Testing for Payment Card Framing effect on Contingent Willingness to Pay

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Abstract

The coherent arbitrariness principle argues that individual preferences may be manipulated by irrelevant factors. In the context of the payment card (PC) format, one irrelevant factor of the contingent market is the order in which amounts are framed or presented to respondents. The economic theory of consumer behavior, however, suggests that such a manipulation cannot occur as long as all relevant constituents of the transactions proposed remain the same. This paper investigates whether willingness to pay (WTP) for the same good is sensitive to the order of presenting bid amounts on a card. The main finding is that individual sensitivity to PC framing is related to uncertainty in preferences. Specifically, presenting bid amounts in ascending, descending or random order does not influence respondents who are fully sure about the amounts they are willing to pay. On the order hand, respondents who have any doubt about their single point values adjust their responses depending on how the bid amounts are listed on the card, suggesting a starting-point bias. Our results imply that it is possible to mitigate, if not eliminate, the PC framing bias by restricting the analysis to only fully sure respondents or by acting on the causes of uncertainty.

Keywords: Contingent valuation; payment card format; uncertainty; salt marsh conservation.

JEL classification: Q24; Q57

1. Introduction

Different elicitation formats have been developed and applied by contingent valuation (CV) practitioners to estimate the preferences of respondents for non-market goods and services. Due to its incentive compatibility (Carson and Groves, 2007) and low cognitive burden on respondents, the dichotomous choice (DC) format has been endorsed and recommended by the NOAA panel (Arrow et al., 1993). Though the DC replicates real life decision-making (Vossler and McKee, 2006), it gives little information about the preferences of respondents. To overcome this problem, the payment card (PC) format is commonly applied in health economics and environmental economics. So far, it is one of the most widely used valuation question formats (Covey et al., 2007)[1]. Several reasons might explain its popularity (Mitchell and Carson, 1989; Bateman et al., 2002): statistical efficiency gains in the estimation of parameters relative to the DC, insensitivity to starting point bias as compared to the bidding game and lower cognitive effort than the open-ended format, resulting in a low non-response rate.

Two types of biases, however, have been identified and seemed to question the validity of PC format, namely the range bias and centering bias (Mitchell and Carson, 1989). These biases have been widely explored in CV studies (Covey et al., 2007), and empirical evidence tends to suggest that the PC format is free to them as long as the range of the WTP distribution listed on the card is not truncated, i.e. covers the range of respondents' WTP values (Rowe et

[1]It is important to note that, at this time, there is no consensus regarding the preferred elicitation format (Bateman et al., 2002). Perhaps a simple guide is to use a question format which is consistent with the circumstances of the survey (Venkatachalam, 2004; Champ and Bishop, 2006). For example, Champ and Bishop (2006) argued that the PC format is more appropriate than the other formats if the donation payment vehicle is employed.

al., 1996). Another potential bias which, at this time, is not yet tested in the field of environmental economics is the effect on WTP of the order in which the bid amounts are framed, or presented to respondents. A change in valuation behavior from respondents due to changes in the order of presenting the bid amounts to them is problematic in CV studies because the order of bid amounts is intended to be an irrelevant factor of the constituents of the hypothetical transaction proposed, and hence should not influence their responses. Alberini et al. (2003) explored this bias in the context of multiple bounded dichotomous choice (MBDC), but their analysis was restricted to only ordered sequences of bid amounts. It was found that putting the bid amounts in descending order leads to higher welfare estimates than putting the bid amounts in ascending order.

Traditionally, the PC format involves presenting a set of bid amounts arranged in an orderly way (particularly in ascending order) to respondents from which they have to tick their maximum WTP. There are very few studies that opt for a random version, commonly called randomized card sorting procedure (RaV). The RaV is to write individual monetary amounts on separate cards, which are then shuffled manually, and presented one at a time to respondents who have to sort them into amounts they would be certain that they would pay and would not pay, and those they would be uncertain (e.g. Carthy et al., 1998; Smith, 2006 ; Covey et al., 2007; Shackley and Dixon, 2013). Alternatively, the bid amounts are shuffled with the help of a computer program and presented all together and at the same time on one sheet (e.g. Nielsen, 2011)[2]. Although it has been stated (but not tested) that the valuation task is fundamentally more expensive in terms of cognitive effort under the random arrangement of amounts (Andersen et al., 2006), the popularity of ordered versions remains surprising at

[2] A computer program also has been employed to randomize amounts in the context of the iterative bidding game payment format (e.g. Guria et al., 2005).

least for two reasons. First, there is no theoretical or empirical justification for the superiority of a version over the other (Smith, 2006). Second, the RaV offers some potential advantages over other versions (Covey et al., 2007; Shackley and Dixon, 2013). For instance, the fact that the bid amounts are shown in random order attenuates the risk of range bias. The RaV also avoids the starting point bias or attenuates the effect of this bias on welfare estimates, since each respondent in the sample receives a different randomized PC series. The starting point bias occurs when the WTP estimates are sensitive to the starting bid amounts (Mitchell and Carson, 1989).

To the best of our knowledge, the effect of PC framing on WTP has been tested only in the field of health economics by Smith (2006). The author found that the descending version (DcV) yields significantly higher values than the RaV or the ascending version (AsV). However, our article differs from this study in two fundamental ways. First, in Smith (2006), both AsV and DcV present all bid amounts together on a sheet, whereas the RaV presents to respondents the bid amounts, not only in random order, but also on separate cards. Consequently, differences observed in mean WTP across the three versions might not be due to the only randomization procedure (randomization effect); rather they would reflect the combined effect of the randomization and the use of separate cards (card effect). In our survey, we apply the same administration mode for all versions, so that differences in welfare estimates, if any, reflect the only randomization effect. Second, and more importantly, Smith (2006) implicitly assumed that the PC framing effect is homogeneous across respondents, in that those who have well-defined preferences are as vulnerable to PC framing effect as respondents whose preferences are malleable. Our study assumes that such an effect is rather heterogeneous across respondents, in that well-defined preferences are insensitive to PC framing. To the best of our knowledge, this is the first paper that explores the link between

respondent uncertainty and PC framing. Our main finding is that presenting the bid amounts in ascending, descending or random order does not influence respondents who are fully sure about their stated WTP. On the other hand, respondents who are uncertain about their WTP, adjust their WTP responses for the same good depending on how the amounts are listed on the card.

The article is structured as follows. Section 2 presents the theoretical background. Section 3 reviews existing approaches that allow uncertainty in the PC format, and introduces our approach. The case study, survey design and implementation are described in Section 4, followed by the preliminary statistical results in Section 5. The outcomes of the econometric analysis are provided in Section 6. Section 7 concludes the paper with the discussion of results, their implications and considerations for future research.

2. Theoretical background

Psychologists have, over the years, demonstrated that decision-making outcomes may be influenced by price framing, i.e. the way price information is presented. This could explain why sellers devote considerable time and money to applying pricing psychology strategies. Psychological pricing is a marketing practice of structuring and presenting prices to appeal to consumers' emotions and influence their purchase decision (Pride and Ferrell, 1997; Asamoah and Chovancová, 2011). One aspect of the psychological pricing is the impact on purchasing behavior of price presentation order (Bennett et al., 2003). In the pricing context, adaptation-level theory (Helson,1964) suggests that consumers perceive purchase prices differently according to whether they are preceded by higher or lower prices[3]. That is, when buyers encounter prices in an orderly way, the first amount serves as a reference point (an anchor)

[3] Prospect theory (Kahneman and Tversky,1979) also provides a basis for the reference price concept.

that is likely to influence their perception of other amounts, and hence their purchase decision making (Monroe, 1990; Bennett et al., 2003). Della Bitta and Monroe (1974) tested this theory by exploring the effect of the order of price presentation on consumers' judgments of the relative expensiveness of alternative prices. Respondents were asked to evaluate a set of prices for the same product arranged in ascending order and descending order. It was found that common prices ($10 to $20) are perceived as being significantly more expensive by individuals evaluating them in increasing order than individuals evaluating these same prices in decreasing order. The conclusion is that when initially faced with high prices (low prices), people tend to perceive subsequent prices as less expensive (more expensive) than they would if they initially saw low prices (high prices) (Monroe, 1990). The perceptual effect explains why prior research found that the descending price order format has a tendency to produce both a purchase probability and an average price significantly higher than the ascending price order format (e.g. Monroe, 1990; Brennan, 1995; Alberini et al., 2003; Bennett et al., 2003). There is reason to believe that such an effect might be mitigated, if not eliminated, under the random price order sequence, since this sequence avoids the focus on the same initial amount by all respondents in the given sample. This theory for reference prices, however, does not tell whether the perceptual effect occurs regardless of whether consumers are fully sure or unsure about the price that they are willing to pay for the product offered.

Economic theory of consumer behavior tells a different story that can be summarized as follows: price framing has no effect on purchasing decision as long as the relevant terms of exchange are held constant (Arrow, 1982). The reason is that, according to the assumption of completeness, consumers have well-defined preferences for any choice they are faced with (Pindyck and Rubinfeld, 2005). In the context of PC format, this implies that respondents' preferences, and therefore their WTP, are invariant to changes in the order of presenting the

bid amounts. Indeed, it makes intuitive sense to expect that respondents who are fully sure about their reservation value for a good whose quality or quantity is fixed do not change their value depending on how the bid amounts are shown on a card. Several CV studies, however, contradict the usual assumption of the standard economic theory of consumer behavior by showing that some respondents are rather uncertain about their responses to valuation questions (for a review, see Akter et al., 2008). Kahneman and Sugden (2005) argued that an anchoring effect can arise when respondents are uncertain regarding the value they place on a good. This implies that individuals who do not have stable preferences could be sensitive to PC framing. For instance, they could interpret the rank of bid amounts as conveying implicit information about the appropriate value for the good in question, and adjust their WTP responses accordingly. Our thesis is that three sequences of similar amounts, ordered differently (low-to-high, high-to-low, and randomly) will yield similar WTP estimates for respondents who are fully sure about the exact bid amount they would be willing to pay, but will yield statistically different WTP estimates for those who have some doubts about their exact point values.

3. Accounting for uncertainty about WTP in the PC format

The common way to deal with the WTP response elicited from the traditional PC format involves considering the bid amounts selected to be the minimum indicator of the true maximum WTP, which falls between this bid amount and the next bid amount on the card (Cameron and Huppert,1989). Although Cameron and Huppert (1989) did not employ the term uncertainty in their paper, their idea can be interpreted as an implicit recognition that the respondents are uncertain about their true point value and can only locate it within an interval. Indeed, in the context of non-market valuation, the implication of the assumption from the microeconomic theory that consumers know their preferences is that they are able to express

them in monetary terms for any change in the provision of a good by stating an exact WTP (Hanemann et al., 1996). The problem, however, with this interpretation of responses from the traditional PC format is that uncertainty is not stated by the respondent himself; rather it is assumed by the researcher. Consequently, a "researcher effect" could occur on the welfare estimates (Håkansson, 2008).

Several approaches that explicitly allow for expressions of uncertainty in the PC format have since been developed. Ready et al. (2001) introduced a post-decision uncertainty valuation question, which is an ordinary PC question followed by an uncertainty question about the single amount ticked. The respondent is asked to select one of five uncertainty response categories ranging from "I am almost certain (95% sure) that I would pay that much money" to "I am almost certain (95% sure) that I would not pay that much amount". Wang and Whittington (2005) proposed a stochastic payment card (SPC), which differs from the approach of Ready et al. (2011), in that uncertainty is about each amount on the card and is elicited simultaneously with WTP. Specifically, the PC is accompanied by a list of uncertainty levels, and the respondents have to select their uncertainty for each bid amount. The SPC is similar to the MBDC except that uncertainty levels are expressed in terms of both verbal and percentage scales: definitely yes (100%); probably yes (90% - 60%); not sure (50%); probably no (40% - 10%); definitely no (0%). The main problem with these approaches is the subjective nature of uncertainty scales used, which requires the researcher to make strong assumptions about their interpretation by the respondent (Loomis and Ekstrand, 1998; Hanley et al., 2009).

An alternative approach, which avoids this problem, is the two-way-payment ladder (TWPL). Initially, it consists in a two-step payment question (e.g. Jones-Lee et al., 1995).

First, respondents are presented with an ordered sequence of values and asked to tick the bid amounts they would definitely pay, cross off bid amounts they would definitely not pay, and leave blank bid amounts for which they cannot say either definitely yes or definitely no. Second, they have to tick a single bid amount between their highest tick and lowest cross as the amount they "have the most difficulty in deciding over", which is taken as the "best point estimate" of WTP. Several adjustments have since been made (e.g. Hanley et al., 2009; Mentzakis et al., 2010; Mahieu et al., 2012). For instance, Hanley et al. (2009) restricted the approach to the only first step, which leads to a WTP elicited in the form of either a single point estimate or an interval. This provides a richer set of information about individuals' preferences. Mahieu et al. (2012) used the second step to identify "more precisely" the endpoints of the range of the WTP. The respondents are then required to specify their bound amounts from ones located between the highest amount for which they say "definitely yes" and lowest bid amount from which they say "definitely no". In the same vein, Mentzakis et al. (2010) presented two separate and similar ordered sequences of bid amounts and asked the respondent to choose a single bid amount from each sequence and then to indicate the degree of uncertainty associated with each bid amount ticked on a scale from 0 (not sure at all) to 10 (absolutely sure). The main concern with the TWPL is that the format of the valuation question tends to inflate the proportion of WTP interval responses (Vossler and McKee, 2006; Hanley et al., 2009). In other words, it encourages the respondents to make the mental effort required by the valuation exercise to identify the endpoints of the range in which their true WTP falls rather than the true WTP itself (Voltaire, 2015). This could explain why Hanley et al. (2009) found that about 99% of respondents stated their WTP as an interval.

In response to this concern, Voltaire et al. (2013) introduced a new PC question format, which avoids the respondent to tick, cross and leave blank amounts. It can be seen as

a kind of combination of the valuation question format proposed by Håkansson (2008) and the PC design of Mentzakis et al. (2010). Two separate and similar ordered sequences of bid amounts are displayed and respondents are given the opportunity to indicate their WTP in the form of either an exact amount (option 1) or an interval (option 2). Under this format, uncertainty is implicitly embedded in stated WTP, but the interpretation of responses is similar to the one from the TWPL. If option 1 is chosen, it is assumed that respondents are fully certain about the exact bid amount they would be willing to pay, since their lower and upper values coincide. That is, they would *definitely* pay this amount. On the other hand, if option 2 is used, it is assumed that they are uncertain, since their lower and upper values do not match. As a result, their true WTP is assumed to be at least as great as their lower value ticked but are less than the upper value ticked. The size of the interval reported (Upper values – Lower values) reflects the uncertainty level (e.g. Håkansson, 2008; Hanley et al., 2009; Mahieu et al., 2012); the higher this size, the more uncertain the respondents are regarding their single point values. In our article, we use this type of WTP elicitation format with however, significant adjustments in the design of the card and the valuation question format. Specifically, we make the issue of uncertainty more salient so that uncertainty is the only major reason why the respondents can choose to formulate their WTP as an interval. In the case of Voltaire et al. (2013), due to the way the valuation question is posed, uncertainty is one reason among others why the respondent can make such a choice, a limitation that authors also acknowledged. Detailed information on our elicitation format is provided in the next section.

4. Study design and survey implementation

The case study for our test involves a CV survey of the general public with respect to their WTP for a salt marshes conservation program in Brest roadstead (France). Covering more

than 85 hectares, salt marshes are one of the most important natural assets of the roadstead. They are particularly threatened by an invasive alien species, called *Spartina alterniflora*, which comes from the Northeast coast of the United States and Canada (Géhu, 2008). As part of Natura 2000 management approach and the application of the Habitats Directive, salt marsh natural habitats are known at European level as of major interest. This is one reason why the end of Brest roadstead has been designated as a Natura 2000 site, in order to implement a management scheme to maintain this area in a satisfactory state of conservation. The Regional Natural Park of Armorique is operating this Natura 2000 site. Since 2010, many actions have been separately tested to fight against the spread of the *Spartina alterniflora* through experimental sites. Of these actions, two are considered to be the most efficient ones by the team of experts from the regional park: (1) the use of a black sheet to stifle the invasive plant, and (2) the digging of small tranches near the *Spartina alterniflora* area to avoid its spread. These actions will be jointly undertaken in a number of sites, in particular in the site of Troaon, where salt marshes are still well-preserved and the spread of the *Spartina alterniflora* is limited.

A first draft of the questionnaire was designed in January 2013, followed by some rounds of modifications in the wording of questions, and then pre-tested in May 2013 on a sample of 60 residents in Brest roadstead under the same conditions to be followed in the final survey. The objective of the pre-test was twofold: (1) to determine if the contingent program as well as the payment method were understandable and credible; (2) to determine the most suitable number and levels of bid amounts in order to avoid the application of inappropriate PC intervals for the full sample in the main survey (Cameron and Huppert, 1989). To this end, an open-ended elicitation format was employed as suggested by Bateman et al. (1995). Regarding the payment vehicle, based on feedback from a focus-group, which consisted of

environmental economists and an expert in invasive plant species, we adopted a one-time donation. Though donation is subject to criticism (see Wiser, 2007), several reasons may justify its use in CV studies. For instance, it is the appropriate way to pay for small-scale public goods, such as the one under valuation in this paper (Champ et al., 1997; Champ and Bishop, 2001). It is more consistent than a mandatory payment vehicle (e.g. a tax) with the PC format (Champ and Bishop, 2006). Donation is less prone to protest responses than the tax (Champ et al., 1997). It may be more credible than the tax, since respondents are familiar with messages calling for donations to fund such nature conservation projects. In addition to these reasons, numerous studies have successfully implemented actual and contingent voluntary payment comparisons (for more details, see Champ and Bishop, 2001).

The final questionnaire contained four parts: (1) introduction, where the purpose of the survey was presented and respondents were asked to be honest in their answers; (2) attitudinal and behavioral questions regarding nature conservation in general, followed by questions about the conservation of salt marshes; (3) the key components of the CV survey; and (4) demographic and socio-economic questions. With respect to part three, it began with clearly defining the term "salt marsh" and showing a picture of the salt marsh in the study area, so that all respondents knew what they were being asked to value. This was followed by a description of main services provided by salt marshes in Brest roadstead. Next, we informed that salt marshes in the roadstead are threatened by the invasive aquatic plant, *Spartina alterniflora.* A picture depicting the spread of this plant was given. At this stage, the two salt marshes conservation actions previously mentioned were described and visualized by respondents with the help of pictures. Subsequently, they were told that these actions would be jointly undertaken in Troaon as part of a salt marsh conservation program.

After describing the payment vehicle and stressing that the money collected would be fully allocated to the program, we presented the PC to respondents. It consists of two separate parts: Part A - "*I have no doubt*", and Part B - "*I am unsure*" (see Box 1). While at the same time seeing the card, respondents are told that, if they are *completely* certain about the exact maximum amount they would be willing to pay, they have to indicate this amount in part A. Specifically, they have to pick it from the card or report it in the blank box labeled "other amount" if the amount they would pay is not included on the card. On the other hand, if they have any doubt with respect to their exact maximum WTP, they have to use part B. Specifically, they have to indicate the interval in which their true maximum WTP lies. This means that they have to pick from the card or report in the blank box (if necessary) the lower and the upper bounds of this interval.

(Box 1, here)

Based on results of the pre-test, we decided to use twelve amounts. For the RaV, a sample of 12! respondents is needed to achieve all combinations. Clearly, this set should be reduced to a realistic and manageable sample size. Given our budget limitations, we selected about 120 people for each version of PC, giving a pooled sample of 364. Regarding the RaV, the 122 series of PC were generated with the help of functions ALEA and RANK in Excel. Given the very small number of series drawn relative to possible ones, we imposed two constraints during the randomization process to ensure that the bid amounts are "shuffled" as best as possible: (1) each series generated is unique; hence each respondent receives a distinct series of PC; and (2) each amount holds at least four times each rank on the card; that is, each amount has a non-zero probability of holding the rank j on the card, where $j = 1, \ldots, 12$.

(Table 1 and Figure 1, here)

The main survey was conducted in Brest roadstead between July and August 2013 by three enumerators on a face-to-face survey applying quotas by age and sex. The 364 respondents were aged eighteen years or older. They were randomly allocated to one of the three PC versions. Table 1 presents the lists of variables constructed from their responses. Figure 1 summarizes the research design. As can be seen, for each PC version, respondents are split into two samples on the basis of the WTP response format chosen. To be more specific, those who state their WTP as an exact amount constitute the fully sure sample, since their lower and upper values are similar, whereas those who state their WTP as an interval are identified as the unsure sample, since their lower and upper values differ. The fully sure sample is then split into protesters and zero/positive bidders after careful analysis of major arguments (presented below) provided to justify the refusal to pay anything. The unsure sample consists of only positive bidders, since their upper values are greater than zero.

5. Main statistical results

Before testing for the effect of PC framing, it is crucial to ensure that, for each sample (fully sure and unsure), respondents are statistically identical in terms of characteristics summarized in Table 1. Overall, our experimental groups are identical except for some very few cases (Table A in appendix). Specifically, for the sample Fully sure, AsV consists of significantly less men than DcV group ($Z = -1.863$; $p \leq 0.063$), whereas for the unsure sample, respondents in AsV group are more likely to be men ($Z = -2.077$; $p \leq 0.038$) and to believe that the program would not be implemented ($Z = -2.434$; $p \leq 0.015$) than DcV group.

Of 364 individuals surveyed, 35.2% do not want to pay anything at all (their lower values = upper values = 0). The analysis of the main reasons given for refusing to pay leads to the identification of 59.4% of protest bidders and 40.6% of zero bidders. Respondents

classified into protesters are those who state: "the payment mechanism is inappropriate" (9.4%); "I have too little information about the project" (3.9%); "it is not my responsibility to pay" (46.1%). Those who state: "my income does not allow me to pay" (24.2%); "it is not necessary to protect salt marshes" (2.3%); "I have other priorities" (10.9%); "I do not feel concerned" (3.1%) are treated as zero bidders. We examined differences in the distributions of non-payers (both zero and protest bidders) across the three PC versions for each sample using the Pearson χ^2 test. None of paired comparisons leads to significant differences. We also arrive at the same conclusion, when focusing on the distributions of protest bidders (Table B in appendix). These results suggest that the decision either to participate in the contingent market or protest is independent of the order in which the bid amounts are presented to respondents.

Regarding the WTP response format, 59.3% of respondents are fully sure about the amount they would be willing to pay, since they report an exact WTP, and 40.7% are unsure, since they report an interval. Significant differences exist between single point estimate and interval bidders. Specifically, the sample Unsure consists of younger people ($Z = -1.688$; $p \leq 0.091$) and higher household size ($Z = -2.520$; $p \leq 0.012$), has higher income ($Z = -3.030$; $p \leq 0.002$) and is more likely to believe that the project would not be implemented ($Z = -1.692$; $p \leq 0.091$). These differences suggest that we are confronted with two distinct samples, and as such they are likely to react differently to PC framing.

6. Econometric analysis

Descriptive statistical results presented above shown that the fully sample consists of protest bidders, zero bidders and positive point estimate bidders. The simultaneous presence of a substantial number of protest and zero bidders requires the use of a Tobit model with

selectivity, which is a mixture of a censoring and a type of truncation. However, a strong assumption underlying the Tobit model is that zero bidders actually have a negative WTP, but because no amounts below zero are allowed, they are "forced" to state a zero WTP. In other words, the latent dependent variable is assumed to contain negative values that have been censored to zero in the empirical realization of the variable (Sigelman and Zeng, 1999). From an economic perspective, this means that the provision of the good would lead to a welfare loss for these respondents (Ami and Desaigues, 2000). In our case, when examining the reasons behind the refusals-to-pay, we found that only a marginal number of zero bidders (those 2.3% of respondents who stated that it is not necessary to protect salt marshes) might be negatively affected by the realization of the scenario. Thus, the Tobit model appears not to be relevant for analyzing our data. As an alternative, we employ the well-known two-part model, where the first step is a binary outcome equation (usually a Probit model) that models the decision to either participate in the hypothetical market or protest, and the second step uses a linear regression to model the contribution decision (including true zero bids). The two decisions are assumed to be independent and are estimated separately (for more detail see Cameron and Trivedi, 2009)[4]. In this article, the dependent variable in the Probit model takes the value 1 if the respondents protest and 0 otherwise.

With respect to the unsure sample, WTP responses are provided in terms of intervals, which indicates that the respondent's true valuation lies somewhere within the interval defined by lower and upper limits ticked from the card or reported in the blank box. Cameron and Huppert (1989) developed a well-known maximum likelihood framework that suits such data. Their model, called Interval Regression (IR) model, is used here (for more details see

[4] We first estimated a sample selection model using the two-step procedure, but the inverse Mills ratio was not significant, implying that the two decisions are independent.

Cameron and Huppert, 1989). However, given problems related to assumptions underlying parametric maximum likelihood estimators, a non-parametric method is further applied. Non-parametric estimators require neither any distributional assumption for WTP data nor complex calculation for optimization like parametric estimators. In the context of interval-censored data, the calculation of non-parametric welfare estimates could be done through the estimators of Kaplan and Meier (1958) and Turnbull (1976), which impose monotonicity. The properties of these estimators have been thoroughly explored (Kriström, 1990; Haab and McConnell, 1997; Vaughan and Rodriguez, 2001). As suggested by Scarpa et al. (2001), in the case of interval-censored data, the Kaplan-Meier-Turnbull (KMT) is obtained by first computing the point probability of positive response at the bid values and then estimating the expected WTP by discrete integration under the step function probability estimates. In the current study, the point probability of positive response is estimated at the vector $\{0,2,5,10,15,20,30,40,50\}$. The standard errors are obtained by bootstrap technique (Efron and Tibshirani,1993) over 1000 simulations.

6.1. Results and welfare estimation

Results of the two-part model and IR model are displayed in Table 2. Both linear and log-linear functional forms were tested. We finally adopt the log-linear form since the distribution of WTP is right skewed and this functional form has the highest log-likelihood value. The variables of interest are the dummy variables for the three versions of PC. Starting with the fully sure sample, the coefficients on these variables are not significant, neither for the selection equation nor the value equation[5]. Comparisons of parameters for variables DcV and RaV are also conducted to test whether respondents value the commodity in question in the

[5] We have the same conclusion when recoding protest responses as true zero bids.

same way when faced with a descending or a randomized PC version. We do have strong statistical evidence that we cannot reject the null hypothesis [F (1*df*) = 0.61; Pr.> F = 0.435]. Therefore, we are inclined to conclude that respondents who are fully sure about the bid amounts they are willing to pay are not influenced by the order of presenting bid amounts. Results tell a different story regarding the unsure sample. The descending and randomized versions lead to statistically higher values than the ascending version. But there is no significant difference between DcV and RaV [$\chi 2$ (1*df*) = 0.08; Pr.> $\chi 2$ = 0.772]. Results of an OLS regression analysis (available upon request) using the mid-point in each interval reported as the true WTP value point confirm these findings. The fact that parameters for DcV and RaV are significant suggests a PC framing bias for uncertain respondents.

(Table 2, here)

We now examine whether the effects of variables of interest translate into differences in predicted mean WTP estimates (Table 3). Predicted mean WTP estimates from the linear form are presented for purposes of information. For the fully sure sample, the three PC versions statistically produce the same mean WTP value irrespective of the functional form used (log-linear and linear functional forms) since the 90% confidence intervals overlap[6]. This confirms the absence of PC framing bias for this category of respondents[7]. For the unsure sample, the mean WTP value generated from AsV is significantly lower than the one generated from DcV or RaV since the 90% confidence intervals do not overlap. This indicates

[6] The differences between WTP estimates depending on whether a linear or a log-linear functional form is used are not surprising. As it is well known, contrary to the linear functional form, the log-linear form constrains predicted WTP to be positive. Here, the log-linear form is particularly relevant since the salt marsh conservation program under valuation is expected to increase respondents' utility.

[7] Table C in appendix report the mean WTP estimated through an OLS regression where protest responses are treated as true zeros. As can be seen, the results confirm this conclusion.

that the order in which amounts are listed is not neutral in the valuation process for respondents who are unsure about their WTP. The examination of the results from the Turnbull method leads to the same conclusion. The survival functions illustrated in Figure 2 show that the proportion of "yes" responses declines with the bid amounts in the three PC versions. However, the ascending version results in lower proportions of "yes" responses to almost all bid amounts than the descending or random version. Consequently, it produces the lowest welfare estimates (Table 3).

(Figure 2 and Table 3, here)

7. Conclusions, discussion and suggestions for future work

Two major lessons emerge from this article. First, our results clearly contradict some researchers' argument that the random sequence of amounts is cognitively more cost consuming than ordered sequences. One way to evaluate the cognitive effort required by two types of valuation questions is to compare the proportions of protest zero responses. For instance, the open-ended format is considered to be more cognitively burdensome to respondents than the other elicitation formats on the basis of this indicator (Mitchell and Carson, 1989). In our case, if the argument in question were true, then the random PC version should have led to significantly higher protest rates than ordered versions. We found that the PC versions yield statistically equivalent results in this respect. This means that no single version is unequivocally better or worse than the others in terms of difficulty in answering the CV question. Thus, our results provide a cautionary note regarding the systematic use of ordered PC versions based on the only argument that they demand a lower cognitive effort from respondents than the random version.

Second, in their paper on coherent arbitrariness, Ariely et al. (2003) argued that individuals' preferences can be manipulated by irrelevant factors, such as option "framing", changes in the "choice context", or the presence of prior cues or "anchors". In the context of PC format, this implies that, by changing the order of presenting bid amounts, it is possible to manipulate respondents' preferences for a good, and thus to elicit different WTP values for the same good. Our article shows that such a manipulation does not occur if respondents are fully sure about the bid amount they are willing to pay. This is clearly a positive result for the CV method in that it provides evidence that fully sure respondents (people who have well-defined preferences for a good) behave as economic theory predicts, i.e. are insensitive to factors which, from the economic perspective, should not influence their valuation behavior. On the other hand, our article shows that the manipulation of preferences does occur if respondents have any doubt about their single point values. Because they do not have well-defined preferences, these respondents adjust their values for the same good depending on how the bid amounts are arranged on the card. This suggests a starting-point issue (the perceptual effect described in Section 2). Our intuition is that, when individuals do not have well-defined preferences for a good, even if all bid amounts are shown together and at the same time on a card, the first bid amount still provides them a focal point or anchor, and therefore influences their perception of subsequent bid amounts. This is in line with the results of Alberini et al. (2003) which found that the MBDC format suffers from starting point bias. In our case, the fact that the ascending version generates the lowest welfare estimates suggests that the first bid amount makes each subsequent amount like "much money", which leads respondents to be more inclined to tick amounts listed at the top on the card. Explaining reasons for starting point bias, Alberini et al. (2003) suggested that it could be due to uncertainty in preferences. Our study provides evidence of the link between this bias and respondent uncertainty.

How to interpret the fact that the descending and random versions statistically produce similar WTP estimates? Let us begin by saying that this result is contrary to our expectations. We expected the random version to yield WTP estimates that significantly lie between that of the ascending and descending versions since the average starting card value typically lies somewhere between (Smith, 2006; Covey et al.,2007). This result can be interpreted in two different ways. First, as was pointed out above, the random version has the potential advantage of avoiding the focus on the same first amount as each respondent in the given sample receives a different randomized PC series. Therefore, this version would attenuate the starting point bias effect. The fact that the descending version gives valuations which are similar to the random version suggests that only the ascending version suffers from the starting point bias here. Thus, the ascending version would lead to a net underestimation of welfare estimates. This interpretation, however, implicitly assumes that, when faced with a random sequence of amounts, the respondents do not re-order the amounts in their head (i.e. treats the information as given by the interviewer) before stating their WTP. As no researcher knows without any uncertainty what the respondents do with their information in their head at the time of valuation exercise, we cannot totally exclude the possibility that they first re-order and rank the bid amounts from cheap to expensive or *vice versa* and then tick the preferred bid amounts. Therefore, the fact the descending and random versions statistically generate identical values might imply that respondents receiving the random version first re-ordered amounts from high to low. So the random version would be as prone to starting point bias as ordered versions. These two conflicting interpretations suggest that, at this time, no firm conclusion about the optimal PC version can be drawn; rather future research about the likely vulnerability of the random PC version to the starting point bias is needed. For instance, future research might investigate the respondent's ability to re-order amounts initially arranged randomly in the PC format at the time of answering a face-to-face valuation

question. Another avenue for future research would be to compare our random PC version with the classic interval open-ended (CIOE) format introduced by Häkansson (2008). This format directly asks individuals to state WTP either as an exact amount or an interval. It is free from starting point bias as no monetary cue about the likely value of the good in question is provided. So it is the "gold standard" for such a type of comparison.

Having established that a PC framing bias is present for uncertain respondents, the question that then arises is how to mitigate, if not eliminate, such a bias. Our results provide two suggestions. First, since fully sure respondents were found to be insensitive to this bias, the radical solution would be to restrict the analysis to this only category of individuals. However, this may not always be a good strategy. For instance, CV practitioners usually want to aggregate results to obtain a total valuation at a certain population level. For this purpose, it is of a crucial importance that the sample is representative of the whole target population. It may well happen that, after removing unsure respondents, the sample fails to meet the representativeness condition. Sample selection bias might also be introduced if unsure respondents are systematically different from others in terms of observable or unobservable characteristics, or both. Moreover, in the real life market situation, uncertain economic agents are not excluded from trading. Thus, it may not be rationale from a point of view of validity to drop uncertain responses. The other solution would be to act on the causes of uncertainty in order to help respondents to become fully sure about their single point values, or at least, less unsure as possible. Most reasons explaining preference uncertainty are listed in Shaikh et al. (2007). Giving the respondent more time to think before answering the CV question, more information in terms of quality and quantity about the amenity being evaluated, using cheap talk are some means likely to alleviate respondents' preference uncertainty. In our case, for instance, we found that uncertain respondents are more likely than fully sure respondents to

believe that the program would not be realized. Anything that allows increasing their confidence in the realization of the program could narrow the uncertainty range and, as a consequence improve the quality of their responses[8].

Finally, as this article is the first to address the issue of the PC framing in the field of environmental economics, it would be interesting to test the robustness of results by repeating the study using a larger sample, other non-market goods, a mandatory payment, vehicle and /or using separate cards rather than presenting all bid amounts together on the sheet. As we have mentioned above, although the voluntary payment (one-time donation) is the most appropriate payment vehicle under some circumstances, it is subject of critical debate about its incentive to free-riding behavior. According to this concept, the voluntary payment provides incentives to people to avoid paying for the provision of a good when they believe that others will pay (Wiser,2007). However, at least for our study, there is reason to believe that the free-riding critic is perhaps not persuasive. Indeed, when looking at the effect of the variable "participants" in the selection equation (Table 2), we find that it is negative. This suggests that the more someone believes that others will donate for the program, the lower the likelihood of protesting (i.e. the higher the likelihood of participating in the market). Results not reported here show also a negative effect of the variable in question when recoding the dependent variable as one if the respondent states a positive WTP and 0 otherwise (i.e. both false and true zeros). A positive effect would suggest a free-riding problem associated with the participation decision. Thus, although it is premature to draw firm conclusions, we can at least be reasonably confident in our findings.

[8] However, the uncertainty may not be completely eliminated, especially when it is due in part to socio-economic factors (e.g. age, sex, income).

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Tables

Table 1. **Descriptive characteristics**

Variables	**Description and coding**	**(Std. Dev.)**
Attitudinal and behavioral questions about nature conservation in general and salt-marsh conservation in particular		
Conservation	The respondent acquires himself information about nature conservation via indirect sources, such as television, newspapers, books etc. (1 = never; 2= seldom; 3= sometimes; 4 = often)	2.93 (0.889)
Contribution	1 if the respondent has already contributed for the realization of a nature conservation program through donations or voluntary work; 0 otherwise	0.21 (0.407)
Info_saltmarsh	1 if the respondent has already heard about salt-marshes; 0 otherwise	0.65 (0.479)
Aware_problem	1 if the respondent was aware of the salt-marsh conservation problem in Brest roadstead; 0 otherwise	0.24 (0.429)
Opinion about the contingent program		
Imp_scenario	Rating of the importance of the salt march conservation program for the respondent (1 = not at all important; 2=somewhat important; 3= important; 4 = very important)	2.99 (0.702)
Participants	Rating of the potential number of donors for the program (1 = very small; 2= small; 3= large; 4 = very large)	2.15 (0.638)

Implementation	1 if the respondent thinks that the program would be not implemented; 0 otherwise	0.15 (0.353)
Respondent socio-economic characteristics		
Male	1 if male ; 0 otherwise	0.46 (0.499)
Age	Age in years	48.90 (17.734)
Education	1 if the respondent has university degrees; 0 if he has a secondary school education university degrees	3.28 (1.255)
Nb_household	Household size	2.49 (1.328)
House_income	The midpoint of household income brackets in euros	2500.84 (1442.59)

Table 2. **Multivariate analysis for the two samples (fully sure and unsure samples)**

Variables	**Fully sure sample**				**Unsure sample**	
	Two-part Model				**Interval regression model**	
	Probit regression		Outcome equation			
	Coefficient	*p*-value	Coefficient	*p*-value	Coefficient	*p*-value
Constant	– 0.2795 (0.5140)	0.587	– 0.5336 (0.6451)	0.410	1.3447 (0.4438)	0.002***
Conservation	– 0.1560 (0.1165)	0.181	0.0044 (0.1555)	0.977	0.0666 (0.0875)	0.447
Contribution	0.2266 (0.2517)	0.368	0.2430 (0.3305)	0.464	0.0406 (0.1326)	0.759
Info_saltmarsh	0.4165 (0.2462)	0.091*	– 0.5354 (0.3026)	0.079*	0.4095 (0.1569)	0.009***
Aware_problem	– 0.4099 (0.2245)	0.068*	0.2833 (0.2947)	0.338	– 0.1234 (0.1498)	0.410
DcV	0.1412 (0.2290)	0.537	– 0.1374 (0.3230)	0.671	0.2799 (0.1523)	0.066*
RaV	0.0037 (0.2262)	0.987	0.0950 (0.2914)	0.745	0.3228 (0.1475)	0.029**
AsV	Reference		Reference			
Imp_scenario			0.5400 (0.1724)	0.002***	0.2629 (0.1365)	0.054*
Participants	– 0.4258 (0.1607)	0.008***				
Prog_implementation	0.6294 (0.2708)	0.020**	– 1.151 (0.5496)	0.038**	0.1374 (0.1565)	0.380
Male	– 0.0016 (0.1924)	0.993	0.0918 (0.2656)	0.730	– 0.1197 (0.1253)	0.339
Age	0.0111 (0.0067)	0.099*	0.0144 (0.0089)	0.100*	0.0005 (0.0042)	0.891

Income	0.00009 (0.00006) 0.140	0.0001 (0.00008) 0.099*	0.00001 (0.00004) 0.734
Lnsigma			0.6782 (0.0405)
Log-likelihood	– 364.0961		– 233.4832
Wald $\chi 2$ (p-value)	38.52***		28.09***
Pseudo-R^2	0.1424		
Nb. observations	216	140	148

*Note: ***, **, and * indicate significance at the 1%, 5%, and 10% level respectively.*

Robust standard errors are in parentheses.

Table 3. **Predicted mean WTP estimates**

PC versions	**Fully sure sample**		**Unsure sample**		
	Log-linear form	Linear form	IR: Log-linear form	IR: Linear form	Turnbull method
AsV 90% CI	20.44 [18.78 – 22.11]	13.84 [10.02 – 17.66]	18.48 [17.73 – 19.22]	15.70 [15.07 – 16.34]	11.78 [10.53; 13.02]
DcV 90% CI	17.70 [16.24 – 19.15]	15.11 [9.19 – 21.06]	24.78 [23.79 – 25.76]	21.94 [21.30 – 22.57]	18.73 [17.40; 20.06]
RaV 90% CI	22.57 [20.75 – 24.41]	14.26 [10.31 – 18.19]	25.90 [24.87 – 26.93]	22.45 [21.81 – 23.08]	18.30 [16.96; 19.64]

Note: Only conditional mean WTP estimates are reported for the fully sure sample (i.e. protest bidders excluded).

The welfare estimates are in euros.

Box 1. **A series of the randomized payment card version**

PART A : I HAVE NO DOUBT

Given the program and my income constraint, I would be willing to make an exact one-time donation of ….

Please, tick your exact amount from the list below. If your exact amount is not included on the list, please report it in the blank box labeled "Other amount"

30 €	5 €	15 €	20 €	0 €	2 €	60 €	40 €	10 €	80 €	100€	50 €

Other amount :

€

PART B : I AM UNSURE

Given the program and my income constraint, I would be willing to make a one-time donation of between …. and ….

Please, tick your lowest amount from the list below. If your lowest amount is not included on the list, please report it in the blank box labeled "Other amount"

Your lowest amount:

30 €	5 €	15 €	20 €	0 €	2 €	60 €	40 €	10 €	80 €	100€	50 €

Other amount :

€

Please, tick your highest amount from the list below. If your highest amount is not included on the list, please report it in the blank box labeled "Other amount"

Your highest amount:

30 €	5 €	15 €	20 €	0 €	2 €	60 €	40 €	10 €	80 €	100€	50 €

Other amount :

€

Figure 1. **Research design**

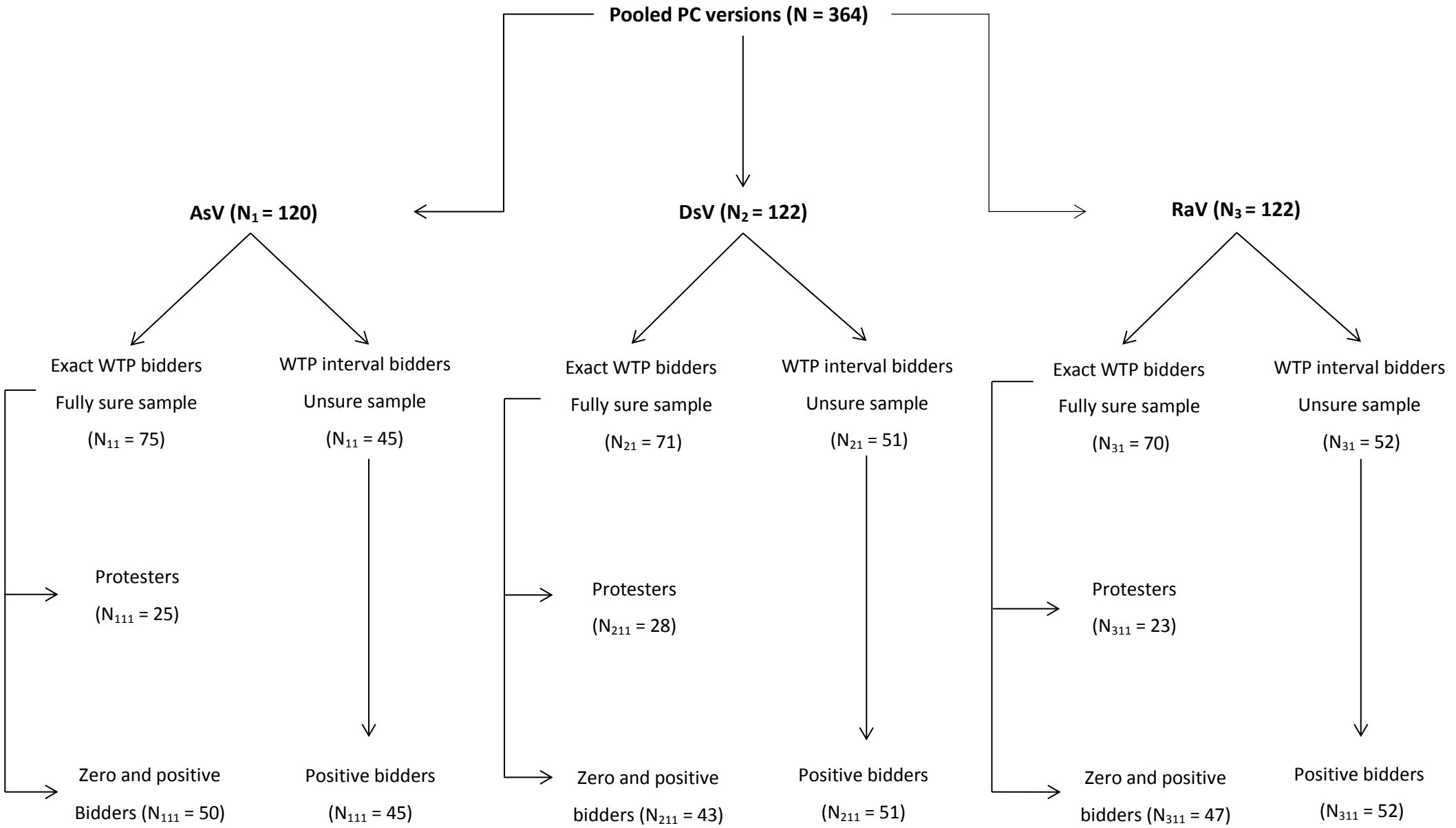
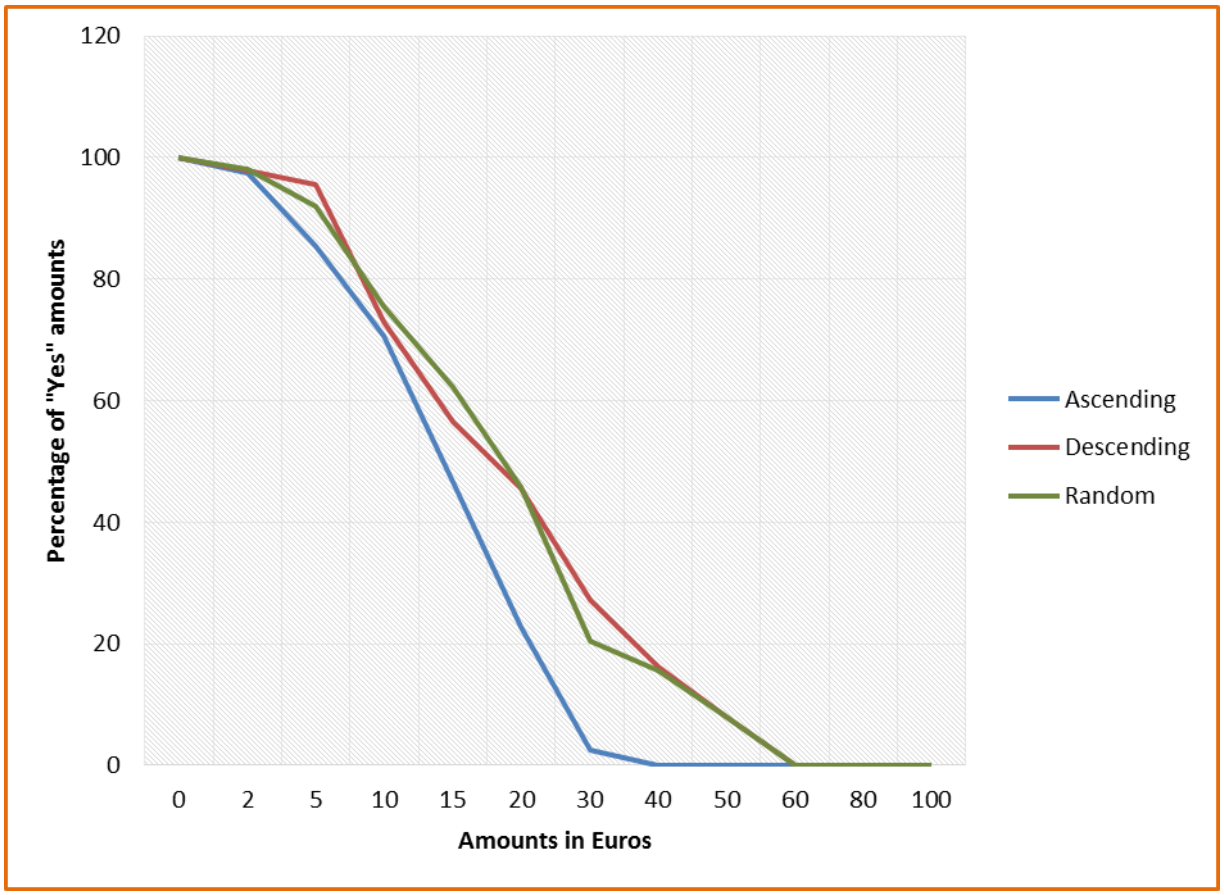


Figure 2. **Survival functions for each PC version**



Appendix

Table A. **Comparison of characteristics across the PC versions**

Variables	**Fully sure sample**				**Unsure sample**		
	AsV. *vs* DcV.	**AsV. *vs* RaV.**	**DcV. *vs* RaV.**		**AsV. *vs* DcV.**	**AsV. *vs* RaV.**	**DcV. *vs* RaV.**
Conservation	$Z = -0.153$; $p \leq 0.878$	$Z = -0.130$; $p \leq 0.897$	$Z = -0.029$; $p \leq 0.977$		$Z = -0.238$; $p \leq 0.812$	$Z = -0.390$; $p \leq 0.697$	$Z = -0.669$; $p \leq 0.503$
Contribution	$Z = -0.203$; $p \leq 0.839$	$Z = -0.238$; $p \leq 0.812$	$Z = -0.433$; $p \leq 0.665$		$Z = -0.587$; $p \leq 0.557$	$Z = -0.100$; $p \leq 0.921$	$Z = -0.508$; $p \leq 0.611$
Info_saltmarsh	$Z = -0.224$; $p \leq 0.823$	$Z = -0.643$; $p \leq 0.520$	$Z = -0.414$; $p \leq 0.679$		$Z = -1.096$; $p \leq 0.273$	$Z = -0.198$; $p \leq 0.843$	$Z = -1.339$; $p \leq 0.181$
Aware_problem	$Z = -0.960$; $p \leq 0.337$	$Z = -0.506$; $p \leq 0.613$	$Z = -0.446$; $p \leq 0.655$		$Z = -1.400$; $p \leq 0.162$	$Z = -1.349$; $p \leq 0.177$	$Z = -0.060$; $p \leq 0.952$
Imp_scenario	$Z = -0.488$; $p \leq 0.626$	$Z = -1.046$; $p \leq 0.296$	$Z = -0.445$; $p \leq 0.656$		$Z = -0.107$; $p \leq 0.915$	$Z = -0.318$; $p \leq 0.751$	$Z = -0.190$; $p \leq 0.849$
Participants	$Z = -0.465$; $p \leq 0.642$	$Z = -0.159$; $p \leq 0.874$	$Z = -0.314$; $p \leq 0.753$		$Z = -0.761$; $p \leq 0.447$	$Z = -1.172$; $p \leq 0.241$	$Z = -0.471$; $p \leq 0.637$
Implementation	$Z = -0.369$; $p \leq 0.712$	$Z = -0.065$; $p \leq 0.948$	$Z = -0.426$; $p \leq 0.670$		$Z = -2.434$; $p \leq 0.015$	$Z = -1.519$; $p \leq 0.129$	$Z = -1.078$; $p \leq 0.281$
Male	$Z = -1.863$; $p \leq 0.063$	$Z = -0.583$; $p \leq 0.560$	$Z = -1.262$; $p \leq 0.207$		$Z = -2.077$; $p \leq 0.038$	$Z = -1.239$; $p \leq 0.216$	$Z = -0.888$; $p \leq 0.374$
Age	$Z = -0.304$; $p \leq 0.761$	$Z = -0.564$; $p \leq 0.573$	$Z = -0.250$; $p \leq 0.803$		$Z = -0.624$; $p \leq 0.532$	$Z = -0.373$; $p \leq 0.709$	$Z = -0.815$; $p \leq 0.415$
Education	$Z = -0.449$; $p \leq 0.654$	$Z = -0.440$; $p \leq 0.660$	$Z = -0.134$; $p \leq 0.894$		$Z = -1.493$; $p \leq 0.135$	$Z = -0.474$; $p \leq 0.635$	$Z = -1.101$; $p \leq 0.271$
Income	$Z = -1.109$; $p \leq 0.267$	$Z = -0.854$; $p \leq 0.393$	$Z = -0.223$; $p \leq 0.824$		$Z = -0.616$; $p \leq 0.538$	$Z = -0.361$; $p \leq 0.718$	$Z = -1.071$; $p \leq 0.284$

Note: The paired comparisons were carried out using the Mann-Whitney statistic test

Table B. **Proportions of non-payers and protesters across the PC versions**

	Percentage of non-payers	**Percentage of protesters**
Ascending version	35.0	33.3
Descending version	38.5	39.4
Random version	32.0	32.9
Chi-square test results		
AsV *vs.* DcV	Pearson χ^2 value: 0.323 ($p \leq 0.570$)	Pearson χ^2 value: 0.159 ($p \leq 0.690$)
AsV *vs.* RaV	Pearson χ^2 value: 0.250 ($p \leq 0.617$)	Pearson χ^2 value: 0.149 ($p \leq 0.699$)
DsV *vs.* RaV	Pearson χ^2 value: 1.149 ($p \leq 0.284$)	Pearson χ^2 value: 0.620 ($p \leq 0.431$)

Table C: Welfare estimate for fully sure respondents (protesters included)

PC versions	**Fully sure sample**	
	Log-linear form	Linear form
AsV	9.71	8.94
90% CI	[6.59 – 14.13]	[8.34 – 9.55]
DcV	7.77	9.62
90% CI	[5.12 – 11.53]	[9.01 – 10.23]
RaV	10.40	9.59
90% CI	[6.95 – 15.38]	[8.99 – 10.21]