Author's response to reviews

Title: Consistency between stated and revealed preferences: a Discrete Choice Experiment and a behavioral experiment on vaccination behavior compared.

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Author's response to reviews: see over
Reviewer's report

Title: Consistency between stated and revealed preferences: a Discrete Choice Experiment and a behavioral experiment on vaccination behavior compared.

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Reviewer: Catharina Groothuis-Oudshoorn

Reviewer's report:
The authors have carefully paid attention to all points raised in the previous review reports. After reading the second version, some issues are still unclear or could be improved. I think especially point 11 below should get attention.

1. Page 5 second paragraph: the transition from the previous paragraph to this paragraph is abrupt. In this paragraph one speaks of scenarios and it should be clarified that a scenario is a description of a vaccine scenario with the attributes that are enumerated in the previous paragraph.

We shifted the last sentence of the second paragraph to the beginning of the paragraph, hereby introducing the presentation of another attribute. This should improve readability of these texts. Subsequently we rewrote the sections that introduce the attributes and tried to clarify the link with table 2 by adding in parentheses the names of the attributes in the precise wording as in table 2. The paragraph now reads:
The first attribute refers (Infection Risk without vaccination, in Table 2) to the importance of knowledge on the a priori chance of getting hepatitis B infection without vaccination. This was included in the design because Brown et al (2010) found that the protection level of the vaccine influenced the preference of mothers of daughters who were eligible for HPV vaccine [5]. The second attribute (Side effects of vaccination) addressed the importance of knowledge on the risk of side effects following vaccination. This attribute was included because in earlier studies it was found that the risk of side effects affected girls' preferences for vaccination [4, 16]. The third attribute (Possibility to choose for hepatitis B or not) was included because what parents indicated in the focus groups [15]. We included an attribute on the freedom of choice for parents between a vaccine with hepatitis B (DTaP-IPV-Hib-HepB) or without hepatitis B (DTaP-IPV-Hib). This implies that an active choice can be made for a vaccine with or without the hepatitis B component [see also 17].
Paulussen et al [18] emphasized that the reliability and trustworthiness of the health care practitioners might have an important influence on the decisions of parents whether to have their child vaccinated or not, this was confirmed by our experts. Therefore, an attribute (Source of
information that the vaccine is safe) that consisted of three different sources stating that the vaccine was safe was included in the DCE. Previous research found indications that various forms of information exchange affect the uptake of vaccination.

Subsequently, we included an attribute on various informal sources spreading a rumour that a child was taken to hospital after being vaccinated (Source of information that the vaccine causes problems (a child has been hospitalized after getting the vaccine)). This attribute was selected because it was found that after the introduction of vaccination against cervical cancer for 12-year-old girls (with a catch-up campaign for girls aged 13-16 years) in the Dutch NIP in 2009, national media attention negatively affected the uptake of vaccination[19]. Van Keulen et al described how information exchange by girls on the internet led to fear of vaccination [20] and this was confirmed by our experts. Finally, peer groups are known to affect attitudes towards vaccination [21]. Therefore, an attribute (Attitude of Social environment) on the vaccination behaviour of friends and relatives was introduced.

2. Page 5 second paragraph: which process is meant here? I assume you mean the ‘random foldover’.

Yes, that is correct. We added “foldover” to the last sentence. It now reads “We repeated this foldover process to create 2000 unique questionnaires.”

3. Page 5, last paragraph: some information from the sentence ‘The DCE…attributes’ seems to replicate information given in the previous paragraph. I advise to rewrite the second and third paragraph slightly to make it a more coherent part.

We rewrote paragraph 2 and 3 from page 5. We included both paragraphs into the heading Design of DCE, introduction of the scenarios. In the first paragraph of this new structure, we explain the random foldover process and its result. In the second paragraph we explain the choices as they were presented to the respondents. The text now reads:
In total, the full factorial set consisted of $2^4 \times 3^2 = 144$ scenarios. We used random foldover to pair scenarios to choice sets. This means that each scenario was randomly paired with another scenario from the full factorial set, resulting in 72 choice sets. The 72 choice sets were blocked, resulting in 18 unique questionnaires (each with four unique choice sets). We repeated this foldover process to create 2000 unique questionnaires.

The DCE consisted of four choice sets per respondent; each set contained two unlabeled scenarios. Parents were then asked to choose between the two scenarios. Subsequently, they were asked to state how certain they were about their choice on a 10-point scale anchored by the statements “I am certain that I would not have my child vaccinated in this situation” and “I am certain that I will have my child vaccinated in the chosen situation”. The choices were introduced with a detailed description of the case. An illustration of the DCE is displayed in appendix A.

4. Page 7: When reading ‘were first recoded to identify the opt-out’ I was wondering what was meant here with recoding. It was clarified in the next sentences, but I suggest to rewrite this paragraph.

We deleted the confusing sentence. The paragraph now reads:

The answer on the question how certain the respondent was that their child would be vaccinated after making the choice of scenarios was used to identify the opt out. When the score on the 10-point scale was below 6, the respondent was coded to have chosen the opt-out in that choice set.

5. Page 7: ‘Table 2 presents..’. This is a repetition of the first sentence of the methods section.

We deleted the second sentence.

6. Page 7: it should be stated somewhere (not only implicitly in Table 2) what coding is used in the analysis.

We added the following sentence on page 7, where the model is explained.

The levels were effects coded (see Table 2 for precise coding).

7. Page 7: the utility of the opt-out is set to zero. Should it be the negative value of $b_{0,i}$? Or the other way around, can we interpret the parameter $b_{0,i}$ as the part worth utility to prefer vaccination over no vaccination? Is the opt-out estimated by a dummy variable that has value 1 for all opt-out scenario's and zero otherwise?
We chose to set the opt-out as zero in the analysis. A dummy variable was included for the \( b_{0,i} \), this dummy variable was coded 1 for scenario A and scenario B and 0 for the opt-out. So \( V(\text{opt-out}) = b_{0,i} \times 0 = 0 \) and \( V(\text{scenario A&B}) = b_{0,i} \times 1 + \text{values of effects codes} \).

We could also have coded the \( b_{0,i} \) as a dummy for opt out (i.e., 1 for opt out and 0 for scenario A and scenario B), then we would have found the negative of the currently estimated \( b_{0,i} \) value. However, the utility difference between participation and non-participation remains the same (namely, the value of all effects coded attribute levels). So \( V(\text{opt-out}) = -b_{0,i} \times 1 = -b_{0,i} \) and \( V(\text{scenario A&B}) = -b_{0,i} \times 0 + \text{values of the effects codes} \).

8. Page 7, last sentence ‘assuming a normal distribution’: for what is a normal distribution assumed? Is it meant that # has a normal distribution?

A normal distribution was assumed for the random parameters, based on model fit tests.

We moved the statement on the random distribution to the explanation of the random parameters for clarity:

The test for the necessity of random parameters, based on log likelihood improvement, resulted in the following parameters being set random, assuming a normal distribution: The effectiveness of the vaccine, the side effects of the vaccine and the source of information that the vaccine causes problems (both social media and acquaintance).

9. Page 8, ‘These individual values’: this sentence contains errors.

We rewrote the text. It now reads.

These individual values (betas) were then used to compute the utility for the scenario and the per respondent probability of acceptance of vaccination by entering the following scenario into the equations: the effect of the vaccination is known (INF=1), the risk of side effects is known (SID=1), people have no choice (CHO=0), the child welfare centre advises to use the vaccine (WFC=1), the National Institute of Health advises to use the vaccine (NIH=1), a social media notification of hospitalization of a child after vaccination (SCM=1), this story is also told by acquaintances (ACQ=1) and all friends take the vaccine (FRI=1).

10. Page 8: CHO=0 should be CHO=-1?; SCM is SOCME in Table 2, FRI is FRIE in Table 2.

No, CHO is 0. This is not the effect coding, but the definition of the scenario. Since the parents in real life have no choice between vaccination with and without the hepatitis B component, the CHO parameter is set to zero.

We changed SOCME into SCM in table 2.
We changed FRIE into Fri in table 2.

11. Page 8: ‘This resulted in utility scores per respondent (maximum four, one for each choice)’: I do not understand this. As far as I understand one obtains with
the mixed logit estimation procedure for each respondent values for the betas. And with these betas one can calculate the predicted utility for the defined scenario (one scenario), obtaining one utility value for this scenario. Next one gets one utility value for the opt-out choice (namely with the beta minus b_0,i). So I do not get how one gets more than one score per respondent.

The reviewer is right that you would get one utility score for vaccination and one utility score for opt-out per respondents in other cases. However, we calculated individual beta’s scores for all random parameters for every choice set. So, for every choice set every respondent had an individual beta for the random parameters. Since respondents completed 4 choice sets, per respondent we had 4 individual betas (1 per choice made by respondents), for every random attribute. We could therefore calculate the utility of a new scenario vs opt-out by means of 4 individual beta scores.

12. Page 8 last sentence: this seems a replication of the last part before Step 2.

Correct. We deleted this sentence.

13. Page 9, first sentence: what simulation is meant here? And what is meant by ‘given every vaccination scenario’? Shouldn’t it be based on the scenario that is defined in step 1. In that case one has only one scenario.

Yes, this simulation is based on the scenario in step 1. We included random parameters in the MNL model. Consequently, we had to account for this. We therefore did simulations where we draw random values from a distribution with a mean and standard deviation for all the random parameters.

In order to clarify, we changed the text in the Methods section:

The first step resulted in binary estimated stated preferences of the respondents on their choice to vaccinate or not. We used two methods to assess the agreement between predicted behaviour (interpreted as stated preference) and observed behaviour (interpreted as revealed preference). First, we used a 2x2 table to study how many predictions were correct, defined as correspondence of predicted acceptance of hepatitis B vaccination by the parents and the children’s vaccination status (yes/no) as recorded in the database of the NIP. Second, the mean vaccination coverage of all simulations (n=10,000) was estimated by taking the average of all simulated potential vaccination coverage for the most probable vaccination scenario, as described in step 1,
which was calculated as $\frac{1}{1+\exp(-v)}$.

14. Page 9, ‘In the Netherlands, about 3% …’: please provide a reference for this. The same holds true for “These groups refuse vaccination..’.

We added three references. We had to adjust 3% to 1.3

References:

15. Page 11: ‘the average probability of our sample..’ is this based on the formula $\frac{1}{1+\exp(-v)}$? If so, please make the text coherent, as in the methods section it is called ‘mean vaccination coverage’ and here it is named average probability.

We changed ‘the average probability of our sample..’ into ‘mean vaccination coverage’. And checked for further inconsistencies. We found no other.

16. Page 11: The confidence interval for the average probability is rather large, therefore I doubt whether it is correct, especially if it is based on the mean utility estimates and the formula mentioned above.

We have checked and recalculated the CI. The results were the same. Please bear in mind that four out of eight parameters in the model are random; so they contain standard errors. If the parameters are uncorrelated, the different SE’s may sum up to a large uncertainty, expressed in the large CI.

17. Page 11, ‘This represents … ‘ : this sentence contains duplications and errors.

We rewrote the text:

The mean vaccination coverage of our sample to choose for a vaccination scenario is 76% (95% CI: 44%-94%) (based on the mean utility for the most realistic scenario). This represents the mean expected vaccination coverage, in a scenario similar or close to the real situation.

18. Page 11: ‘is the case for 212’: please give also a percentage.; and ‘vice
versa’ does that mean the number of opt outs?

We added the percentages, and added more explanation on vice versa.

“However, when computing which part of the sample would have a higher utility for the vaccination scenario than for the opt out, we found that that is the case for 212 responders (91%). For 20 responders, (9%), the utility for opt out was larger than the utility for the scenario. The 15 respondents with similar utility scores for both opt-out and vaccination scenario were not presented the further analyses).”

19. Page 11, after ‘further analyses)’: this sentence seems incomplete.

We rephrased the sentence:

Of the respondents, we predict that 91% of the sample would choose to vaccinate

20. Page 11, 84%: please provide a CI.

84% refers to the percentage of our sample that chose to vaccinate (vs not to vaccinate) in real life (table 4). We do not believe that a CI in this case is informative.

21. Page 11, second paragraph: Table 4. The table has the wrong number (number three is used twice).

Correct, the second table 3 is changed to Table 4, we also changed the references in the text.

22. Page 11: ‘The terms “positive predictive…”’: this belongs to the methods section.

We shifted the explanation of the terms to the Methods section.

23. Page 11, ‘This assymetry ..’: do the authors mean something like ‘despite the high percentage of correct predictions’? And I think this conclusion should be given in the discussion paragraph, with appropriate reference(s) to this behaviour of the Kappa statistic.

We are now more explicit about which asymmetry we meant:

“This asymmetry in the distribution of the vaccination behaviour is the cause of the Kappa measure being non significant, despite the percentage of correct predictions [27, 28].

We added the following references for the Kappa statistic


24. Page 12, second sentence: ‘table 3’ should be ‘Table 4’.

We changed it.

25. Page 12, discussion first sentence: ‘in the comparison of’ should be ‘by comparing’.

We changed this accordingly.

26. In the discussion no comparison of these results is given to relevant other literature. Is this the first study that compares revealed and stated preferences based on predictive value? What other types of comparisons can be found in the literature and can these results be compared with the present study? Are they in line?

To our knowledge, there is one previous study in the field of health care that compared stated and revealed preferences. We added the following to the discussion to refer to that study and compare the results:

Previous research in health care that compares stated and revealed preferences of patients, was conducted by Ryan and Watson (de Bekker-Grob et al., 2012, Ryan and Watson, 2009). That study compared the results of a DCE that used multiple hypothetical scenarios to the real life choice to participate in chlamydia infection screening. The study found 81% correspondence between the stated and revealed preferences. The authors concluded that their predictions overestimated real behaviour and that more research was needed (Ryan & Watson, 2009). The percentage of correct predictions in the current study is similar to that study, but the current study did not overestimate, but rather underestimated the real participation.

27. Discussion: a limitation is the cut off value used to determine the opt-out. Please elaborate on this. Is this way of defining an opt-out used more often in the literature? And do the results depend heavily on this cut off value?

In the discussion, we added the following text to elaborate on this.
In this study we used a dual-response choice design with a scale to indicate the respondents’ certainty of the answer. Research found no differences between the dual-response choice design and a single-step opt-out design [31]. Because of the scale, we had to make a choice for the dichotomization of the scores into either opt-in (acceptance of vaccination) and opt-out (refusal of vaccination). We decided to make the cut off at the centre of the 10 point-scale (between 5 and 6). In order to test how this affected the answers, we analysed the answers leaving out the choices with a value 5 or 6 on the scale (analyses not shown). We found that the general answer patterns remained similar.

28. Table 2: Some attributes (ref) is meant and ‘effects coded’. In the two level attributes also effects coding is used and there is a reference level. I suggest to be more consistent.

We changed table 2 accordingly.

29. Table 3, ‘Source of tory’: replace with ‘Source of story’.

We corrected this.

30. Table 3: I suggest to give, instead of (ref) the part worth utility values. In case of effects coding e.g. that would be the negative value of the other level in case of two level variables.

We now report the part worth utilities for the levels that were referred to as (ref) in Table 3.

**Level of interest:** An article of importance in its field  
**Quality of written English:** Needs some language corrections before being published  
**Statistical review:** Yes, and I have assessed the statistics in my report.  
**Declaration of competing interests:**  
I have no competing interests.