Preference revelation under lie detection

[preliminary version; please do not circulate]

Abstract

Stated preference surveys rarely provide respondents with such conditions in which a respondent's optimal strategy is to answer truthfully. As a result, reliability of stated preference data is questioned. We propose a new ex-ante method, grounded in economic theory, to incentivize respondents to truthfully reveal their preferences. Our method is based on a lie detector coupled with a reward. We discuss theoretical predictions of the method, and test them empirically in an empirical application.

Code JEL: Q51

Keywords: Contingent valuation, choice experiments, incentive compatibility

1. Introduction

Stated preferences (SP), although widely used since late 80's (after the well-known the Exxon Valdez oil spill), is still under doubts on whether it provides true value estimates. The critique mainly points out that in SP surveys, respondents usually have no incentive to answer truthfully. Struggling to make the SP data as reliable as possible, researchers have proposed various ex-ante and ex-post techniques, as well as formulated the conditions under which SP surveys are incentive compatible, that is, create such conditions under which a respondent's optimal strategy is to reveal preferences truthfully. Because of important shortcomings of the existing ex-ante and ex-post approaches, in particular as the former are not based on economic theory, and because of important limitations placed on SP studies by incentive-compatibility requirements, we propose an alternative ex-ante method, which has economic theoretical properties and can improve SP data reliability.

The ex-ante methods are thought (and often empirically observed) to enhance incentives of SP respondents to truthfully reveal their preferences. The following belong to the most commonly used techniques: (i) a "cheap talk" approach (Cummings & Taylor, 1999), which uses a special script to directly inform respondents that in SP surveys, a problem of the so-called hypothetical bias arises, meaning that the survey answers are affected by the hypothetical nature of the survey, and that respondents should take it into account while making their choices (in a way to self-correct for the bias); (ii) an "oath" approach (Jacquemet, Joule, Luchini, & Shogren, 2013), which at the beginning of the survey, asks respondents to sign a form that they swear to tell the truth; (iii) a "ten commandments" approach (K. H. Lim, Grebitus, Hu, & Nagya, 2015; Mazar, Amir, & Ariely, 2008), which asks respondents to adhere, to the best of their ability, to ethical guidelines about lying and (iv) an "honesty priming" approach (De-Magistris, Gracia, & Nayga, 2013), which invites honest behavior of respondents by exposing them prior to the valuation question to a task involving honesty concepts. Although the methods (i) and (iv) might appear effective in bringing the respondents'

hypothetical answers closer to their true valuations (De-Magistris et al., 2013), the incentives they provide to encourage truthful preference revelation are not based on any economic theory. In other words, according to economic theory, the behaviors of respondents who answer surveys with and without any of the proposed approaches should not differ; the approaches do not change the incentive structure.

Partly because of the lack of economic foundations behind the ex-ante approaches used, on a basis of mechanism design theory, researchers have recently defined a set of conditions which assures incentive compatibility of a SP survey. Carson and Groves (2007) [1] identify the following conditions: (a) the authority can enforce the payment by voters upon the program implementation (namely a coercive payment mechanism), (b) the valuation question is viewed as a take-it-or-leave-it offer, (c) the valuation question has a single, binary format (involves a yes-or-no answer), (d) participants care about the survey outcome(s), and (e) the probability that the proposed program is implemented increases monotonically with the proportion of votes in favor of it. The last two conditions are jointly termed as survey's consequentiality by Carson and Groves (2007) – respondents who care about the survey's outcome view their responses as potentially influencing the finally undertaken action. These conditions are not met in many studies according to authors. Vossler, Doyon, and Rondeau (2012) further develop the conditions for the case when a survey consists of a sequence of binary valuation questions, and set two more requirements to maintain an incentive compatible character of a survey. As seen, the conditions for incentive compatibility of SP surveys impose strict limitations on the design of the surveys. This, in turn, results in lowered statistical efficiency (less information is revealed from a single respondent than in a surveys consisting of multiple questions with several choice alternatives) and increases the costs of the research. Further, the conditions cannot be always met in some SP research, as, for example, the coercive payment mechanism might not be credible in some study contexts or trigger a large proportion of protest responses. Thus, a solution for obtaining truthful responses in SP surveys when the incentive-compatibility conditions are not fulfilled would importantly contribute to the existing methodological literature.

Recently, there has been attempt to use a new ex ante approach in SP that truthfully reveal preferences according to economic theory. This method called (v) the Bayesian Truth Serum (BTS) (Prelec, 2004) requires that each person responds a given question and predicts how people will respond to this question. Scores based on personal answers and predictions are combined to produce an aggregate score that is used to reward the respondents. The "Bayesian Truth Serum" can be used in all the situations where the "objective truth is unknowable" (Prelec, 2004). This includes question such as "is Picasso your favorite twentieth-century painter" or "will you vote in the next presidential elections (definitely / probably / probably not / definitely not)? So far, this approach has been used in two contingent valuation (CV) studies (Barrage & Lee, 2010; Weaver & Prelec, 2013) and one choice experiment only (Menapace & Raffaelli, 2015). Results are mixed. Barrage and Lee (2010) compared several ex-ante formats on a public good and found that BTS reduces but fails at eliminating hypothetical bias unlike the consequential approach. In a CE, Menapace and Raffaelli (2015) show that the way to implement BTS strongly affects willingness-to-pay (WTP).

[1] The article of Carson and Groves (2007) had (and continues to have) very strong influence on the CV literature (Carson & Groves, 2011). As shown in Mahieu, Andersson, Beaumais, Crastes, and Wolff (2014), Carson and Groves (2007) has been by far the most quoted article among all the stated preference articles published in the last 10 years.

This paper proposes a novel ex-ante method to incentivize respondents to reveal their preferences truthfully in SP surveys. The idea behind the method is to apply a lie detection device and to reward participants. The main advantages of our approach over methods (i) to (iv) are that economic theory provides predictions how the technique revises the strategies of respondents how to optimally answer in a SP survey. Compared to (v) "Bayesian Truth Serum", our approach has several advantages. It does not increase the length of the questionnaire.[2] Also, it can be easily used during the whole interview which is interesting given that people can lie during the whole survey. A "yes" respondent with modest income in a CV survey can benefit from overestimating his income at the end of the survey if he thinks that it will increase the chance for the tax to be progressive rather than flat. Finally, it is not uncommon to include open-ended questions in SP. Open-ended questions can be used in several parts of the surveys, like the elicitation question, socio-demographic questions (e.g., income, age) or debriefing questions. However, the BTS only fits for multiple choice questions. A possible disadvantage of our approach over methods (i) to (v) is that it can increase the stress of the respondents, especially when special devices like polygraphs are used. Another limitation is related to deception. Deceiving participants is banned in experimental economics (Alberti & Güth, 2013) and can be criticized for ethical reasons, so one must make a real attempt to detect the lying behavior of respondents. Therefore, we really attempted to monitor people body reactions when responding to the questionnaire.

The purpose of this paper is twofold. First, we theoretically discuss how the lie detection method changes the voting behavior of a rational agent in inconsequential surveys, and, at the same time, how the method contributes to enhance reliability of stated preference data. Second, we empirically test how the method works using data from a lab study conducted in France February 2015. In an inconsequential discrete choice experiment survey, respondents state their preferences towards programs of tree planting in Senegal or Peru. Some of the participants have their cardiac pulses recoded and are explained that they will participate from a lottery for a 50-euro gift card unless they are suspected to lie. We use the (ii) "oath" approach to compare the respondents' behavior across the two ex-ante methods because this approach is now commonly used in the SP literature to avoid deception.

The remainder of the article is structured as follows. Section 2 describes the reward approach. Section 3 discusses the reward approach in inconsequential surveys. Section 4 reviews available methods of lie detection. Section 5 provides details of the study conducted. Section 6 presents the results, which are subsequently discussed in Section 7.

## 2 Reward approach: principle

In order to incentivize respondents in SP surveys to reveal their preferences truthfully, we propose a new ex-ante method which involves a lie detection mechanism[3] coupled with a reward approach. The lie detection mechanism might be not a sufficient enough tool to encourage truthful preference disclosure, and this is why we propose to join it with a reward. Lie detection on its own would reveal that a given answer is probably not truthful, however, this would not necessarily encourage the respondents to tell the truth. Reward approach may help solving the problem.

[2] The Bayesian Truth Serum drastically increases the number of choice set in CE or questions in CV and therefore increase the cognitive burden placed on the respondents.

[3] Various available techniques of lie detection are discussed in Section 4.

The reward approach monetarily rewards the participants who tell the truth. It differs from a typical participation fee, which mainly tries to increase participation rates, but does not provide any economic incentives to encourage respondents to answer truthfully in a SP survey. In contrast, the reward approach provides the latter. Both payoff mechanisms, namely the standard participation fee and the reward for being truthful, are compatible, in the sense that respondents can be rewarded separately for participation and for honesty.

We distinguish two types of the monetary reward: a "weak" reward and a "strong" reward. The weak reward can be used when respondents are indifferent between two situations / behaviors (here, lying and not lying), and then, the reward makes one of the two optional situations / behaviors more attractive. In contrast, the strong reward can be used when respondents prefer one situation / behavior to another (here, prefer lying to being truthful), and then, the reward can be used to motivate them to choose their less preferred situation (but more preferred from the perspective of the researcher; here, being truthful). Thus, depending on the expected preference of respondents towards possible situations / behaviors (that is, whether the respondent is indifferent, or has a strict preference), rewards can be relatively high or low. When the reward approach is applied, a respondent needs to make trade-offs between potential benefits from lying and possible losses when being caught lying, and this affects the respondent's preferences towards lying and being truthful in an economically predictable manner.

We also distinguish two types of response: a true valuation and a true response. A free rider provides a "true response" when stating that he would donate nothing for a public good funded through voluntary donations (he would actually not donate if such a donation program was implemented) while his "true valuation" is positive (he likes the good to be valued). Likewise, in CE, a rational individual provides a "true answer" if he does not vote for his preferred alternative if he thinks that it will receives a low number of votes. He would provide a "true valuation" if he chose his most preferred alternative, regardless of other people's vote. From the perspective of a researcher it would be valuable to get to know the true valuation, which depends on preferences and budget constraint. Lie detection coupled with appropriate question formulation might be of help here. In CE, instead of asking the participants to vote, they can be asked to indicate the alternative they would prefer to be implemented. When valuing a public good, a coercive payment should be favored. At the same time, however, a coercive payment mechanism (for example, levying a new tax) looks unreliable in many survey contexts, and such a payment vehicle as voluntary contributions provides an often used alternative.

## 3 consequential surveys: a "weak reward"

The survey is inconsequential when a respondent does not care about the survey's outcome and / or he does not believe that his vote in a survey will have any effect on a finally undertaken action by an agency. In inconsequential surveys, a "weak reward" can be applied because the individual is indifferent between lying and not lying. The reward makes one of the two optional situations / behaviors (i.e., not lying ) more attractive

It is easy to show that when the reward approach is employed in inconsequential survey, the optimal strategy of the respondent is to provide a true answer as long as the perceived probability of being caught lying ($P_c \in [0,1]$ is higher than the perceived probability of being wrongly caught lying when telling the truth ($P_{wc} \in [0,1]$). Say that there is a participation fee equal to $x \geq 0$ paid regardless of

whether a respondent is not perceived as a liar, or not. And say that there is a monetary reward for being truthful (paid to the respondent when he is not observed to lie) equal to $a > 0$. Then, given that the monetary payoff linearly increases the respondent's utility, the respondent will choose not lie as long as the probability of lie detection being right is larger than the probability of lie detection being wrong. The choice between lying and not lying is equivalent to choosing between two lotteries, as shown in Figure 1.

Figure 1. An inconsequential survey perceived as a choice between the two lotteries


## 4 Lie detection

Various methods can be used to detect deception in SP. Lie detection is based on bodily reactions that require special devices (e.g., polygraph), or on answers (e.g., statistical treatment). Since none of this approach is 100% reliable, they can be combined.

### 4.1 Device

In face-to-face surveys, polygraph can be employed because it is a well-known measure (e.g., in the context of crime detection, such as (Kleiner, 2002), providing at the same time relatively high perceived effectiveness. Typically polygraphs rely on several measures including heart rate, respiration rate and blood pressure.

In internet surveys, web-cams can be used to try to capture eye-tracking because eye movement, pupil dilation and response time are shown to indicate deception (K. K. Lim, Friedrich, Radun, & Jokinen, 2013). Further, facial expressions can also be examined, while voice stress analysis can provide evidence on lying in phone surveys. In phone interviews, pitch, frequency and intensity are sometimes used to detect lies. For example, Streeter, Krauss, Geller, Olson, and Apple (1977) find that the average voice frequency is higher when a person lies than when a person is truthful.

In mail surveys handwriting can provide information about deception. For example, Luria and Rosenblum (2010) find differences in mean and spatial measures in an experiment in which 34 participants had to write true and false sentences on a digitizer. Other approaches include functional magnetic resonance imaging (FMRI), electroencephalography, thermal imaging (see for instance, Pavlidis, Eberhardt, & Levine, 2002; Rusconi & Mitchener-Nissen, 2013), but they may be too complex or costly to use on larger sample sizes.

### 4.2 No Device

Questionnaires and statistical treatments can also be employed to try to detect deception. For instance, one can ask debriefing questions to test whether people try to influence the outcome of the study by misrepresenting their preferences.[4] Alternatively, outliers can be identified with regression analysis, or people for whom the stated willingness to pay represents a very large portion of their income could be suspected of deception (Loomis, 2014). For example, a student with no income who states very high willingness to pay can be suspected of lying. One can also examine the time to answer the question(s) with people who respond too quickly being suspected of either deception or insincerity.

## 5 What we Did: Survey

To verify how the proposed reward approach works, we conducted in February 2015 in Nantes, France, an inconsequential laboratory discrete choice experiment that asks about respondents' preferences about tree planting. We introduce three treatments: "baseline", "oath" and "lie detection". The "oath" treatment differs from the "baseline" only in that it involves asking respondents to sign a form.[5] The "lie detection" treatment differs from the "baseline" in employing a special mechanism for detecting insincere behavior of respondents.

A computer-based discrete choice experiment on reforestation was conducted in February 2015 at the University of Nantes, France, among undergraduate economics students. A total of 424 students participated in the survey. All subjects were recruited from classes and surveys were conducted during regularly scheduled class-meetings in a computer room[6]. Prior to the experiment, in November 2014 at the University of Nantes we pre-test the perceived effectiveness of the lie detection devices. Specifically, we asked 149 undergraduate economics students in computer-based courses which type of lie detection devices they saw as the most efficient: voice, cardiac pulse or facial expressions. In total, 65.10%, 25.50% and 9.40% indicated the cardiac pulse, facial expressions and voice, respectively, were more efficient. Therefore, we used a special device to record cardiac pulse in the final survey. We did not use a polygraph due to the high cost, an unclear gain in effectiveness and a potential strong effect on stress. Finally, we also used the pre-test to help choose a reward: a single prize lottery instead of a multiple prize lottery. The choice of the lottery mechanism is consistent with Gajic, Cameron, and Hurley (2012) who examine four types of payments in stated preference studies: i) "no incentive", ii) prepaid cash incentive ($2), (iii) a low lottery (10 prizes of $25) and (iv) a high lottery (2 prizes of $250). They find the high lottery to be the most cost-effective; the level of the prize was worth the effort.

The baseline questionnaire[7] was constructed as follows. In the first part, participants were informed that a lottery would be organized and one participant would win a gift voucher of 50 EUR, with no information provided on the total number of survey participants. To highlight the inconsequentiality of the experiment, it was explained that only students would participate in the experiment. In the second part, the role of forests in the ecosystem was described. Among other things, it was explained

[4] However, there is no guarantee that people respond truthfully to these questions (that is, those questions are usually not incentive compatible).
[5] We used the same oath as in Jacquemet et al. (2013)
[6] People could discard the invitation to participate in the experiment.
[7] The questionnaire is available as supplementary material.

that forests slow climate change, limit desertification by hydrating soil and preserve biodiversity by providing many ecological services. Next, the activities of an existing NGO called "reforest action" were described, using information available on the official website of the NGO. This NGO conducts several tree planting programs in Peru and Senegal. Then, four characteristics of the proposed program were described, which constituted the attributes used in the choice tasks. They include the place of tree planting (Senegal or Peru), whether online information about the program implementation is available, whether the program provides restoration or conservation of lands, and the cost attribute, which was phrased as a price of planting a tree.

Table 1 provides the details of the attributes and their levels. In the third part of the survey, people were shown an example choice set that contained two unlabeled programs and a no-program option. After this example, 16 choice sets followed, in which respondents were asked to choose their preferred alternative[8]. Before making a choice, participants had to imagine that one of the 16 choice sets would be randomly drawn at the end of the exercise and the choice made in that set would be binding; they had also to imagine that the tree would not be planted if they chose the status quo (a similar procedure can be found in Bosworth & Taylor, 2012). In the last part of the survey, participants were asked questions about their gender, age, income, and their perceived importance of the attributes.

Table 1. Attribute and attribute levels

| | Description | Level |
|---|---|---|
| Country | The tree is planted in Senegal or in Peru | Senegal<br>Peru |
| Online information | Donors are regularly updated with photos, mails, etc, about the project | Yes<br>No |
| Ecosystem services | The project provides restoration or conservation of lands | Conservation<br>Restoration |
| Cost | The price to plant a tree is | 2, 5, 10, 15 EUR |

In the "lie detection" treatment, we put an oximeter on each participant's finger at the very beginning of the survey. Then, the lottery was explained, as in the "baseline" version, and the following message appeared on the screen: "People suspected of lying will be excluded from the lottery. In an attempt to identify them, we will use the device you have on your finger. This device records heart pulse. When people do not tell the truth, the body tends to react"[9]. We used the term "attempt" because lie detection is not fully reliable.

We used a main effects fractional factorial design to construct 16 choice sets (Louviere & Woodworth, 1983). The choice sets were identical used in the three treatments to facilitate comparisons between them. However, the choice set order was randomized. The time was recorded each time a respondent moved to a next choice task. We did not allow participants to go back or change their answers. Each of the participants was randomly assigned of the treatments. No

[8] Pre-test did not suggest fatigue effects. Evidence, notably in transport, suggests that such concerns have been overstated (Hess, Hensher, & Daly, 2012).

[9] The message originally was in French. Here we present a translated version.

difference is found between treatments in term of socio-demographic characteristics as shown by Table 2, which is not surprising given the random allocation.

Table 2. T-test mean comparison of socio-demographic characteristics

| | | Mean | | | *P*-value | | |
|---|---|---|---|---|---|---|---|
| | | Baseline N=146 | Lies N=141 | Oath N=137 | Baseline *versus* Oath | Oath *versus* Lies | Lies *versus* Baseline |
| Female | 1 if the respondent is a female, 0 otherwise | 0.534 (0.501) | 0.539 (0.500) | 0.599 (0.492) | 0.277 | 0.318 | 0.936 |
| Income | Monthly income | 291.781 (221.459) | 264.362 (236.930) | 267.701 (218.243) | 0.358 | 0.903 | 0.312 |
| Age | Age in years | 19.884 (1.896) | 19.773 (1.555) | 19.737 (1.521) | 0.476 | 0.846 | 0.590 |
| *Note*: The standard deviation is in brackets. | | | | | | | |

## 6 Results

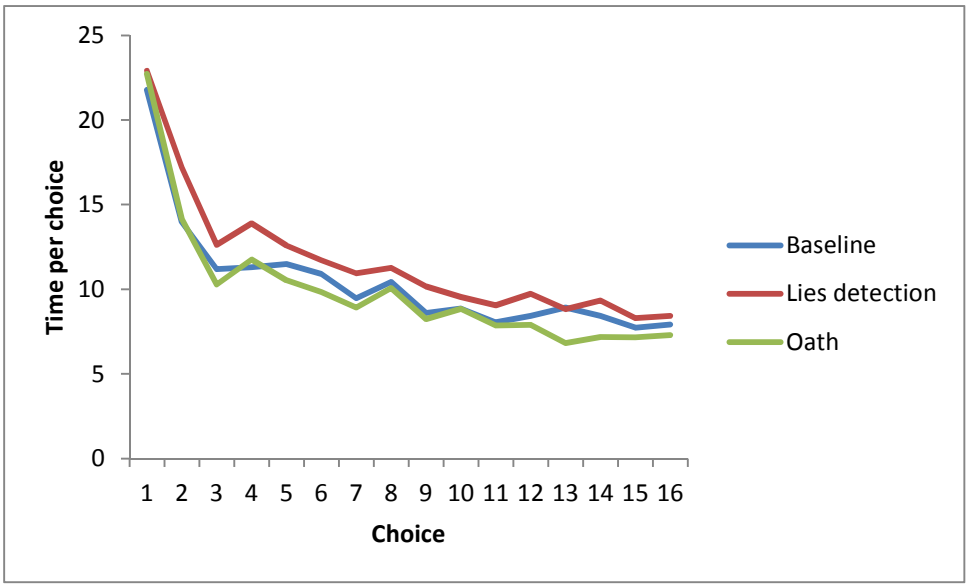
*Result 1*: Nobody refused to use the oximeter or the oath sheet.

*Support*: Among the 141 and 137 students in the oath and lie detection treatments, respectively, none refused to use the oximeter or to sign the oath sheet. Also, no student stopped the experiment.

*Result 2*: The time to complete the valuation task was higher in "lie detection" than the other treatments.

*Support*: In the baseline, lie detection and oath treatments, participants took on average 2min 47, 3min 07 and 2min 40, respectively. The differences are statistically significant between baseline and lie detector treatments (p-value = 0.0032) and between oath and lie detector treatments (p-value = 0.0001). However, the difference between baseline and oath treatments is not statistically significant (p-value = 0.223). Figure 1 indicates the differences between treatments are relatively small for the first and last valuation task. It takes on average 22 seconds to respond to the first valuation task in each treatment, while it takes only 10 seconds for the last valuation question. Although for some valuation questions, the differences between the treatments are more prominent (for instance, it takes 13.97, 17.20 and 14.15 seconds to respond to the second valuation task in the baseline, lie detection and oath treatments, respectively), in general, the lines depicting average response time across all valuation tasks follow a very similar pattern.

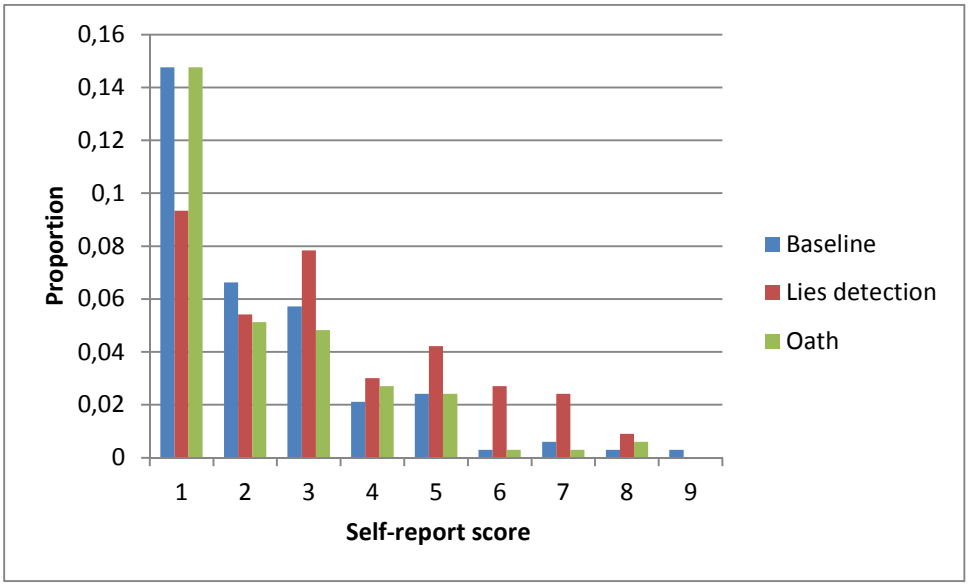
Figure 1. Average time to complete each of the valuation task in each of the group.




*Result 2*: The self-reported stress was higher in "lie detection" than in the two other treatments.

*Support*: Respondents self-reported their level of stress on a scale from 1 ("not stressed at all") to 10 ("highly stressed"). The means of the self-reported stress are 2.318, 3.629 and 2.291, in the baseline, lie detection and oath groups, respectively. The average stress is statistically higher in the lie detection treatment than in the baseline (p-value = 0.0001) and in the oath treatments (p-value = 0.0002), but there is no statistically significant difference between oath and baseline groups with this respect (p-value = 0.9063). The distribution of the self-reports for each treatment is provided in Figure 2. The distribution is very similar for the oath and baseline groups and highly skewed to the right compared to the lie detection group.

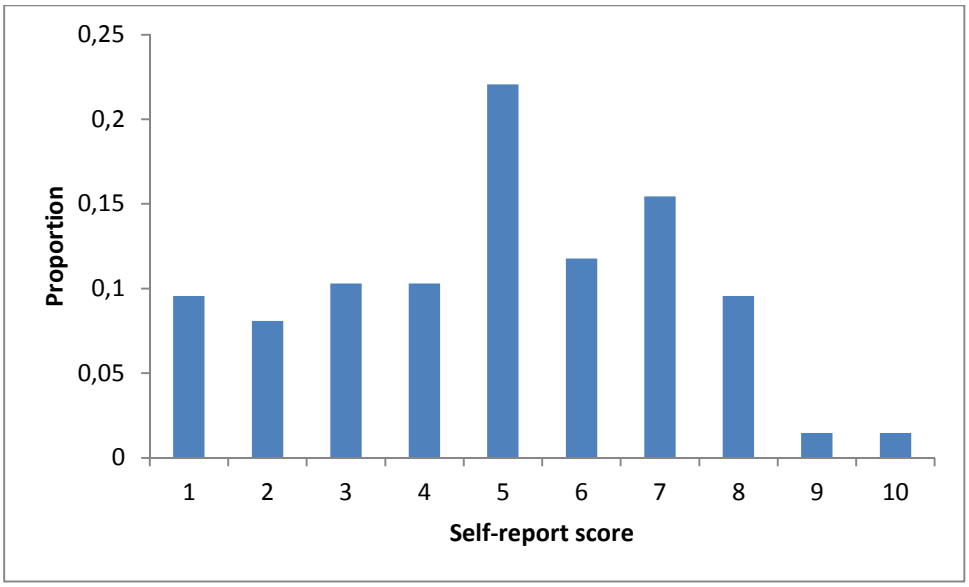
Figure 2. Average time to complete each of the 16 valuation tasks for each of the treatment groups.



*Result 3*: People tend to believe that the lie detector is relatively effective.

*Support*: Only 9.6% of participants picked 1 on a 10-degree scale where 1 means "not reliable at all", and 10 means 100% effective, indicating that for a very small part of respondents lie detection is viewed as not working at all (see Figure 3). However, a similar number of participants have chosen 2 and 3 which means also a significant doubt in the effectiveness of the detection device.

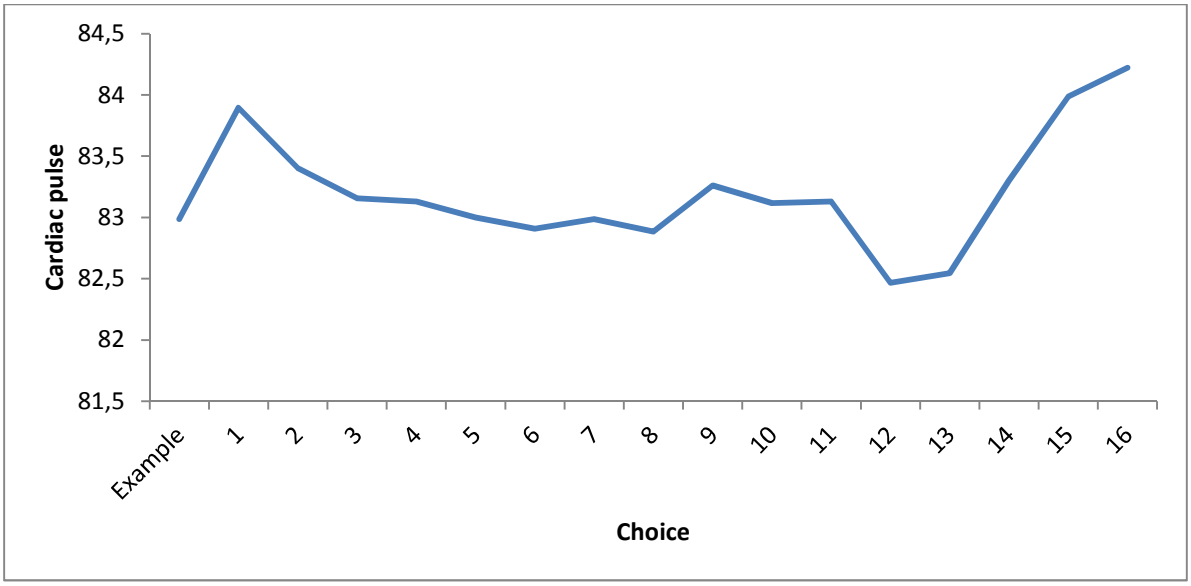
Figure 3. Histogram of the self-report level of lies detection effectiveness in the treatment group lies detection




*Result 4*: The "cardiac pulse" tends to vary across the choice tasks.

*Support*: Figure 4 displays the mean heart rate for each valuation choice. The cardiac rate tends to decrease in the first choices and then drastically increases after the 12$^{th}$ choice. A possible explanation is that fatigue contributes to heart acceleration (Johnson & Campos, 1967). Alternatively, the heart rate could also represent respondent's interest, which falls down from one task to the next one, but rises as the experiment approaches the end. However, it should be noted that the variation are rather modest, which could suggest that the oximeter alone is not fully reliable to detect deception.

Figure 4. Average number of cardiac pulse times when viewing the example choice set ("prior") and completing each valuation choice task (from 1 to 16) in "lie detection".




*Result 5*: "Oath" and "lie detection" both lower the probability of choosing the "no program" option, but do not have an effect on price sensitivity.

*Support*: We estimate a SMN-L (Scaled Multinomial Logit Model) logit model to take scale heterogeneity into account. Results show that "oath" and "lie detection" both lowered the probability of choosing the "no program" option, but did not affect price sensitivity (see Table 3).

Table 3. Scaled Multinomial Logit Model (S-MNL)

| Variable | Coefficient | Standard errors |
|---|---|---|
| Asc | -4.089*** | 0.418 |
| asc_lie detector | 0.798** | 0.402 |
| asc_oath | 0.897** | 0.402 |
| cost_lie detector | 0.015 | 0.015 |
| cost_oath | 0.018 | 0.018 |
| Senegal | -0.134*** | 0.029 |
| Restoration | 0.045** | 0.021 |
| On line | 0.712*** | 0.086 |
| Cost | -0.174*** | 0.019 |
| Lie Detector | 0.045 | 0.169 |
| Oath | 0.066 | 0.169 |
| Model characteristics | | |
| Log-likelihood | -5426.679 | |
| N (observations) | 20352 | |
| Note: *, ** and *** refer to statistically significant at the 1, 5 and 10% level | | |

## 7 Discussion and conclusion

The approach we proposed and tested to enhance incentive compatibility have several potentially appealing aspects:

- It is consistent with standard economic theory which emphasizes the probability of being caught lying and the magnitude of the reward as key ways to overcome dishonesty (see Mazar et al., 2008 for a difference between economics and psychology perspective).
- Lie detection can help to obtain truthful responses for any type of WTP questions (clode-ended, open-ended question, …) and non-WTP questions. Rational people may lie throughout a survey (i.e., income question).
- Research in lie detection technology is on-going, which could benefit the approach we proposed. Detecting deception is not an easy task for researchers, nor one that can yet be done with certainty, but recent advances may make it easier and improve actual and perceived effectiveness.

Our proposed approaches to enhance incentive compatibility also have some limitations and would benefit from more research:

- Lie detection can stress people. For instance, they may think they are being observed, well-known in the social science literature to affect behavior.
- Some people doubted the effectiveness of lie detection, which can increase survey costs in consequential surveys. The higher the perceived effectiveness of lie detection, the lower the reward if people consider both the reward and the probability of getting caught, as suggested by standard economic theory. However, the lack of perceived effectiveness is not an important issue in inconsequential surveys: it only reduces the expected gain (see Figure 1).

In conclusion, we propose a new ex-ante approach that can be potentially used in a higher number of studies, such as in inconsequential surveys or in consequential which are not incentive compatible (e.g., voluntary payment). More research is needed on the reward approach before it can be used for policy making purpose. One challenge for the future is to use a lie detector in a field experiment. When doing so, care will be needed when choosing the lie detecting device (focus group, pre-test, etc…) to avoid protest answers. Another challenge will be to use the reward approach in a consequential survey. The reward should not be too low, otherwise rational people will prefer lying since rational people are expected to make a trade-off between the benefits from lying and the direct benefit derived from the reward. Finally, further research may try to combine the different approaches. In case a given individual do not want to use a lie detector or think that it will not be effective at all, the oath approach could be employed.

References

Alberti, F., & Güth, W. (2013). Studying deception without deceiving participants: An experiment of deception experiments. Journal of Economic Behavior & Organization, 93, 196-204.

Barrage, L., & Lee, M. S. (2010). A penny for your thoughts: Inducing truth-telling in stated preference elicitation. Economics Letters, 106(2), 140-142.

Bosworth, R., & Taylor, L. O. (2012). Hypothetical Bias in Choice Experiments: Is Cheap Talk Effective at Eliminating Bias on the Intensive and Extensive Margins of Choice? The BE Journal of Economic Analysis & Policy, 12(1).

Carson, R. T., & Groves, T. (2007). Incentive and informational properties of preference questions. Environmental and resource economics, 37(1), 181-210.

Carson, R. T., & Groves, T. (2011). Incentive and information properties of preference questions: commentary and extensions. The International Handbook on Non-Market Environmental Valuation.

Cummings, R. G., & Taylor, L. O. (1999). Unbiased value estimates for environmental goods: a cheap talk design for the contingent valuation method. American economic review, 649-665.

De-Magistris, T., Gracia, A., & Nayga, R. M. (2013). On the use of honesty priming tasks to mitigate hypothetical bias in choice experiments. American journal of agricultural economics, 95(5), 1136-1154.

Gajic, A., Cameron, D., & Hurley, J. (2012). The cost-effectiveness of cash versus lottery incentives for a web-based, stated-preference community survey. The European Journal of Health Economics, 13(6), 789-799.

Hess, S., Hensher, D. A., & Daly, A. (2012). Not bored yet – Revisiting respondent fatigue in stated choice experiments. Transportation Research Part A: Policy and Practice, 46(3), 626-644. doi: http://dx.doi.org/10.1016/j.tra.2011.11.008

Jacquemet, N., Joule, R.-V., Luchini, S., & Shogren, J. F. (2013). Preference elicitation under oath. Journal of Environmental Economics and Management, 65(1), 110-132.

Johnson, H. J., & Campos, J. J. (1967). The effect of cognitive tasks and verbalization instructions on heart rate and skin conductance. Psychophysiology, 4(2), 143-150.

Kleiner, M. (2002). Handbook of polygraph testing: Academic Press San Diego, CA.

Lim, K. H., Grebitus, C., Hu, W., & Nagya, R. (2015). Can the ten commandments mitigate hypothetical bias? University of Arkansas.

Lim, K. K., Friedrich, M., Radun, J., & Jokinen, K. (2013). Lying through the eyes: detecting lies through eye movements. Paper presented at the Proceedings of the 6th workshop on Eye gaze in intelligent human machine interaction: gaze in multimodal interaction.

Loomis, J. B. (2014). Strategies for Overcoming Hypothetical Bias in Stated Preference Surveys. Journal of Agricultural and Resource Economics, 39(1), 34-46.

Louviere, J. J., & Woodworth, G. (1983). Design and analysis of simulated consumer choice or allocation experiments: an approach based on aggregate data. Journal of marketing research, 350-367.

Luria, G., & Rosenblum, S. (2010). Comparing the handwriting behaviours of true and false writing with computerized handwriting measures. Applied Cognitive Psychology, 24(8), 1115-1128.

Mahieu, P.-A., Andersson, H., Beaumais, O., Crastes, R., & Wolff, F.-C. (2014). Is Choice Experiment Becoming more Popular than Contingent Valuation? A Systematic Review in Agriculture, Environment and Health.

Mazar, N., Amir, O., & Ariely, D. (2008). The dishonesty of honest people: A theory of self-concept maintenance. Journal of marketing research, 45(6), 633-644.

Menapace, L., & Raffaelli, R. (2015). Does Prelec Bayesian Truth Serum prevent Social Desirability Bias in Choice Experiments? Paper presented at the International Choice Modelling Conference 2015.

Pavlidis, I., Eberhardt, N. L., & Levine, J. A. (2002). Human behaviour: Seeing through the face of deception. Nature, 415(6867), 35-35.

Prelec, D. (2004). A Bayesian truth serum for subjective data. science, 306(5695), 462-466.

Rusconi, E., & Mitchener-Nissen, T. (2013). Prospects of functional magnetic resonance imaging as lie detector. Frontiers in human neuroscience, 7.

Streeter, L. A., Krauss, R. M., Geller, V., Olson, C., & Apple, W. (1977). Pitch changes during attempted deception. Journal of Personality and Social Psychology, 35(5), 345.

Vossler, C. A., Doyon, M., & Rondeau, D. (2012). Truth in consequentiality: theory and field evidence on discrete choice experiments. American Economic Journal: Microeconomics, 4(4), 145-171.

Weaver, R., & Prelec, D. (2013). Creating truth-telling incentives with the Bayesian truth serum. Journal of marketing research, 50(3), 289-302.