Discussion Paper DP-06/05

None-Of-These Bias in Hypothetical Choice Experiments

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Frode Alfnes is a postdoctoral fellow, Department of Economics and Resource Management, Norwegian University of Life Sciences, and Gro Steine is a PhD student at AKVAFORSK, Institute of Aquaculture Research AS. Frode Alfnes was a visiting scientist at Iowa State University when the paper was written. The authors would like to thank Atle Guttormsen, Kari Kolstad, Mia Bencze Rørå, Ingrid Olesen, Bjarne Gjerde, Hans Jørgen Whist, and Juan Francisco Aldunce Meyer for valuable discussions and assistance in data collection. The Research Council of Norway (grant nos. 143045/140 and 159523/110) financed this research.

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Abstract

Empirical evidence strongly suggests that participants in most hypothetical studies exaggerate their willingness to pay (WTP) for private as well as public goods. However, there is mixed evidence regarding the importance of real economic incentives in choice experiments. We test for hypothetical bias in a choice experiment conducted to investigate consumers' WTP for the color of salmon. We find that the results from the hypothetical choice scenarios overestimate the total WTP for salmon fillets, but that the marginal WTP for a change in salmon fillet color does not significantly differ between the hypothetical and actual payment scenarios.

Key words: Choice experiment, color, hypothetical bias, mixed logit, salmon, willingness to pay

JEL: C81, C93, D12, Q22

Introduction

Hypothetical stated choice (SC) experiments are increasingly used to investigate consumer preferences for new and unavailable products, and to investigate socioeconomic differences in product preferences. Recent examples of SC experiments used to study food demand include Burton et al., Lusk, and Lusk et al., who investigated the demand for GMO food; Blend and van Ravenswaay, Wessells, Johnston and Donath, and Loureiro, McCluskey and Mittelhammer, all of whom studied the demand for ecolabeled food; Holland and Wessells, who investigated preferences for safety inspection and production method of salmon; Enneking, who analyzed the WTP for safety improvement in the meat sector; Unterschultz et al., Quagrainie, Unterschultz and Veeman, and Alfnes, all of whom analyzed preferences for country-of-origin for beef; and Lusk, Roosen and Fox, who analyzed international preferences for hormone-treated beef.[1]

Recently, several papers have employed a nonhypothetical version of the choice experiments, hereafter referred to as real choice (RC) experiments (Carlsson and Martinsson; Cameron et al.; Lusk and Schroeder; Johansson-Stenman and Svedsäter; Alfnes et al.). Participants in both SC and RC experiments were asked to make choices in a series of choice scenarios. In each scenario, two or more product alternatives are presented with their attributes, for example, price and color. In addition, a none-of-these alternative is commonly included in each choice scenario to avoid forced choices between the product alternatives. To induce real economic incentives in the RC experiment, one of the choice scenarios is randomly drawn as binding at the end of the experiment. The alternative that each participant has chosen in the binding RC scenario is implemented for the respective participants. In the SC experiment the choice has no economic consequences, whereas in the RC experiment the choice is nonhypothetical. It is in the RC experiment participants' own interests to choose the alternative they prefer in each scenario, and their incentive to reveal true preferences is

relatively transparent.

By varying the product attributes between the choice scenarios in SC and RC experiments, the researchers can estimate logit or probit models with sensitivity parameters for the various attributes. If a variable, e.g., price, is negatively correlated with the choice frequency, the respective parameter will be negative, and if a variable is positively correlated with the choice frequency, then the respective parameter will be positive. The size of the individual parameters has no economic interpretation in itself, but the ratio between two parameters is equal to the marginal rate of substitution between the two attributes in the choice experiment. Marginal willingness to pay (WTP) for the product attributes is found as the marginal rate of substitution between the respective product attributes and money (usually represented by the negative of the price). The total WTP for a product alternative is found by subtracting the utility of the none-of-these (NOT) alternative from the total utility of the product alternative, and dividing the sum by the negative of the price sensitivity parameter.

The empirical evidence strongly suggests that participants in most hypothetical studies exaggerate their WTP for private as well as public goods; see List and Gallet, List, List and Shogren, Harrison and Rutström, and Murphy et al. However, there is mixed evidence regarding the importance of real economic incentives in choice experiments. Carlsson and Martinsson and Cameron et al. fail to reject equal marginal WTP in a real and a hypothetical setting, while Lusk and Schroeder find that hypothetical choices overestimate total WTP, but do not reject equal marginal WTP for changes in individual attributes. Johansson-Stenman and Svedsäter reject equal marginal WTP, and find that the hypothetical bias is largest for products with an ethical dimension.

The objective of this paper is to conduct a within-subject test of hypothetical bias in total and marginal WTP estimates from choice experiments. To do this we use the results of a choice experiment with both hypothetical and nonhypothetical choices conducted to

investigate consumers' WTP for salmon color. The rest of the paper is as follows. First, we give some background information on salmon color, followed by the experimental procedure, products, design choice scenarios, sample, econometric model, results, and concluding remarks.

Background on Salmon Color

Salmon are recognized for their pink-red flesh color, which distinguishes them from other species. Consumers use intrinsic cues such as color to infer the quality of food products. In surveys as well as focus groups, consumers have stated that they see the color of salmon as an indicator of flavor and freshness. For a review of the literature on consumers' attitude toward salmon color, see Steine, Alfnes and Rørå.

The characteristic color is caused by depositions of carotenoids in the muscles. In the wild, salmon absorb carotenoids from the crustaceans they eat. The most important carotenoid for the color of salmon is astaxanthin. Salmon are unable to biosynthesize astaxanthin, and thus without astaxanthin in their diet, the salmons' flesh would be gray. Farm-raised salmon do not have access to natural sources of astaxanthin. To create the pink-red color in farmed salmon, synthetically produced carotenoids, mainly astaxanthin, are added to their feed. However, astaxanthin is expensive and the marginal return in form of color is decreasing. In conventional salmon farming astaxanthin accounts for approximately 15% of feed cost.

The internationally recognized method for salmon color measurement is comparing the salmon fillet flesh with the colors in the *SalmoFan*^{TM}. The SalmoFan is a color fan developed on the basis of the color of salmonid flesh pigmented with astaxanthin. The color of conventional farmed salmon fillets sold in the Norwegian market normally range from 23 to 30 on the SalmoFan, and most common are fillets ranging from 25 to 27. In a consumer study conducted by Roche Vitamins, the producer of astaxanthin for the salmon farming

industry, they used R26 as their base product (Fish Farming International 2003).

Experimental Procedure

The experimental session included a survey, an SC experiment with pictures, and an RC experiment. The SC experiment consisted of 10 choice scenarios and the RC experiment consisted of three sets of 10 choice scenarios. The last 10 RC scenarios, focusing on organic and ecolabeled salmon, will not be analyzed in this article. In each choice scenario, the participants chose between two salmon fillets with posted prices. After the first 10 RC scenarios we conducted the SC experiment. The setup of the SC experiment was the same as the setup of the RC experiment, but the salmon fillets were replaced with pictures of salmon fillets, and the choices were hypothetical. See Table 1 for an example of the choice scheme used in both the RC and the SC experiment.

In each of the RC scenarios we displayed two 400-gram consumer packages of salmon fillets placed on a box filled with ice. The prices of the two alternatives in each scenario were posted on laminated paper in the back of the boxes. The participants chose one of the two salmon fillets, or a none-of-these (NOT) alternative, in each scenario. To induce real economic incentives, each participant drew one binding scenario; the participants then had to buy the salmon fillet they had chosen in their binding scenario. This setup was very flexible and allowed us to vary not only the price, as done in earlier nonhypothetical choice-based market experiments for food products (Lusk and Schroeder), but also to vary the products among the scenarios according to a statistical design.

The RC experiment had nine steps. Step 1: The experimental procedure was explained to the participants. Step 2: The participants studied the alternatives in scenarios 1 to 10, and marked on a choice scheme which of the alternatives in each scenario they wanted to buy. Step 3: The participants were informed about the origin of the color. Step 4: The participants

studied the alternatives in scenarios 11 to 20, and (as in Step 2) marked on a choice scheme which of the alternatives in each scenario they wanted to buy. Step 5: The participants were informed about organic and ecolabeled salmon. Step 6: The participants studied the alternatives in scenarios 21 to 30, and (as in Steps 2 and 4) marked on a choice scheme which of the alternatives in each scenario they wanted to buy. Step 7: After all participants had completed all scenarios, each participant drew one card determining his or her binding scenario. The drawing was done without replacement, so that only one participant was assigned to each scenario. Step 8: Each participant got the salmon fillet he or she had chosen in his or her binding scenario. Step 9: The participants went to the cashier and paid for their salmon fillets.

In half the sessions, the participants conducted the SC experiment before Step 3 in the RC experiment and in the other half after Step 3. The proportion of the choices in the SC experiment and the RC experiment done before Step 3 was the same. None of the parameters changed significantly after the information was supplied to the participant, and we have therefore not included any information dummies in this paper. For a discussion of the effect of the information in the SC experiment, see Steine, Alfnes and Rørå, and for a discussion of the effect of the information in the RC experiment, see Alfnes et al.

The test of hypothetical bias will be based on a within-subject design. All subjects conduct both hypothetical and nonhypothetical choices. The primary disadvantage with a within-subject design is that participation in a nonhypothetical treatment can alter the behavior in a hypothetical treatment or vice versa. Therefore, we are more likely to find no hypothetical bias than if we had used a between-subject design. On the other hand, the within-subject design gives more observations in each treatment and the within-subject design generates statistical tests with greater power since we know that the differences we find are not related to differences in the sample.

Products

For the RC color experiment we bought salmon from three conventional and one organic salmon farm. The salmon fillets were cut into portions weighing approximately 400 grams, put into packaging familiar to consumers, exactly weighted, and we recorded if the fillet portions were from the front or tail of the fillet. The fillet colors were determined using a SalmoFan, and colors ranged from 20 to 30 on this scale. The fillets were grouped into five color categories, hereafter referred to as alternatives R21, R23, R25, R27, and R29. The mean weight of the fillets was 400.28 grams with a standard deviation of 40.25 grams. To prevent weight playing an important role in the choices, we imposed a 40-gram upper limit of by how much a choice pair were allowed to differ.

For the SC experiment, we used 18 cm x 13 cm pictures of salmon fillets obtained from the salmon photo library of Photofish, a subsidiary company of AKVAFORSK. We developed pictures of salmon fillets with a flesh color that were equal to alternatives R21, R23, R25, R27, and R29. In addition, we also developed pictures of an extremely red salmon, matching 32 on the SalmoFan. We will hereafter refer to this last alternative as R32. The color of the pictures was checked after development. Fillets as pale as 21 are only available from organic salmon producers and are never seen in the Norwegian market, whereas fillets as red as 32 are usually seen only for rainbow trout.

Price was a five-level attribute, with the levels NOK 24, 30, 36, 42, and 48 per 400 grams in both the RC and SC experiments.[2] This corresponds to NOK 60, 75, 90, 105, and 120 per kilogram. The week before the SC experiment, the price of salmon fillets in the three largest grocery stores in the area were NOK 79, 89, and 119 per kilo. Thus, all prices except for that of NOK 24 is within a familiar price range for salmon fillets in Norway.

Design Choice Scenarios

We used a SAS macro to generate the statistical design of the choice scenarios.[2] We generated two fractional factorial designs with 40 choice scenarios in each. Each scenario had two alternatives described by color and price. In both designs price was a five-level attribute, while color was a five-level attribute in the RC design and a six-level attribute in the SC design. To avoid clearly dominated alternatives we limited the design to scenarios where the color of the two alternatives differed. There were, however, no limitations on the price attribute, and several scenarios had the same price for both alternatives. Both designs were divided into four blocks of scenarios, and the scenarios were randomly arranged within the blocks. SAS reported a D-efficiency of 96.85 for the RC design and a D-efficiency of 95.70 for the SC design. Each block of scenarios in the RC design was used once as scenarios 1 to 10, and in another session as scenarios 11 to 20. For a description of the SAS macro, see Kuhfeld.

Sample

The experiment was conducted at MATFORSK, The Norwegian Food Research Institute, during four nights in February 2004. We conducted two sessions each night, and the sessions lasted approximately one and a half hours each. In total, 115 participants were recruited through various local organizations in southeastern Norway. Between 13 and 16 persons participated in each session. The organizations were given NOK 200 for each participant they recruited, and the participants were given NOK 300 to take part in the experiment. One participant who said that he did not eat fish was excluded from the sample.

Table 2 presents the descriptive statistics for the sample. The participants' ages ranged from 20 to 63 years, with an average of 39 years. Fifty-eight percent of the participants were

women. The average household income was NOK 562,000.

Econometric Model

In this study the participants made discrete choices among a set of exclusive alternatives. We follow the recent trend in the choice literature and analyze the data with a mixed logit model (also known as a random parameter logit model). Let us assume that the individual's utility from each alternative can be decomposed into a linear-in-parameters part that depends on observable variables, and an error term that is an independently and identically distributed (iid) extreme value. Given these assumptions, the utility of individual *n* from alternative *i* in choice scenario *s* is denoted by:

(1) $$U_{nis} = \beta' x_{nis} + \sigma_s^{-1} * \varepsilon_{nis}$$

where x_{nis} is a vector of observed variables relating to alternative *i*; β is a vector of fixed and random parameters; σ_s is a scaling parameter; and ε_{nis} is an iid extreme value error term. The standard logit is a special case of the mixed logit where the variance of all the random parameters is zero, i.e., all parameters are fixed.

The joint choice data from the RC and SC experiments were analyzed with the following mixed logit model:

(2) $$U_{nis} = (\beta_{0i} + \beta_1 Tail_{nis}) Weight_{nis} + \beta_2 Price_{nis} + \beta_3 Price24_{nis} + \sigma_s^{-1} * \varepsilon_{nis}$$

where β_{0i} is the alternative specific constant for color *i*, in other words, there is a constant for each color; $Tail_{nis}$ is a dummy taking the value one if the product is a fillet tail, and zero otherwise; $Weight_{nis}$ is the exact weight of the alternative *i* in kilograms; $Price_{nis}$ is the price of alternative *i* in NOK 100; $Price24_{nis}$ is a dummy taking the value one if the price is NOK 24,

and zero otherwise; and σ_s a scaling parameter taking the value one for the RC data. The random parameters β_{0i} are triangularly distributed,[3] and constant over choice made by the same individual. We have restricted the standard deviations of the random parameter to be identical for all color alternatives and to be identical for the two NOT alternatives. For identification, the alternative-specific parameters for the palest alternative, R21, is normalized to zero. For estimation purposes, the weight of the NOT alternative is set to one. All parameters, except the price sensitivity parameter, the alternative-specific constant for the NOT alternative, and the scale variable were the same between the RC and SC data.

We inspected the data and found that the choice probability increased as we reduced the price down to NOK 30. However, in both the SC and RC data we found that the choice probability significantly decreased from NOK 30 to NOK 24. Since we were interested in the price sensitivity for price levels found in the market (i.e., prices higher than NOK 30), we have included a dummy for the NOK 24 price. For a further discussion of the NOK24 dummy, see Alfnes et al.

The mean WTP per kilogram of alternative *i* can be calculated by dividing the utility difference between one kilogram of the varieties and the NOT alternative, with the negative of the price sensitivity parameter. Since the price sensitivity parameter measures the utility of the price in NOK 100, we must multiply the result by 100 to get the WTP in NOK:

$$WTP_{is} = -100 * \frac{(\beta_{0i} + \beta_1 Tail_{is}) - (\beta_{0NOT})}{\beta_2} \tag{3}$$

where WTP_{is} is the estimated mean WTP per kilogram of alternative *i* in scenario *s*; and all other variables and parameters are as described in equation (2).

All the currently available software packages assume a fixed scale for the iid-residual in mixed logit models, and therefore we cannot estimate the scaling factor together with the other parameters. To overcome this problem we conducted a manual search for the optimal

scaling factor. This was done by multiplying all the variables in the SC dataset with a scaling factor, and then estimating the mixed logit model for the combined dataset. We started out with a scaling factor of 1.0, and then gradually decreased or increased the factor by 0.1 until we reached a point where the last two decreases or increases reduced the log likelihood. We then narrowed the search for the optimal scaling factor around the scaling factor that gave the highest log likelihood in the first round of searches. The reported models are the models with the optimal scaling factor, i.e., having the highest log likelihood. This procedure was originally proposed for multinomial logit models by Swait and Louviere, and is suggested as a manual method by Louviere et al. (2000, page 238). This is a time consuming procedure for the mixed logit model, and we do not obtain a standard error estimate for the scaling factor. For a general discussion of the scale parameter in logit models, see Train (2003, pp. 44–46) or Louviere, Hensher and Swait (pp. 234–236).

Results

Table 3 shows the frequency with which the participants chose the NOT alternative in the first two series of RC scenarios and the series of SC scenarios. The participants are significantly less likely to choose the NOT alternative in the SC scenarios. In the first 10 RC scenarios, 54 (47.37%) of the participants chose the NOT alternative less than three times, and in the last 10 RC scenarios 59 (51.75%) participants chose the NOT alternative less than three times. In the 10 SC scenarios, on the other hand, 84 (73.68%) of the participants chose the NOT alternative less than three times. Furthermore, in the first 10 RC scenarios, 32 (28.07%) of the participants chose the NOT alternative at least eight times, and in the last 10 RC scenarios 24 (21.05%) participants chose the NOT alternative at least eight times. In the 10 SC scenarios, on the other hand, only seven (6.14%) of the participants chose the NOT alternative at least eight times.

Table 4 is a cross table for the frequency of the NOT choice in the SC and RC experiments. From the first row, we can see that 58 participants never chose the NOT alternative in the SC experiment. Of these, only 30 never chose the NOT alternative in the RC experiment, and nine chose the NOT alternative 18 or more times in the RC experiment. Furthermore, we notice that the lower left triangle of Table 4 is filled with zeros. In fact, only 21 (18.42%) of the participants had a higher percentage of NOT choices in the SC experiment than in the RC experiment, while 61 (53.51%) had a higher percentage of NOT choices in the RC experiment than in the SC experiment. In a reduced sample where we excluded the 15 participants who chose the NOT alternative in all 20 RC scenarios, the corresponding numbers are 21 (21.21%) and 52 (52.52%). This shows that a significant number of the participants that never chose a product alternative in the RC experiment chose product alternatives in the SC experiment. Furthermore, even among those who chose product alternative in some RC scenarios there is a hypothetical bias with respect to the NOT alternative. They chose the NOT alternative more often in the non-hypothetical RC experiment than in the hypothetical SC experiment.

Table 5 presents the results of the estimation of the mixed logit model on the joint RC and SC dataset. We have estimated the model with three samples. The first sample includes the RC and SC data from all 114 fish-eating participants. The second sample includes the RC data from the 99 participants who chose one of the product alternatives in at least one of the 20 RC scenarios and the SC data from the 108 participants who chose one of the product alternatives in at least one of the 10 SC scenarios. The third sample includes the RC and SC data from the 99 participants who chose one of the product alternatives in at least one of the 20 RC scenarios. The joint mixed logit model has restrictions on the four color-specific parameters, the price parameter, the Price24-dummy parameter, and the two standard deviation parameters. By estimating the mixed logit model for the joint RC and SC data, as

well as separately for the RC and SC data, we can test for preference regularity with respect to these variables. We use a log ratio test, LR = –2 [LL^{Joint} –(LL^{RC}+ LL^{SC})], which is χ^2 distributed with seven degrees of freedom. The test statistics for samples 1, 2, and 3 are LR = 9 .96 (p = 0.19), LR = 13.06 (p = 0.07), and LR = 17.44 (p = 0.01), respectively. Parameter equality is rejected at a 5% level for sample 3, but not for samples 1 and 2.

To test for hypothetical bias in marginal WTP and in total WTP, we have allowed the price parameter and the NOT alternative-specific constant to vary between the RC and SC data. Hypothetical bias in marginal WTP is found when people put less emphasis on the price in the hypothetical setting than in the non-hypothetical setting. Hypothetical bias in total WTP can be a result of hypothetical bias in marginal WTP or a result of people choosing the NOT alternative less often in the hypothetical setting than in the nonhypothetical setting. We found that, as in Lusk and Schroeder (2004), price sensitivity is slightly lower in the SC data than in the RC data, but we cannot reject price parameter equality between the RC and SC data in the three samples; Wald = 0.38 (p = 0.54), Wald = 0.36 (p = 0.55), and Wald = 0.00 (p = 0.99), respectively. For the NOT parameter, however, the parameter value from the hypothetical SC data was significantly lower than the NOT parameter from the nonhypothetical RC data in all three samples; Wald = 7.04, (p = 0.01), Wald = 6.18, (p = 0.01), and Wald = 6.95, (p = 0.01), respectively. We find the total WTP for the salmon color alternatives by inserting the parameters from the mixed logit model into equation (3). Using the parameter estimates from sample 2, the total WTP for R21, R23, R25, R27, and R29 are NOK 29.17, 116.37, 141.96, 157.44, and 157.74 in the RC data and the total WTP for R21, R23, R25, R27, R29 and R32 are NOK 66.44, 165.76, 194.92, 212.54, 212.88 and 227.12 in the SC data, respectively. The level of WTP is higher in the SC data than in the RC data, but the differences between the alternatives are not significantly different between the two datasets. For a more thorough discussion of the color parameter estimates, the Price24 dummy, and the tail parameter in the

RC experiment, see Alfnes et al. For a similar discussion for the SC data, see Steine, Alfnes and Rørå.

These results confirm the findings of Lusk and Schroeder, who found that hypothetical choices overestimated total WTP for beef steaks, but that marginal WTP for a change in steak quality was, in general, not statistically different across hypothetical and actual payment settings. This means that even in a within-subject test of hypothetical bias, participants choose the NOT alternative more frequently in the hypothetical SC experiment than in the nonhypothetical RC experiment. However, given that they chose one of the alternatives, their response to the price variable was not significantly different between the two settings. In terms of WTP, this means that the level of the WTP estimates relative to the NOT alternative was higher in the hypothetical than in the nonhypothetical data. However, the marginal difference in WTP between the salmon color alternatives are not significant different between the two datasets.

Concluding Remarks

Our results confirm the results of Lusk and Schroeder. For uncontroversial product attributes such as tenderness of beef and the color of salmon, it seems possible to design hypothetical choice experiments that give unbiased marginal WTP estimates. However, the total WTP estimates found in hypothetical choice experiments are too high. Furthermore, by inserting an SC experiment using pictures into the RC experiment we cannot reject parameter equality in two of the three estimations, except for the alternative-specific parameter for the none-of-these alternative. This is positive with respect to the possibility of combining SC and RC data to estimate parameters that are unidentifiable in the RC data.

There are several aspects that are not included in either this study or the Lusk and Schroeder study that may very well result in a hypothetical bias in marginal WTP estimates.

First, as discussed by Johansson-Stenman and Svedsäter, product attributes with an ethical dimension such as fair trade, environmental friendly, or animal friendly are much more likely to have a hypothetical bias than uncontroversial products attributes such as beef tenderness and the color of salmon. Second, some product attributes have important externalities that people are more likely to take into account in a hypothetical setting. An example of such externalities can be seen in Alfnes and Rickertsen, and Alfnes. Alfnes, using an SC experiment, found much higher WTP differences between domestic and imported beef than did Alfnes and Rickertsen, using an experimental auction with real economic incentives. Most participants expressed strong support for the current Norwegian small-unit, high-cost agricultural policy (Alfnes). Since the SC is hypothetical, the SC participants can consider any externalities from their choices without any costs. In such cases, the SC experiment will come closer to reflecting a referendum over the agricultural politics than reflect what would happen if the imported alternatives were available in the stores. Third, in experimental markets, real physical goods are used, whereas in SC surveys, typically only a list of attributes is used (e.g., Burton et al.; Lusk; Lusk et al.; Alfnes). This difference in product representation is an unexplored source of hypothetical bias. The three potential sources of hypothetical bias discussed above need further investigation before we can draw any general conclusions about hypothetical bias in choice experiments.

Footnotes

1. For a thorough survey of SC methods and applications in other fields, see Louviere, Hensher and Swait.

2. NOK 1 = EUR 0.1144 = US$ 0.1434. February 4, 2004. http://www.oanda.com.

3. The triangular distribution is chosen over the normal distribution, since the former is a limited distribution while the latter is not. Unlimited distributions imply unlimited WTP. For a discussion of various distributions on the non-iid error term, see Hensher and Greene.

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Table 1. Example of choice scheme

Scenario 1	**400 grams of farmed salmon**		**None of these**
	Alternative 1 **NOK 36**	**Alternative 2** **NOK 48**	
I would choose (check ✓one)	☐	☐	☐

Table 2. Descriptive statistics for the sample

Variable	Definition	Mean	St.dev.[a]
Gender	Gender of participant (Female = 1; Male = 2)	1.43	0.49
Age	Age of participant	38.81	10.29
Income	Total income of household[a] (in NOK 100 000)	5.62	2.63
Education	Highest completed education (Elementary school = 1; High school = 2; College/University = 3)	2.54	0.67

[a]The income question had six classes. The midpoints of the classes were used in the estimation.

Tabel 3 Number of none-of-these choices made by the participants

# NOT Choices	RC Scenario 1 to 10		RC Scenario 11 to 20		SC Scenario 1 to 10	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
0	42	36.84	35	30.70	58	50.87
1	4	3.51	13	11.40	14	12.28
2	8	7.02	11	9.65	12	10.53
3	12	10.53	11	9.65	8	7.02
4	7	6.14	4	3.51	7	6.14
5	8	7.02	6	5.26	2	1.75
6	2	1.75	6	5.26	4	3.51
7	8	7.02	4	3.51	2	1.75
8	10	8.77	5	4.39	1	0.88
9	4	3.51	3	2.63	0	0.00
10	18	15.79	16	14.04	6	5.26
Total	114	100.00	114	100.00	114	100.00

Table 4 Cross-table for frequency of non-of-these choices in SC and RC

	# RC									
# SC	0-2	3-5	6-8	9-11	12-14	15-17	18-20	Total	Mean[a]	Std.err
0	30	6	5	3	3	2	9	58	5.93	7.35
1	6	5	1	0	2	0	0	14	3.86	4.40
2	4	4	3	1	0	0	0	12	4.50	3.12
3	1	2	1	2	0	1	1	8	8.87	6.13
4	1	1	2	1	2	0	0	7	7.69	4.17
5	0	0	1	0	0	0	1	2	12.00	6.02
6	0	0	0	1	0	2	1	4	14.25	3.27
7	0	0	1	0	0	1	0	2	11.50	3.51
8	0	0	0	0	0	0	1	1	20.00	0
9	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	6	6	20.00	0
Total	42	18	14	8	7	6	19	114		
Mean[b]	0.50	1.28	2.14	2.27	1.42	3.67	4.32			
Std.err	0.93	1.19	2.13	2.04	1.67	1.67	4.47			

[a]Mean number of non-of-these choices in RC experiment.

[b]Mean number of non-of-these choices in SC experiment.

Table 5. Estimated parameters for the mixed logit model

Variables	Sample 1[a]	Sample 2[b]	Sample 3[c]
Price sensitivity parameters			
Price (RC) [d]	–3.34	–3.36	–3.44
	(0.56)	(0.57)	(0.57)
Price (SC)	–2.93	–2.95	–3.43
	(0.60)	(0.62)	(0.65)
Alternative specific constant for the none-of-these alternative, NOT			
NOT (RC)	–0.44	–0.98	–0.99
	(0.33)	(0.29)	(0.29)
NOT (SC)	–1.68	–1.96	–2.07
	(0.42)	(0.37)	(0.38)
Alternative specific constant for the colors			
R23	2.88	2.93	2.98
	(0.28)	(0.29)	(0.29)
R25	3.77	3.79	3.78
	(0.29)	(0.29)	(0.29)
R27	4.29	4.31	4.35
	(0.29)	(0.30)	(0.30)
R29	4.25	4.32	4.37
	(0.31)	(0.32)	(0.32)
R32	4.63	4.74	4.76
	(0.36	(0.37)	(0.39)
Generic parameters			
Tail dummy	–0.69	–0.71	–0.72

	(0.28)	(0.28)	(0.28)
Price24 dummy	–0.41	–0.41	–0.43
	(0.11)	(0.11)	(0.11)
Standard deviation parameters			
R23-R32	2.54	2.43	2.42
	(0.44)	(0.47)	(0.48)
NOT	7.43	4.85	4.42
	0.50	(0.34)	(0.32)
Scaling factor SC	1.23	1.18	1.14
Summary statistics			
# Participants RC/SC	114/114	99/108	99/99
Log likelihood Joint	–2819.08	–2712.54	–2651.57
Log likelihood RC only	–1895.14	–1816.76	–1816.76
Log likelihood SC only	–918.96	–889.25	–826.09

Notes: Estimated with Nlogit 3.0.

[a]All 114 fish-eating participants. [b]RC data excluding the 15 participants who chose the NOT alternative in all 20 RC scenarios. SC data excluding the six participants who chose the NOT alternative in all 10 SC scenarios. [c]RC and SC data excluding the 15 participants who chose the NOT alternative in all 20 RC scenarios. [d]Price in NOK 100.

Appendix for referees use:

Instructions for marked experiment with salmon

Introduction:

I thank you all for taking the time to participate in today's session.

The market study you are going to participate in is a part of a large research project on salmon conducted by the Agricultural University of Norway and Akvaforsk. The project is financed by the Research Council of Norway. The aim of the project is to give advice to researchers working with breeding and feed development on product characteristics important for consumers when buying salmon.

As you entered the building you were given an identity number. You will use this ID number to identify yourself. The ID number must be written on all papers handed in today. You were also given a questionnaire and three vouchers with a total value of NOK 300. The vouchers can be exchange for money when you have completed all parts of the market study. The price of any buys will be drawn from the NOK 300. Therefore, each of you will leave with between NOK 250 and NOK 300, and any products you choose to buy. When you have completed all part of the study, the organization that recruited you will be

After you have completed today's session you will get a short questionnaire to take home. The filed out questionnaire must be posted by February 13. The organization that recruited you for this market study will get NOK 200 for each returned questionnaire.

Importantly, from this point forward, I ask that there be no talking among the participants. If you have a question, please ask one of the monitors.

Are there any questions before we begin?

Questionnaire:

The first thing I want you to do is to fill out the questionnaire you have been given.

Shopping scenario 1-10

We have 30 shopping scenarios with different varieties of farmed salmon fillets. Each shopping scenario is represented by a box. In each of the 30 boxes standing in this room there are two alternatives. The alternatives are fillets from farmed salmon. The fillets are approximately 400 grams.

In the first round of shopping scenarios, you will walk around and study each of the alternatives in the first ten scenarios. Mark on the scheme which of the two alternatives in each scenario you would like to buy. After we have conducted three rounds of shopping scenarios, and you have made your choice in all 30 scenarios, each of you will draw an exclusive number between 1 and 30 determining your binding scenario. You will get the product you chose in your binding scenario, and must pay the price posted in the scenario.

Three important points

1) You will have the opportunity to purchase one salmon fillet here to night. After you have made your choice in all 30 shopping scenarios, each of you will draw a binding scenario. Since each of you draw one binding scenario, none of you can leave here with more than one salmon fillet. That is, under no circumstances will you take home more that one fillet from this experiment.
2) You have to pay for the salmon fillet you chose in your binding scenario. The price of the salmon fillet will be drawn from the NOK 300 when you cash in your vouchers.
3) If you do not want to buy any of the alternatives in a scenario, you can mark for the *none-of-these* alternative. If you have market for none-of-these in the scenario you

draw as binding, you will not purchase salmon here today. That is, you will receive NOK 300 for your vouchers and leave without a salmon fillet.

Are there any questions?

Please, go to the first table where you will get the choice scheme. You do not need to start on scenario 1, so please spread around the table.

Poster scenario 1-10

We are now finished with the first round of shopping scenarios. Before we conduct the second round of shopping scenarios, we want you to conduct ten hypothetical choices between pictures of salmon filets.

On each of the ten posters, there are two alternatives. Each alternative is a 400 gram farmed salmon filet. The prices of the alternatives are posted under the pictures. Please, study the alternatives on each poster carefully, and mark for the alternatives you would like to buy here today if you had the opportunity. This is hypothetical choice and none of these ten poster scenarios will count when drawing binding shopping scenario.

As in the shopping scenarios, you have the opportunity to mark for none-of-these.

Are there any questions?

Please, go to the posters where you will get the choice scheme. You do not need to start on poster 1, so please spread around.

Shopping scenario 11-20

In the second round of shopping scenario, you will walk around and study each of the alternatives in scenario 11 to 20. Mark on the scheme which of the two alternatives in each scenario you would like to buy.

The rules are as in the first round. After we have conducted three rounds, each of you will draw an exclusive number between 1 and 30 determining your binding scenario. You will get the product you chose in your binding scenario, and must pay the price posted in the scenario.

Are there any questions?

Please, go to the second table where you will get the new choice scheme. You do not need to start on scenario 11, so please spread around the table.