.g., Tisdell and Wilson 2006; van Til et al. 2009; Chalak and Abiad 2012; Bieberstein et al. 2013). Although Hu et al. (2009) found an interdependence between information access and product choices, there was a significant variation across individuals.

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Our findings indicated that there was no significant difference in the mean scale between the information groups after allowing the mean parameters for the attributes to differ. Even though the covariate of scale was significant in Model 1, it was driven by the effect of accessing information on selected mean parameters, as shown by the comparison with Model 2. These results differ from those obtained by Czajkowski et al. (2016), who found that respondents who were given more information in the CE made less random choices. Also, in contrast to Christie and Gibbons (2011), who stated that it is important to control the scale heterogeneity when the good in question is unfamiliar to the respondents, we did not find significant scale heterogeneity after the mean parameters for the attributes were allowed to differ.

Even though the information affected respondents' choices, some attribute coefficients for the conservation program were similar across models and information groups. These attributes included the conservation of plants on farms, horses in gene banks, and cattle breeds on farms. Willingness to support the conservation programs was lower for the group that did not read the information compared with those who read the information, especially at low-cost levels.

Although we found significant differences between the information groups, defined based on the time spent reading the additional material, setting the cut-off time to 30 s was arguably arbitrary. Although the sensitivity analysis regarding the cut-off time demonstrated that the results were consistent and that, in general, the more time was used to access information, the lower the preferences for the status quo and the more preferred selected attributes were, we cannot be sure that information access was associated with an increase in a respondents' knowledge level. Testing the knowledge level of respondents before and after the possible information access may have provided certainty on the effect of information. However, it is more difficult to find non-irritating approaches for testing the ability of respondents to assimilate new information in online surveys than in valuation workshops (e.g., Aanesen et al. 2015). Our results demonstrated that information access was not significantly correlated with the educational level. Based on the high reading skills of Finns (PIRLS https://timssandpirls.bc.edu/pirls2016/index.html), we can also assume that reading comprehension

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is not a problem in information provisioning. Still, we recommend that future research should investigate ways of properly identifying how much effort respondents actually put into reading the provided material in stated preference surveys. More information is required on information effects in CE, for example, examining the relationship between uncertainty and information access, and whether information use affects respondent uncertainty.

As the data for this study were collected in 2011, the time gap poses a potential problem. However, studying the link between information and preferences is still important. In addition, the number of studies (especially valuation studies) related to native animal breeds and plant varieties is still very limited. As there have been no events that could be expected to cause a major change in peoples' knowledge concerning traditional breeds and varieties or their preferences, our results can still be used for predicting the current preferences of the Finnish population.

Czajkowski et al. (2016) raised the issue of how well-informed preferences should be before they are used for cost–benefit analysis or policy-making, and how much information should be provided to the survey respondents. Our results demonstrated that even though neutral information was available, only about 60% of respondents studied the information and used the opportunity to familiarize themselves more with the environmental good. Promisingly, the respondents who were not familiar with the good at the outset were more interested in reading the information. This outcome is encouraging from a policy standpoint, as it suggests that the share of well-informed respondents can be increased by providing access to additional voluntary information.

In the conservation of AgGR, there are no strong disagreements between stakeholder groups. An interesting future topic would be to examine how respondents use information from different standpoints, and whether they tend to select the information that is congruent with their existing perceptions or extend their understanding with a new type of information that could, however, make the choice process more demanding.

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Table 1. Sociodemographic profile of the respondents and the population

Sociodemographic characteristic	In the data	In the population[a]
Proportion of females, %	48	51
Mean age, years	52	47
Proportion of people with a higher educational level, %	24	23
Proportion of people living in households with a gross income under €40,000, %	43	53
Proportion of people with children (<18 years) in the family, %	35	40
Proportion of people living in Southern Finland, %	40	41

[a] *Source:* Statistics Finland (2010; www.stat.fi)

Table 2. Attributes of conservation programs and their levels

Attribute	Description	Current state/status quo	Level (unit)
Native food plant varieties in gene banks	Native food plants are stored in a gene bank, either as seeds or plant parts.	The gene bank contains seeds from about 300 landrace varieties. Plants that are added vegetatively (e.g., berry and apple varieties) are missing.	300, 400, 500 (number of plants)
Farms growing native food plants	Farmers and hobby gardeners cultivate native food plants on farms or in gardens.	Seven farms grow seeds of native food plants with agri-environmental support. Other activities than growing seeds are not supported.	7, 500, 1000 (number of farms)
Native ornamental plant varieties mapped and in gene banks	Scientists identify and register native ornamental plants. Varieties are preserved in a gene bank, either as seeds or plant parts.	Only a small proportion of the native ornamental plants are known. Storage in the official gene bank is not provided.	A small proportion, about half, the majority (proportion of plants)
Native breeds in gene banks	Landrace breeds are kept in a gene bank as gametes and embryos.	The gene bank contains Western, Eastern and Northern Finncattle, as well as Finnsheep, and Åland and Kainuu sheep. Native chicken, goat and horse breeds are missing from the gene bank.	3 cattle breeds and 3 sheep breeds (status quo level), + all combinations of goat, horse and chicken breeds (breeds)
Native breeds on farms	Native breeds are kept on farms in their natural environment. A breed is considered to be endangered if the number of females is less than 1000.	Farms secure goat, horse and chicken breeds, Finnish sheep and Western Finncattle. Eastern and Northern Finncattle, as well as Åland and Kainuu sheep, are endangered.	1 cattle breed, 1 sheep breed, goat, horse and chicken (status quo level), + all combinations of additional 1–2 cattle and sheep breeds (breeds)
Cost	Cost for taxpayers, €/year during 2012–2021.	No additional costs.	0, 5, 20, 40, 80, 100, 150, 300 (€)

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Table 3. Example of a choice task

Attribute	Current state	Conservation program A	Conservation program B
Native food plant varieties in gene banks	Approximately 300	400	400
Farms growing native food plants	7 farms	2000 farms	1000 farms
Native ornamental plant varieties mapped and in gene banks	Some	The majority	About half
Native breeds in gene banks	3 cattle breeds 3 sheep breeds	**Current +** Chicken Goat Horse	**Current +** Goat
Native breeds on farms	Goat Horse Chicken Finnsheep Western Finncattle	**Current +** Northern Finncattle	**Current +** Western Finncattle Åland sheep
Cost for taxpayer €/year during 2012–2021	€0/year	€80/year	€200/year
I support the alternative	( )	( )	( )

Table 4. Variables used in the logit model

Variable	Description	Mean	Standard deviation	Min	Max
Information	Time spent on at least one of the additional information pages is more than 30 seconds	0.64	0.48	0	1
Gender	1 if female, 0 if male	0.48	0.50	0	1
Age	Respondent´s age, continuous	52.31	14.28	19	80
Income	Household gross income (thousands €/year), continuous	49.45	24.04	5.00	95.00
Landowner	1 if respondent owns forest, croplands or home garden, 0 otherwise	0.59	0.49	0	1
High education	1 if the respondent has a university or polytechnic education, 0 otherwise	0.30	0.46	0	1
Taxpayer responsibility	Factor score based on nine measures of stakeholder responsibilities in conservation[a]	0	1	-3.38	2.30
Citizen responsibility	Factor score based on nine measures of stakeholder responsibilities in conservation[a]	0	1	-3.38	2.28
Farmer responsibility	Factor score based on nine measures of stakeholder responsibilities in conservation[a]	0	1	-3.12	2.88
Familiarity	The familiarity of native breeds and varieties to the respondent (1 has not heard of, 2 has heard of, 3 has used/tried/experience with)	2.03	0.42	1	3
Importance	The importance of preserving native breeds and varieties (4 very important – 1 not at all important)	3.09	0.71	1	4

[a]A detailed description of these variables can be found in Tienhaara et al. (2015)

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Table 5. Logit model results for the use of information

Variable	**Coefficient**	**Standard error**	**Odds ratio**
Constant	0.752*	0.456	2.121
Gender (male)	-0.730***	0.127	0.482
Age	0.014***	0.005	1.014
Income	0.050	0.136	1.052
Landowner	0.030	0.127	1.031
High education	0.050	0.136	1.052
Taxpayer responsibility	0.286***	0.063	1.332
Consumer responsibility	0.074	0.068	1.077
Farmer responsibility	-0.278***	0.061	0.757
Familiarity	-0.292*	0.168	0.747
Importance	0.051	0.096	1.052
N	1354		
Nagelkerke R^2	0.089		
Correct predictions	68%		

Variables are significant at the ***1%, **5%, and *10% levels.

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Table 6. Results of the random parameter mixed logit (RP-MXL) models: the effects of accessing information on the respondents' preferences and scale (standard errors in parentheses)

	RP-MXL Model 1		RP-MXL Model 2			RP-MXL Model 3			
Variable	**Mean**	**Standard deviation**	**Mean**	**Interaction with 'information accessed'**	**Standard deviation**	**Mean 'information not accessed'**	**Standard deviation 'information not accessed'**	**Mean 'information accessed'**	**Standard deviation 'information accessed'**
ASC (status quo)	-4.4850***	5.5511***	-3.1538***	-3.3454***	6.2380***	-3.5692***	7.3236***	-6.1497***	5.7934***
	(0.4070)	(0.5318)	(0.5112)	(0.6496)	(0.6312)	(0.6337)	(0.9922)	(0.5288)	(0.6743)
Food plants banked	-0.0532	0.8983***	-0.0443	-0.0214	1.0910***	0.0327	0.6261***	-0.1093	1.2196***
300 -> 400	(0.0752)	(0.1439)	(0.1490)	(0.1792)	(0.1839)	(0.1647)	(0.2589)	(0.1124)	(0.2194)
Food plants banked	-0.0328	0.3971***	-0.0842	0.0607	0.5671***	-0.0870	0.9331***	-0.1069	0.9196***
300 -> 500	(0.0777)	(0.1237)	(0.1572)	(0.1822)	(0.1850)	(0.1927)	(0.2776)	(0.1156)	(0.1925)
Food plants on farms	0.5156***	1.1386***	0.3205**	0.4896**	1.4330***	0.5023***	1.6040***	0.7003***	1.4205***
7 -> 1000	(0.0862)	(0.1579)	(0.1510)	(0.1904)	(0.2490)	(0.1866)	(0.3405)	(0.1156)	(0.2220)
Food plants on farms	0.4823***	1.1521***	0.3370**	0.4042**	1.4594***	0.5346***	1.4439***	0.6138***	1.6122***
7 -> 2000	(0.0805)	(0.1218)	(0.1410)	(0.1725)	(0.2090)	(0.1704)	(0.2371)	(0.1103)	(0.1784)
Ornamental plants	0.3287***	0.9614***	0.2776**	0.2014	1.2273***	0.3126*	1.5594***	0.3729***	1.1914***
banked some -> half	(0.0785)	(0.1292)	(0.1416)	(0.1724)	(0.1803)	(0.1749)	(0.2663)	(0.1093)	(0.1960)
Ornamental plants	0.3002***	1.1419***	0.2441*	0.1961	1.4396***	0.2393	1.9244***	0.4137***	1.6473***
banked some -> majority	(0.0778)	(0.1259)	(0.1464)	(0.1727)	(0.1734)	(0.1864)	(0.2810)	(0.1116)	(0.2936)
Native horses banked	0.2399***	0.6793***	0.1868*	0.1771	0.8566***	0.2008	1.1537***	0.3204***	0.8592***
	(0.0538)	(0.0920)	(0.0983)	(0.1182)	(0.1268)	(0.1263)	(0.2004)	(0.0733)	(0.1529)
Native goats banked	0.1881***	0.5800***	0.0255	0.3054***	0.7017***	0.1001	0.9774***	0.2900***	0.8684***
	(0.0505)	(0.1041)	(0.0949)	(0.1128)	(0.1387)	(0.1198)	(0.1778)	(0.0717)	(0.1435)
Native chickens banked	0.0755	0.8949***	0.0412	0.0516	1.1438***	0.1017	1.3835***	0.0783	1.2700***
	(0.0548)	(0.1278)	(0.1064)	(0.1231)	(0.1678)	(0.1356)	(0.2345)	(0.0782)	(0.3301)
Native cattle breeds on	0.2231***	1.1389***	-0.0790	0.5195***	1.4225***	-0.0601	1.6743***	0.3670***	1.7404***
farms 1 -> 2	(0.0723)	(0.1563)	(0.1346)	(0.1635)	(0.2074)	(0.1685)	(0.2635)	(0.1051)	(0.4899)
Native cattle breeds on	0.2085***	1.0317***	-0.1159	0.5725***	1.2748***	-0.0860	1.4891***	0.4080***	1.4475***
farms 1 -> 3	(0.0689)	(0.1496)	(0.1302)	(0.1598)	(0.1894)	(0.1563)	(0.2562)	(0.0990)	(0.2920)
Native sheep breeds on	0.0384	1.1419***	-0.0179	0.1109	1.5157***	0.0086	1.9440***	0.0191	1.8885***
farms 1 -> 2	(0.0698)	(0.1773)	(0.1325)	(0.1557)	(0.2404)	(0.1672)	(0.3351)	(0.1022)	(0.6129)
Native sheep breeds on	0.1940***	1.3742***	0.1506	0.1330	1.7343***	0.0768	1.8998***	0.2527**	2.4775***
farms 1 -> 3	(0.0736)	(0.2293)	(0.1384)	(0.1622)	(0.2819)	(0.1731)	(0.3414)	(0.1127)	(0.9077)

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- Cost (EUR)	3.5236*** (0.4943)	16.8138** (7.8100)	2.8463*** (0.5303)	0.6695*** (0.1637)	14.4326** (6.8451)	5.3564*** (1.7819)	79.8477 (73.6185)	3.9625*** (0.4823)	12.5230*** (4.4238)
Covariates of scale									
'Info accessed'	0.2396** (0.0941)		-0.0551 (0.1004)						
Model diagnostics									
LL at convergence	-7222.80		-7172.20			-7129.67			
LL at constant(s) only	-10141.25		-10141.25			-10141.25			
McFadden's pseudo-R^2	0.2878		0.2928			0.2965			
Ben–Akiva–Lerman's pseudo-R^2	0.4854		0.4886			0.4944			
AIC/*n*	1.5518		1.5443			1.5605			
BIC/*n*	1.6545		1.6583			1.6178			
n (observations)	9484		9484			9484			
r (respondents)	1608		1608			1608			
k (parameters)	136		151			270			

Likelihood ratio test

Comparison	**Test statistics**	**Degrees of freedom**	***P*-value**
Model 1 vs. Model 2	101.1997	15	0.0000
Model 1 vs. Model 3	176.0196	134	0.0087
Model 2 vs. Model 3	74.8199	119	0.9995

The variables are significant at the ***1%, **5%, and *10% levels.

ASC: alternative specific constant

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Table 7. Results of the random parameter mixed logit (RP-MXL) models: the effects of accessing information on the respondents’ willingness to pay (results in €, standard errors in parentheses)

	RP-MXL Model 1		**RP-MXL Model 2**			**RP-MXL Model 3**			
Variable	**Mean**	**Standard deviation**	**Mean**	**Interaction with 'information accessed'**	**Standard deviation**	**Mean 'information not accessed'**	**Standard deviation 'information not accessed'**	**Mean 'information accessed'**	**Standard deviation 'information accessed'**
ASC (status quo)	-294.45***	318.72***	-233.13***	-99.88***	296.59***	-259.61***	428.74***	-303.52***	263.76***
	(15.09)	(22.31)	(19.95)	(22.32)	(20.00)	(10.04)	(25.18)	(22.02)	(21.62)
Food plants banked 300 -> 400	-1.41	50.11***	5.64	-5.62	49.38***	3.86	54.88***	-0.94	51.07***
	(4.31)	(6.09)	(7.54)	(8.94)	(5.73)	(4.08)	(4.73)	(5.93)	(5.42)
Food plants banked 300 -> 500	2.54	21.84***	3.39	-0.53	27.23***	-13.01***	45.92***	4.27	24.14***
	(4.27)	(6.65)	(8.23)	(9.48)	(5.87)	(4.89)	(7.02)	(5.40)	(5.28)
Food plants on farms 7 -> 1000	51.19***	85.49***	35.12***	20.13**	81.51***	56.18***	93.16***	51.42***	78.29***
	(5.82)	(6.46)	(8.29)	(8.88)	(5.96)	(8.52)	(6.38)	(6.51)	(6.41)
Food plants on farms 7 -> 2000	43.49***	91.27***	38.20***	11.52	88.98***	41.29***	102.02***	47.25***	86.15***
	(5.61)	(6.31)	(7.35)	(8.20)	(6.04)	(7.08)	(5.13)	(5.85)	(6.60)
Ornamental plants banked some -> half	28.46***	80.57***	31.03***	1.78	79.94***	21.55***	118.66***	32.78***	70.11***
	(5.77)	(6.30)	(7.96)	(8.30)	(6.09)	(7.53)	(6.95)	(6.29)	(6.02)
Ornamental plants banked some -> majority	26.23***	84.15***	27.58***	0.42	80.53***	20.76**	127.66***	29.03***	69.80***
	(6.08)	(5.93)	(8.05)	(8.53)	(5.67)	(8.29)	(6.10)	(6.46)	(6.01)
Native horses banked	19.17***	45.66***	18.60***	2.73	45.95***	18.13***	60.27***	22.90***	43.16***
	(3.76)	(4.25)	(6.00)	(5.71)	(4.08)	(5.67)	(4.80)	(4.25)	(4.44)
Native goats banked	15.52***	34.47***	05.07	14.28***	33.49***	2.10	55.90***	20.44***	29.53***
	(3.47)	(3.88)	(5.30)	(5.47)	(4.02)	(5.86)	(3.88)	(3.72)	(3.70)
Native chickens banked	3.21	40.28***	-2.04	4.42	42.66***	7.22	60.78***	2.54	28.10***
	(3.74)	(3.27)	(5.81)	(6.05)	(3.62)	(5.81)	(3.11)	(4.02)	(3.30)
Native cattle breeds on farms 1 -> 2	22.70***	53.71***	0.83	26.55***	51.92***	3.77	92.98***	24.35***	41.07***
	(4.84)	(4.74)	(7.60)	(7.92)	(5.57)	(8.01)	(4.21)	(5.45)	(3.95)
Native cattle breeds on farms 1 -> 3	20.15***	48.40***	0.17	27.32***	40.68***	2.39	75.81***	26.58***	38.45***
	(5.15)	(5.30)	(7.03)	(7.65)	(4.82)	(7.27)	(3.39)	(5.69)	(4.71)
Native sheep breeds on farms 1 -> 2	6.57	58.57***	11.84	-3.21	63.78***	-14.35*	93.28***	11.71**	58.03***
	(5.32)	(5.55)	(7.82)	(7.51)	(5.37)	(7.97)	(5.22)	(5.79)	(5.05)
Native sheep breeds on farms 1 -> 3	20.18***	68.58***	21.78**	-0.93	69.95***	-5.42	109.92***	23.77***	63.83***
	(5.71)	(5.79)	(8.55)	(8.53)	(5.99)	(8.18)	(7.05)	(6.12)	(5.03)

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Model diagnostics			
LL at convergence	-7364.35	-7335.16	-7129.67
LL at constant(s) only	-10141.25	-10141.25	-10141.25
McFadden's pseudo-R^2	0.2738	0.2767	0.2965
Ben–Akiva–Lerman's pseudo-R^2	0.4797	0.4814	0.4944
AIC/*n*	1.5817	1.5785	1.5605
BIC/*n*	1.6843	1.6917	1.6178
n (observations)	9484	9484	9484
r (respondents)	1608	1608	1608
k (parameters)	136	150	270

Likelihood ratio test

Comparison	**Test statistics**	**Degrees of freedom**	***P*-value**
Model 1 vs. Model 2	101.1997	15	0.0000
Model 1 vs. Model 3	176.0196	134	0.0087
Model 2 vs. Model 3	74.8199	119	0.9995

The variables are significant at the ***1%, **5%, and *10% levels.
ASC: alternative specific constant.

[1]The code and data for estimating the specific models presented in this study, as well as the results of the sensitivity analysis, robustness checks and alternative specifications, are available at http://czaj.org/research/supplementary-materials.

[2] The specific distributions (f) must be assumed by the modeler; this is typically based on model fit.

[3] In order to ensure that the global maximum in optimization was reached, we used different optimization algorithms, derived gradients analytically, and used multiple starting points. In simulation of the log-likelihood function, we used 10,000 scrambled Sobol draws (Czajkowski and Budziński, 2019).

[4] The models were estimated using the DCE package, which can be used to estimate MXL models, among others. The package has been developed in Matlab and is available at https://github.com/czaj/DCE.

[5] Note that the MXL model with all parameters random and correlated accounts for unobserved scale heterogeneity (Hess and Rose, 2012).

[6] We also estimated the discrete choice models using familiarity and importance as controls (available at http://czaj.org/research/supplementary-materials). We found that including familiarity and importance as additive preference controls did not change our overall conclusions: the effects of accessing information were still very similar and significant.

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