The Effect of Ambiguity on Status Quo Bias: An Experimental Study*

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Abstract

We conduct an experiment to determine the effect of ambiguity on status quo bias. We find no evidence of the bias in the absence of ambiguity and when ambiguity is present both in the status quo option and the alternative. We do find evidence for status quo bias under asymmetric presence of ambiguity, i.e. when the status quo option is non-ambiguous and the alternative is, or when the status quo option is ambiguous and the alternative is not. These findings are not predicted by the existing models of choice with initial endowment, such as the loss aversion model by Kahneman and Tversky (1979) and the incomplete preferences model by Bewley (1986). Our results, combined with the evidence from the endowment effect literature, suggest that *dissimilarity* between options may be an important determinant of the status quo bias.

Keywords: Status Quo Bias, Risk, Ambiguity, Reference Effects.
JEL Codes: C91, D11, D81.

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1 Introduction

In their seminal work, Samuelson and Zeckhauser (1988) coined the term Status Quo Bias to describe the tendency of decision makers to not give up their status quo option. In a set of field and lab experiments they showed that individuals choose to keep their status quo option more frequently than would be predicted by the standard model of choice. Following these original findings, the status quo bias has been established as a widespread phenomenon whose effects have been observed in the markets for electric services (Hartman et al., 1991), retirement savings (Madrian and Shea, 2001), organ donations (Johnson and Goldstein, 2003), medicare (Ericson, 2012) and in the financial markets (Kempf and Ruenzi, 2006) among others.[1]

While the status quo bias has been heavily documented, it is not universally present. As one might expect, no bias arises in the context of choices between monetary payoffs as shown by Kahneman et al. (1991). Other examples are provided by Dean (2008) and Ren (2014), who report that for smaller choice sets the bias is smaller in magnitude and sometimes absent and also by List (2003, 2004) who investigates the effect of experience and shows that professional traders are less prone to the bias. However, identifying the contexts under which the status quo bias is expected to appear remains largely an open question.

Our paper is intended to shed further light on this question by studying the effect of different types of uncertainty on the emergence of status quo bias. We focus on the distinction between risk, i.e., the case where the probabilities of different outcomes are objective and known to the decision maker and ambiguity, where the probabilities are not objectively specified. Our experiment explores the extent to which introducing ambiguity in the choice problem affects the presence and magnitude of the status quo bias.

The reason for studying the effect of ambiguity is twofold. Firstly, most choices in life entail ambiguity. In the evaluation of car or health insurance, investments and retirement plans, individuals do not know the probability associated to the outcomes. Even choices between simple objects as those used in the experimental status quo bias literature (mugs, candy bars, etc.) may entail a certain degree of ambiguity as shown by Brown (2005). In contrast, choosing between two riskless bond investments involves little to no ambiguity. Understanding the impact of ambiguity on status quo bias can therefore highlight the contexts in which the bias is more likely to emerge. Second, our experiment reveals a behavioral pattern that allows to compare and test the predictions of two fundamental paradigms of choice with a status quo option. The loss aversion model of Kahneman and Tversky (1979) predicts the emergence of the bias regardless of the presence of ambiguity. On the other hand, models of incomplete preferences, in the spirit of Bewley (1986) predict the status quo bias would emerge only in the presence of ambiguity, that is when the decision maker is unable to identify an option which is unambiguously better than the

[1]The status quo bias has also been measured in lab experiments. For classic lab findings see Knetsch (1989), and Knetsch and Wong (2009).

other. As it turns out, our results are partly inconsistent with the predictions of both these paradigms of choice.

Ambiguity may be present in the endowment and/or in the alternative option.[2] In order to examine all possible cases in which ambiguity may enter the choice problem, we run the following four treatments: (1) Risky endowment and Risky alternative (R-R); (2) Risky endowment and Ambiguous alternative (R-A); (3) Ambiguous endowment and Risky alternative (A-R); (4) Ambiguous endowment and Ambiguous alternative (A-A). These 4 treatments can be grouped into cases where the decision maker knows equally well the two options (treatments R-R and A-A, referred to as the *symmetric* treatments) and cases where he has more information about one of the two options (the *asymmetric* treatments R-A and A-R).

Our objects of choice are gambles. The risky gambles are lotteries paying prizes which depend on the color of a chip drawn from a bag comprising 50 white chips and 50 black chips. The ambiguous gambles' prizes depend on the color of a chip drawn from a bag with an unknown composition of chips. In each treatment we perform an identical within-subject design. Subjects' preferences over gambles are initially elicited through pairwise comparisons without a status quo option. Subsequently, subjects receive an endowment and face the same choices again. This time around, questions are presented in the form of a switch from the endowment to the alternative. Comparing choices with and without an endowment allows to assess the presence and magnitude of the status quo bias in each treatment. A comparison across treatments identifies the role played by ambiguity.

We find no bias in the symmetric treatments (R-R and A-A), where ambiguity is either completely absent or present in both the status quo option and the alternative. We find evidence for the bias in the two asymmetric treatments (R-A and A-R), where ambiguity is present either in the status quo option or in the alternative but not in both. Our results suggest that the status quo bias is associated to the asymmetric presence of ambiguity, a finding that to our knowledge is not predicted by any of the existing models of choice with initial endowment.

The experimental literature on status quo bias has mainly focused on the riskless domain. The experiment on status quo bias which is closest to ours was conducted by Roca et al. (2006). They report a positive status quo bias in the case of an ambiguous endowment and a risky alternative. The pattern we document in this paper is consistent with their findings. Although the experimental evidence on status quo bias under uncertainty is not large, there is plenty of evidence in the realm of uncertainty of a closely related phenomenon which is the endowment effect. The endowment effect refers to individuals' higher valuation of a good when they own it compared to when they do not (Thaler, 1980). Several studies provide evidence for the endowment effect for both risky and ambiguous gambles.[3] We refer to these results in section 5 where they are laid out alongside our find-

[2] Throughout the paper we use the terms *status quo option* and *endowment* interchangeably to describe the option in possession of the decision maker when making his choice.

[3] See for example Knetsch and Sinden (1984) and Eisenberger and Weber (1995).

Table 1: SUMMARY OF FINDINGS

		Alternative	
		Risky	**Ambiguous**
Status Quo	**Risky**	NO BIAS	BIAS
	Ambiguous	BIAS	NO BIAS

ings to highlight a novel pattern of choice with a status quo option. This pattern suggests the role of dissimilarity among goods in the choice set as a potential determinant of status quo bias.

The paper is organized as follows: Section 2 describes the experimental design and in section 3 we highlight the main results. Section 4 discusses different theoretical models in light of our findings while Section 5 explores the findings alongside evidence from the endowment effect literature. Section 6 concludes.

2 Experimental Design

Experiment overview. We run four treatments corresponding to the four choice problems obtained from combining a risky or ambiguous status quo option with risky or ambiguous alternatives. In each treatment we adopt a within-subject design where subjects make the same choices under two different frames. In the first part of the experiment subjects make choices under a *neutral frame*. They are presented with pairs of gambles and for each pair are asked to choose their preferred option. In the second part of the experiment subjects receive a gamble as their endowment. Subsequently they encounter the same comparisons as in part 1, this time presented under a *status quo frame:* For each question they decide whether to keep their endowment or switch to the alternative gamble. The status quo bias is observed if subjects choose the endowment more often in the second part, when they own it, compared to the first part, where they choose absent an endowment. The experiment was pencil-paper based and conducted at the CESS lab at NYU. It involved 143 subjects among the NYU undergraduate population. All subjects received a show-up fee of $8 and earned on average a total of $16. The duration of the experiment was approximately 30 minutes.

Experimental procedure: The Risky-Ambiguous (R-A) treatment. We outline the experimental procedure for treatment R-A, where the status quo option is risky and the alternative is ambiguous.[4] Later in this section we explain how the design is modified in the other three treatments.

At the beginning of the experiment subjects are presented with two bags. The first is introduced as the *known bag* and comprises a known composition of poker chips - 50 white and 50 black. The second bag is introduced as the *unknown bag* and it remains empty until subjects complete their tasks. At the payment stage this bag is filled with X white chips and $100 - X$ black chips, where X equals the two decimals of the Dow Jones Industrial Average Index at the time of payment.[5] This mechanism ensures that subjects' beliefs regarding the composition of the unknown bag remain fixed throughout the experiment as we further explain later in this section.

After subjects become familiar with the composition of the bags, they proceed to the first part of the experiment which entails 15 pairwise choices between a gamble from the known bag and a gamble from the unknown bag. A typical question compares the gamble $(10, 4)$ on the known bag, which pays \$10 if a white chip is drawn and \$4 if a black chip is drawn, with a gamble (w, b) from the unknown bag, which pays \$$w$ if a white chip is drawn and \$$b$ if the chip is black. Hence the gamble $(10, 4)$ from the known bag is fixed in all questions, while the alternative gamble varies in each question. Table 2(b) lists the prizes of the 15 alternative gambles. In the paper we will sometimes refer to them as the *alternative set.* Nine additional questions not involving gamble $(10, 4)$ are interspersed in between the 15 questions listed in Table 2(b) (for a total of 24 questions) and are intended to reduce the salience of gamble $(10, 4)$.[6] After completing part 1 subjects participate in a non-incentivized intermission in which they answer 8 questions presented in the same format as in part 1 but involving larger stakes. The intermission serves the purpose of setting a separation between the two main parts of the experiment. More details about the intermission are given in the online Appendix.

In part 2 each subject receives a card with a description of the $(10, 4)$ gamble to be performed on the known bag and is explicitly told he owns it. Subsequently, the subjects answer 24 questions. In each question they are asked whether they would like to keep the $(10, 4)$ gamble or switch to an alternative gamble to be performed on the unknown bag. Of these 24 alternatives, 15 coincide with the gambles presented in part 1 and listed in Table 2. Hence, subjects compare the $(10, 4)$ gamble with the gambles in the alternative set twice. Once under a neutral frame where choices are made based on side-by-side comparisons between two options, and once under a status quo frame in which subjects choose whether to keep their endowment or switch it for the alternative.

[4] The instructions can be found in the online Appendix.

[5] The value of the index was verified online at the payment stage after asking a volunteer subject to step to the front and assist with the procedure.

[6] A typical additional question is a choice between a gamble performed on the known bag (which pays prizes that are different from $(10, 4)$) and a gamble performed on the unknown bag. The aim of part 1 is to elicit preferences in a *neutral* frame of choice. The 9 additional questions are introduced to prevent the gamble $(10, 4)$ from playing the role of a reference by being a fixed term for comparison appearing in all questions.

Table 2

PAYOFFS OF THE GAMBLES IN THE ALTERNATIVE SET

(a) Treatment R-R and A-A

w-b	w-b
4-6	10-2
5-6	11-2
6-6	12-2
7-6	13-2
8-6	14-2
9-6	15-2
10-6	16-2
	17-2

(b) Treatment R-A

w-b	w-b
5-6	12-2
6-6	13-2
7-6	14-2
8-6	15-2
9-6	16-2
10-6	17-2
	18-2
	19-2
	20-2

(c) Treatment A-R

w-b	w-b
4-6	8-2
5-6	9-2
6-6	10-2
7-6	11-2
8-6	12-2
9-6	13-2
	14-2
	15-2
	16-2

We would like to make two important remarks about the gambles included in the alternative set. First, as can be seen from Table 2(b), the alternative gambles are divided into two columns (or subsets): Gambles that pay \$6 if a black chip is drawn and gambles that pay \$2 if a black chip is drawn. In each of these subsets the gambles are ordered in terms of first order stochastic dominance and each subset contains both "attractive" gambles (high expected payoffs) and "non-attractive" gambles (low expected payoffs). As a result, most subjects choose gamble $(10, 4)$ in some questions and the alternative gamble in other questions. In fact most subjects exhibited a switching point in each subset of ordered alternatives, that is they preferred $(10, 4)$ up to a certain alternative gamble and switched to the alternative set for all the alternatives dominating the switching point. The presence of a switching point in the interior of the range of available alternatives for most subjects ensures that the magnitude of the status quo bias is correctly assessed. Subjects that always choose $(10, 4)$ or always choose the alternative gambles are discussed in detail in Appendix C. We notice also that the gambles are separated by fixed increments of expected value. The adoption of fixed increments allows us to quantify the bias in terms of forgone payoffs as we further explain in section 4.

We adopt the *Random Decision Selection* mechanism in which one question is randomly selected and used for payment.[7] At the payment stage we invite a volunteer who assists in constructing the unknown bag using the Dow Jones Index. Then the volunteer flips a coin to determine which part of the experiment is used for payment and rolls a 24-sided fair die to determine the question which is chosen for payment. Finally, the volunteer draws a chip from each bag and subjects are paid according to their choices in the extracted question.

The choice of the Dow Jones Index to determine the composition of the unknown bag

[7] Azrieli et al. (2012) show that this mechanism is incentive compatible under the assumption that dominated gambles are never chosen.

is taken to make it clear to the subjects that the experimenters do not know and have no control over the distribution of chips in the unknown bag. It ensures subjects do not alter their beliefs regarding the composition of the unknown bag throughout the experiment and allows for a *ceteris paribus* analysis of the effect of ambiguity. At the end of the experiment a non-incentivized questionnaire was distributed in which we asked whether the beliefs regarding the composition of the unknown bag changed throughout the experiment (and if so why and at which stage).[8] All subjects except for one answered that their beliefs did not change. One possible concern is that subjects perceive the distribution of the decimals of the Dow Jones as uniform and may not view the unknown bag as genuinely ambiguous. We investigate this hypothesis by asking in the questionnaire: *Did you have any belief regarding how many white chips will be in the unknown bag?* Some typical answers are: *I had no idea, I thought it would be 50-50, Had a feeling there will be more white.* There are also a few answers reporting more "extreme beliefs" (0-20 or 30 white chips). These responses suggest that the unknown bag was perceived as ambiguous and beliefs regarding its composition were held fixed throughout the experiment.[9]

The Other Treatments. The same procedure outlined for the R-A case is adopted in the other three treatments, with the only difference being the type of uncertainty (risk or ambiguity) characterizing the status quo and the alternative options. Thus, $(10, 4)$ are maintained as the payoffs of the status quo gamble and the difference between treatments lies in the composition of the bags on which the status quo gamble and the alternative gambles are performed. The compositions of the bags are as follows:

– Treatment R-R (Risky - Risky): The $(10, 4)$ gamble and the alternative gambles are performed on two bags with known composition of chips: one with 50 white chips and 50 black chips and the other with 50 green chips and 50 red chips.

– Treatment R-A (Risky - Ambiguous): As explained earlier, the $(10, 4)$ gamble is performed on a bag with 50 white chips and 50 black chips and the alternative gambles are performed on a bag with 100 chips, the exact composition of which is determined using the Dow Jones index.

– Treatment A-R (Ambiguous - Risky): The $(10, 4)$ gamble is performed on a bag with a composition determined by the Dow Jones index and the alternative gambles are performed on a bag with 50 white chips and 50 black chips.

[8]The questionnaire is available in the online Appendix.

[9]In a few pilot sessions we used a typical two color Ellsberg Bag in which the bag was set up before the experiment and the composition left completely unspecified to subjects. This attempt was unsuccessful in maintaining the *ceteris paribus* requirement. From the questionnaire following the experiment we concluded that a significant percent of the subjects made inferences regarding the bag's composition based on the stakes of the gambles they faced during the experiment.

– Treatment A-A (Ambiguous - Ambiguous): The $(10, 4)$ gamble and the alternative gambles are performed on two bags with unknown proportion of black and white chips. One has its composition determined using the Dow Jones index and the other is determined using the same procedure with the $S\&P$ 500 index.[10]

A second difference between treatments lies in the range of prizes chosen for the alternative gambles, as can be seen in Table 2. In order to maintain an interior switching point from the gamble $(10, 4)$ to the alternative set for most subjects, we adjusted the range of prizes in the alternative set to account for ambiguity aversion.[11] Pilot sessions were used to determine the range of prizes that would maximize the number of occurrences of switching points in the interior of the range of ordered alternatives.

3 Results

Evidence for status quo bias is found if the status quo option is chosen more frequently when subjects own it as compared to when they do not. We analyze the data using two methods. First, we run a random effects probit regression and test whether the $(10, 4)$ gamble is chosen significantly more often under the *status quo frame* as compared to the *neutral frame*. Second, exploiting the within-subject design, we construct a subject specific status quo bias index and compare the distribution of the index across treatments. Both approaches lead to the same conclusions.

3.1 Regression analysis

A random effects probit model is estimated to test if the frame of choice has an effect on the likelihood that the status quo option is chosen. The probability that the $(10, 4)$ gamble is chosen in any given question is modeled as $\Phi(\tilde{Y})$ where Φ is the CDF of the standard normal distribution and $\tilde{Y}$ is specified as follows:

$$\tilde{Y}_i = \beta_1(T_i^{\text{R-R}} \cdot \text{SQ}_i) + \beta_2(T_i^{\text{R-A}} \cdot \text{SQ}_i) + \beta_3(T_i^{\text{A-R}} \cdot \text{SQ}_i) + \beta_4(T_i^{\text{A-A}} \cdot \text{SQ}_i) + \delta\mathbf{X}_i + \epsilon_i$$

T_i^j is a dummy variable that equals 1 if question i belongs to treatment j where $j \in \{\text{R-R}, \ \text{R-A}, \ \text{A-R}, \ \text{A-A}\}$ and SQ_i is a dummy taking value 1 if question i belongs to part 2 of the experiment, i.e., to the *status quo frame*. X is a vector of controls. The status quo bias is captured by the coefficients of the interaction terms $T_i^j \cdot \text{SQ}_i$ which measure the effect

[10]In all treatments we purposely use two distinct bags: one for the $(10, 4)$ gamble and the other for the alternative gambles. As a result the status quo gamble and the alternative gambles have independent outcomes in all treatments.

[11]For example the average payoffs of the alternative gambles in treatment R-A was higher than in treatment R-R (assuming a uniform distribution over all the possible compositions of the unknown bag) to account for ambiguity aversion.

Table 3

PROBIT REGRESSION: MARGINAL PROBABILITY EFFECTS

	(1)	(2)
$SQ \times T^{\text{R-R}}$	0.03	0.04
	(.405)	(.274)
$SQ \times T^{\text{R-A}}$	0.09***	0.12***
	(.002)	(.000)
$SQ \times T^{\text{A-R}}$	0.07**	0.10***
	(.040)	(.008)
$SQ \times T^{\text{A-A}}$	0.01	0.01
	(.759)	(.692)
White prize		−0.17***
		(.005)
Black prize		−0.31***
		(.005)
No. obs.	4287	4287

NOTES: Both specifications include treatment dummies. P-values in parenthesis. Standard errors are clustered at the subject level. *** Significant at the 1% level. ** Significant at the 5% level.

of the status quo frame on the likelihood that the gamble $(10, 4)$ is chosen in treatment T_j. The results of the estimation are reported in Table 3. Specification (1) controls for the treatment dummies, while specification (2) in addition also controls for the prizes of the alternative gambles.

Under both specifications we find no significant status quo effect in the symmetric treatments R-R and A-A. We do find evidence of status quo bias in the asymmetric treatments R-A and A-R. After controlling for the payoffs of the alternative gambles, the status quo frame increases the likelihood that $(10, 4)$ is chosen by 12% in the R-A treatment and by 10% in the A-R treatment. Both results are significant at the 1% level.

The status quo bias can also be quantified in terms of forgone payoffs. The average premium required to give up the $(10, 4)$ gamble after receiving it as a status quo option is 5% of expected payoff in treatment A-R and 6% of expected payoff in treatment R-A. This means that if a subject is indifferent between options x and y when he has no endowement, then, if x becomes his status quo, in order to restore the indifference, the payoff of y has to increase by 5% and 6% respectively.[12]

3.2 The Status Quo Bias Index

The within-subject design allows us to construct a status quo bias index for each subject by comparing his choices in the neutral frame to his choices under the status quo frame. The index is constructed as follows: Each subject starts off with a measure of 0. If a subject chooses an alternative over the $(10, 4)$ gamble under the neutral frame, but prefers to keep the $(10, 4)$ gamble after it is given to him as an endowment, one point is added to the index. If the opposite behavior takes place, one point is subtracted. Thus, subjects choosing the $(10, 4)$ gamble more often when it serves as the status quo option have a positive index while those exhibiting the opposite behavior have a negative index. Subjects who make the exact same choices in both parts of the experiment receive an index of 0. In Table 4 we report the mean and median level of the status quo bias index in each treatment. The mean is not significantly different from 0 in the symmetric treatments. The median in these treatments is also 0. We find a positive and significant index for the two asymmetric treatments, both in terms of median and mean. In Figure 1 we report the full distribution of the status quo bias measure across treatments. Consistently with the aggregate statistics, we observe that the distribution of the measure is centered around 0 in the symmetric treatments while it is shifted to the right in the two asymmetric treatments.

[12] In this note we explain how the marginal probabilities estimated in the probit regression can be transformed into a measure of the bias in terms of forgone payoffs. Consider treatment $A-R$. Here the estimates suggest that $(10, 4)$ is chosen 10% more often when it serves as the status quo option. 10% is equivalent to 1.5 questions out of 15 total questions. Now consider the majority of subjects who exhibit a switching points. Since there are two subsets of alternatives and assuming subjects switch from the $(10, 4)$ gamble to the alternative set in each subset, the switching point occurs on average 0.75 questions "after" under the status quo frame as compared to the neutral frame. Two consecutive gambles in our alternative subsets are separated by 50 cents in terms of expected payoffs. Thus in order to give up the gamble $(10, 4)$ when it is the status quo option subjects require on average a premium equal to $0.75 \cdot 50 = 37.5c$ which is roughly 5% of the average expected value of a gamble in our experiment (the calculation assumes a uniform prior for the ambiguous gambles).

Table 4

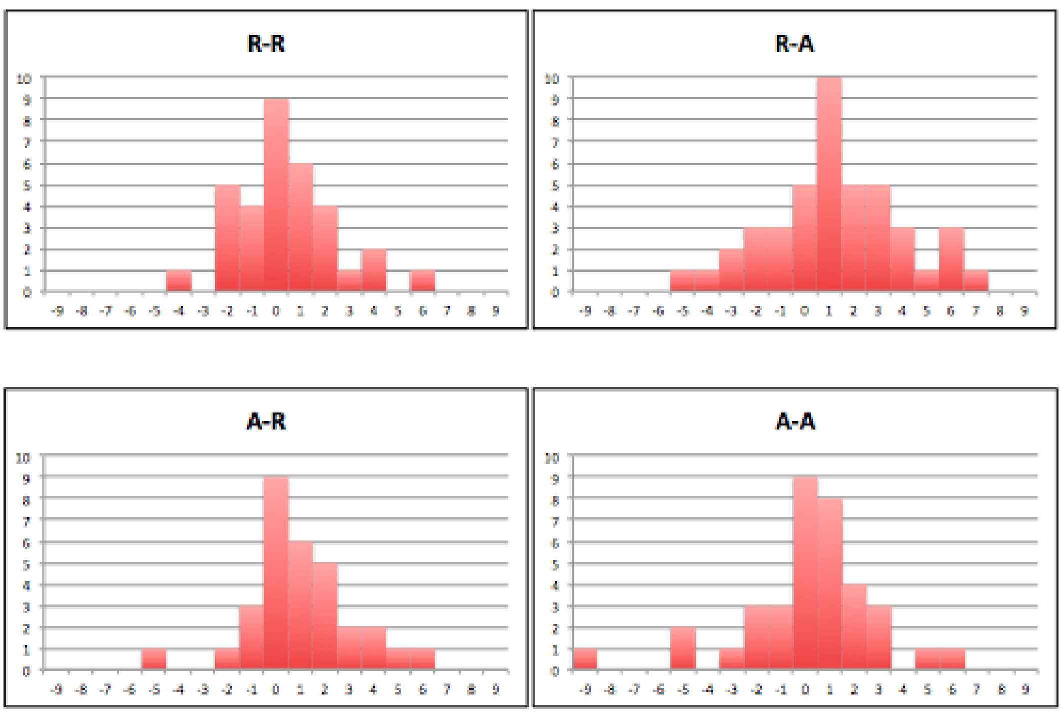
Mean and Median of the Status Quo Bias Measure

	R-R	R-A	A-R	A-A
Mean	0.39 (.277)	1.23*** (.005)	1** (.014)	0.14 (.764)
Median	0	1	1	0
No. obs	33	43	31	36

NOTES: P-values in parenthesis. *** Significant at 1% level. ** Significant at 5% level.

Figure 1

DISTRIBUTION OF THE STATUS QUO BIAS INDEX



4 Comparison with the theoretical literature

The most well-known approach to the status quo bias is to view it as stemming from loss aversion (Kahneman and Tversky, 1979). The two features which generate the status quo bias as a prediction of the loss aversion model are: (i) The decision maker evaluates outcomes in terms of gains and losses with respect to a reference point (typically chosen as the status quo option if it exists, or set to 0 if it is absent); and (ii) losses loom larger than gains. This implies that keeping the status quo option gives a utility of zero, while switching to the alternative generates gains or losses depending on the realization of the state (which in our experiment is given by each one of the four possible chip-color-combinations drawn from the two bags). The downweighting of gains in some state realizations compared to the losses incurred in other states gives rise to the status quo bias. Hence, loss aversion predicts a positive status quo bias in all treatments, counter to our results of no bias in the R-R and A-A treatment.

One may argue that the reason for the absence of the bias in the asymmetric treatments is the fact that we can only observe preferences over a finite set of alternatives. If the loss aversion parameter of our subject pool is small, setting the difference in expected value between two consecutive gambles at 50 cents may be too large an interval and compromise our ability to detect a preference reversal across the two frames of choice. To address this concern, in Appendix A we run a quantitative exercise, using the version of the loss aversion model suggested by Koszegi and Rabin (2006) and with a loss aversion parameter estimated in Sprenger (2015).[13] We show that in the R-R treatment the adopted grid of alternatives is fine enough to detect a bias if one is present. A more general argument that does not rely on specific parameter choices is that the loss aversion model does not explain the heterogeneity of our results, that is it does not shed light on why we find the bias in the asymmetric treatments and not in the symmetric ones.

A second approach associates the emergence of the bias to the incompleteness of the preference relation (Bewley, 1986). The agent faces outcomes which depend on states of the world, the probability of which may not be objectively defined. In this setting the agent acts as if he has a set of priors over the possible states of the world. Facing alternatives which do not dominate the status quo option for every prior in that set, the agent exhibits *inertia*, that is he sticks to the status quo option. In these situations, the decision maker may be thought of as acting "cautiously" - he tries to avoid making a mistake by not moving away from his endowment. In other words, the inertia becomes a way to resolve the incomparability between options and generates status quo biased behavior. Ortoleva (2010) provides axiomatic foundations for such "cautious" behavior by imposing behavioral postulates on the preferences of the agent.[14] In these models incomparability can only arise

[13] This version of reference dependence is well suited for having lottereis serve as reference points as in our experiment. The model has also been largely supported by the experiment run by Sprenger (2015).

[14] Mihm and Ozbek (2012) take a slightly different approach to the interpretation of ambiguity and reach a similar type of "cautious behavior" as in Ortoleva (2010).

when there are multiple priors and the ranking of alternatives depends on the prior under which they are evaluated. Hence the decision maker may exhibit inertia only in the presence of ambiguous prospects. It follows that Bewley-type models correctly predict that in the R-R treatment we should not observe status quo bias. In the two asymmetric treatments involving ambiguity there is scope for the emergence of the bias, as confirmed by our findings. However the model fails to predict the absence of status quo bias in the A-A treatment. In Appendix B we show that in the framework proposed by Ortoleva (2010) under a symmetry assumption on the set of priors that the agent holds, treatment A-A is in fact predicted to be the most prone to status quo biased behavior. More precisely, we show that if a preference reversal is observed in the asymmetric treatments, we should observe a reversal also in the A-A treatment.

A third approach to the status quo bias is proposed by Masatlioglu and Ok (2014). They take as a primitive an arbitrary compact metric space with no added structure and hence their model applies generally to our experimental results. Their decision maker acts as a "constrained maximizer". In the absence of a status quo option he is a standard utility maximizer. The presence of a status quo option induces a psychological constraint set from which the agent chooses the best alternative according to his utility. The status quo bias is captured by the fact that some alternatives which are utility improving when compared to some alternative x, may be excluded from x's constraint set and therefore will not be chosen when x does serve as the current endowment. This model is able to ex-post accommodate our findings. In the symmetric treatments, the constraint set is never binding for the options involved in our experiment. Instead, in the asymmetric treatments the constraint set appears to be more restrictive leading to the finding of a positive status quo bias. However, the generality of the model does not allow for ex-ante predictions regarding the treatments in which the status quo bias would emerge. Indeed the model is compatible with our findings but would also be compatible with the opposite findings.

To the best of our knowledge, no existing model of choice predicts all of our findings. We would like to suggest a conjecture which is based on the observed pattern across treatments. As Bewley (1986) pointed out, incompleteness may indeed be the driving force behind the status quo bias. However such incompleteness may be generated not by the presence of ambiguity but rather by the asymmetric presence of it. More generally, it may be "dissimilarity" of alternatives which is driving the incompleteness of preferences: when all alternatives are "similar" as in the symmetric treatments no incompleteness arises and therefore no bias. When the choice set involves a status quo option which is "dissimilar" to the alternatives, i.e. one is risky while the other ambiguous or vice versa, incompleteness is present and leads to status quo bias.[15] A proper empirical investigation of this conjecture is beyond the scope of this paper and left for future work.

A recent paper by Maltz (2015) formalizes the idea of a dissimilarity-based status quo

[15] The observation that dissimilar alternatives may lead to enhanced difficulty in making comparisons and hence to incompleteness of the preference relation has been suggested by Schwartz (2000).

bias adopting the Masatlioglu and Ok (2014) framework. The model imposes an exogenous partition structure on the space of alternatives, interpreted as categories of goods similar to each other (such as risky lotteries or ambiguous gambles in our experiment). In his representation, the decision maker first identifies the best alternative which is similar to his endowment, i.e., in the same category as the endowment, and treats that alternative as his actual reference point rather than his exogenous endowment. This new reference point induces a constraint set, as in Masatlioglu and Ok (2014), from which the decision maker chooses the best alternative according to his reference-free utility. One key prediction of this model is the absence of status quo bias in choices among options that belong to the same category. If one accepts the categorization of gambles into risky lotteries and ambiguous gambles, this model explains our findings in all four treatments.

5 Status quo bias, Endowment Effect and Dissimilarity

In this section we interpret the findings from the endowment effect literature as additional evidence in favor of the conjecture that similarity may play a role in explaining the status quo bias. We do this by adding the dimension of degenerate lotteries, i.e. fixed monetary payoffs, to the domain of alternatives.

In the introduction we pointed out that the status quo bias is not present in choices where both options are monetary payoffs (Kahneman et al., 1991). A natural question is whether the bias would arise in choices between monetary payoffs and risky lotteries, and between monetary payoffs and ambiguous gambles. Our experiment provides no evidence for the case in which either the endowment or the alternative is a monetary payoff. However, we can turn to the findings of the endowment effect literature as indirect evidence of status quo bias when degenerate lotteries are involved.

The endowment effect phenomenon is closely related to the status quo bias and refers to subjects' increased valuation of a good when they own it compared to their valuation of it when they do not (Thaler, 1980). The studies documenting this effect report the existence of a gap between the willingness to accept (WTA) and the willingness to pay (WTP) values for a given good. The WTA is the amount of money the subject is willing to receive for giving up a good that is currently in his possession. The WTP is the amount of money the subject is willing to give up for the same good in order to acquire it. Hence the WTA-WTP gap may be interpreted as indirect evidence of status quo bias in choices between money and the good under assessment. As a simple illustration, suppose that the decision maker is willing to pay a maximum of \$10 for a good, but when endowed with the same good, he is willing to sell it only at a price equal or above \$15. This means that if any amount lying within the interval \$10 − \$15, say \$12, is offered in comparison to the good, the decision maker would choose as follows: He keeps the \$12 when endowed with the money, while he chooses to keep the good when endowed with it.[16] The WTA-WTP

[16] One has to be slightly careful in interpreting a WTA-WTP gap for a gamble as evidence for status quo

Table 5: OUR FINDINGS COMBINED WITH WTA-WTP EVIDENCE

		Alternatives		
		Money	**Risky gamble**	**Ambiguous gamble**
	Money	*NO BIAS*	*BIAS*	*BIAS*
Status Quo	**Risky gamble**	*BIAS*	**NO BIAS**	**BIAS**
	Ambiguous gamble	*BIAS*	**BIAS**	**NO BIAS**

gap has been reported for a wide range of ordinary goods (as one example see Bateman et al., 1997). More relevant for our study is the fact that the gap is observed also in the case of risky lotteries (Knetsch and Sinden, 1984) and ambiguous gambles (Eisenberger and Weber, 1995). In Table 5 we add the money dimension alongside the risky and ambiguous gambles and combine the findings from our experiment (highlighted in bold) alongside the WTA-WTP evidence (in italics).

The pattern of our results generalizes to the expanded domain and it further highlights the possible role played by *dissimilarity* as a determinant of the status quo bias. When the endowment and the alternative are of *similar* nature, i.e., they are both monetary payoffs, risky lotteries or ambiguous gambles, no bias arises. However, when the endowment is *dissimilar* to the alternative the bias emerges.

6 Conclusions

Our study examines the status quo bias phenomenon under uncertainty. Specifically we check whether the way in which ambiguity enters the choice problem affects the bias. In the symmetric treatments, where the endowment and alternatives are both risky or both ambiguous options, we find no bias. A significant bias emerges when the endowment is a risky gamble and the alternative is an ambiguous gamble as well as when the endowment is an ambiguous gamble and the alternative is a risky gamble. In these asymmetric treatments

bias. The reason is that WTA-WTP elicitations compare the two endowment frames (money as endowment or gamble as endowment). They do not provide information regarding a neutrally framed choice between a sum of money and the gamble. Hence we may only conclude that there is status quo bias in at least one of the two frames. In fact, according to one experiment ran by Kahneman et al. (1991) the gap is mostly due to a higher evaluation of the owners of the good rather than a lower evaluation of those who may purchase the good. In the table we give a summary of the findings assuming that some disparity arises for both types of endowment frames (purchasing or selling) as compared to the neutral choice frame.

the magnitude of the bias is equal to $5\% - 6\%$ of expected payoffs.

The pattern highlighted by our results is not predicted by existing models of choice with initial endowment. The loss aversion model by Kahneman and Tversky (1979) predicts correctly two of our four findings while Bewley incomplete preferences type of models predict three out of four of our findings. The status quo bias model of Masatlioglu and Ok (2014) is too general to provide predictions in our setup but allows for imposing more structure to investigate the findings.

Our work sheds new light on the role played by the asymmetric presence of ambiguity, and more in general, on the role played by the *dissimilarity* of alternatives in the choice set in generating the status quo bias.

A Predictions of the Loss Aversion model

We run a quantitative exercise aimed at showing that the loss aversion model would predict status quo bias in treatment R-R. One major problem when attempting such an exercise is determining the reference point used by the agent. For this purpose we utilize the stochastic reference distribution approach suggested by Koszegi and Rabin (2006) (KR). This approach has been supported by the experiment run by Sprenger (2015). In his paper he also provides an estimate for the parameter of loss aversion which we use here. As pointed out in Sprenger (2015), this estimate is consistent with previous loss aversion estimates from other contexts (Kahneman and Tversky, 1992; Gill and Prowse, 2012 and Pope and Schweitzer, 2011).

According to KR, Let r represent the referent potentially drawn according to measure G. Let x be a consumption outcome potentially drawn according to measure F. Then the KR utility formulation is:

$$U(F|G) = \int \int u(x|r)dG(r)dF(x)$$

with

$$u(x|r) = m(x) + \mu(m(x) - m(r))$$

The function $m()$ represents consumption utility and $\mu()$ represents gain-loss utility relative to the reference, r. We follow Sprenger (2015) and make several simplifying assumptions. First, following Koszegi and Rabin (2006, 2007) small stakes decisions are considered such that consumption utility, $m()$, can plausibly be taken as approximately linear, and a piecewiselinear gain-loss utility function is adopted

$$\mu(y) = \begin{cases} \eta \cdot y & \text{for} \quad y \geq 0 \\ \eta \cdot \lambda \cdot y & \text{for} \quad y < 0 \end{cases}$$

where λ is the parameter of risk aversion which Sprenger (2015) estimates and finds to be equal to 3.4. We also take $\eta = 1$ as in Sprenger (2015). We are now ready for pull off our exercise to show that status quo bias arises in treatment R-R. To this end, we consider the lottery $(10, 4)$ which will become the reference lottery in the second part of the experiment and the lottery $(13, 2)$. We will show that using the above assumptions imposed in the KR model alongside the estimated parameter of loss aversion leads to a preference reversal between these two lotteries which exhibits status quo bias.[17]

We start by evaluating the utilities of the two lotteries in part 1 of the experiment. In this part, no endowment is given to the subjects and it is not immediately clear what

[17] Under the same assumptions and estimate for λ we have that a reversal shows up also for the lottery $(14, 2)$. Using a lower degree of loss aversion of $\lambda = 3$, which has often been used as a benchmark of losses being felt twice as severely as gains (Koszegi and Rabin 2006, 2007), the model would still predict status quo bias but a reversal would show up only for the lottery $(13, 2)$.

lottery should be used as the reference point. In this exercise, we take a natural candidate which is the average expected value of a lottery in our experiment (\$7).[18] Throughout the calculation we use the estimated value of $\lambda = 3.4$.

$$U((10,4)|7) = 0.5u(10|7) + 0.5u(4|7) = 0.5[10 + (10-7)] + 0.5[4 + 3.4(4-7)] = 3.4$$

$$U((7,6)|7) = 0.5u(7|7) + 0.5u(6|7) = 0.5[7 + (7-7)] + 0.5[6 + 3.4(6-7)] = 4.8$$

Thus, the agent described by the KR model will choose the lottery $(7,6)$ over $(10,4)$ in part 1 of the experiment. We now turn to part 2, where the lottery $(10,4)$ serves as the agent's endowment and is therefore used as the reference point. The evaluations of the two lotteries are as follows:

$$U((10,4)|(10,4)) = 0.25u(4|4) + 0.25u(10|10) + 0.25u(4|10) + 0.25u(10|4)$$
$$= 0.25 \cdot 4 + 0.25 \cdot 10 + 0.25[10 + (10-4)] + 0.25[4 + 3.4(4-10)]$$

$$U((7,6)|(10,4)) = 0.25u(7|10) + 0.25u(6|10) + 0.25u(7|4) + 0.25u(6|4)$$
$$= 0.25[7 + 3.4(7-10)] + 0.25[6 + 3.4(6-10)] + 0.25[7 + (7-4)] + 0.25[6 + (6-4)]$$

we obtain

$$U((10,4)|(10,4)) = 3.4$$

and,

$$U((15,2)|(10,4)) = 1.8$$

Thus, in the second part of the experiment the agent described by the KR model would choose $(10,4)$ over $(7,6)$ exhibiting a preference reversal in line with status quo bias.[19]

B Predictions of Bewley Incomplete Preferences model

We show that according to Bewley's incomplete preference model (1986) and specifically using the axiomatic development of this idea by Ortoleva (2010), the emergence of status

[18] Another plausible candidate may be the degenerate lottery that pays 0 for sure since there is no status quo option in this part of the experiment. Using this as a reference point leads to the same result of at least one reversal in choices.

[19] Using the same parameter values and reference points, the lottery $(8,6)$ is also predicted to be chosen over the $(10,4)$ lottery while in part 2 the agent should be indifferent between them. Thus we find a predicted total of 1.5 reversals in line with status quo bias for each subject according to the KR model.

quo bias in treatment $R - A$ implies its presence also in the $A - A$ treatment under a "symmetry" assumption over the set of priors.[20]

Consider the following simplified version of our experimental design. There are two bags made of 2 chips. Each chip can be either white or black. The exact composition of the two bags identifies 9 possible states of nature. States are indicated as $s_{i,j}$, $i, j \in \{0, 1, 2\}$ where i is the number of white chips in bag 1 and j is the number of white chips in bag 2. We follow the representation of Ortoleva (2010) in assuming that the decision maker has a utility function, a set of probabilities over the states and a single prior in the relative interior of the set.[21] The large set is used to decide whether to keep or not the status quo by requiring dominance for all priors as in Bewley (1986); the single prior is used in the other cases and for simplicity we will assume it is the uniform probability that assignes to every state an equal probability of $\frac{1}{9}$. Thus, in the absence of a status quo option, our agent uses the uniform prior and acts as an expected utility maximizer. The set of priors is the ϵ-ball around this uniform prior. Formally, the set of priors Π is given by $\Pi = \{\pi : d(\pi, p_{\frac{1}{9}}) \leq \epsilon\}$ where $p_{\frac{1}{9}}$ is the uniform prior and $d(\cdot\ , \cdot)$ is the Euclidean distance.[22]

We denote by R the constant act paying \$10 and \$4 each with probability $\frac{1}{2}$ regardless of the realization of the state of the world. We define A_1 to be the act paying \$$w_1$ if a white chip is extracted from bag 1 and \$$b_1$ if the extracted chip from bag 1 is black, with $w_1 > b_1$. Finally define A_2 as an act paying \$10 if a white chip is extracted from bag 2 and \$4 if a black chip is extracted from bag 2. Notice that A_2 can be seen as the "ambiguous counterpart" of the constant act R in the following sense: the latter pays \$10 and \$4 with $\frac{1}{2}$ probability in all states, while the former pays \$10 and \$4 with probabilities which depend on the states. If we use the uniform distribution over the set of priors Π then the resulting compound lottery also pays \$10 and \$4 each with probability $\frac{1}{2}$.

We say that the choice between two acts, x and y, *exhibits status quo bias in favor of* x, if absent an endowment the DM chooses y from the set $\{x, y\}$, but chooses x from the same set when x is given to him as an endowment.

Proposition 1 *According to the representation given in Ortoleva (2010) and using the above sets of priors the following holds: if the DM exhibits status quo bias in favor of R in choices between R and A_1, then he will exhibit status quo bias in favor of A_2 in choices between A_2 and A_1.*

[20]A specular argument shows that the presence of status quo bias in treatment $A - R$ would also imply status quo bias in treatment $A - A$.

[21]This specific representation appears in an eariler version of the paper, available at http://gtcenter.org/Archive/Conf07/Downloads/Conf/Ortoleva498.pdf.

[22]The assumption that the set of priors is symmetrically located around the uniform probability implies that the decision maker may well be uncertain regarding the composition, but does not expect one color to be more represented than the other. This assumption is largely confirmed by the answers to the questionnaire regarding the beliefs over the composition of the unknown bag.

Proof. Consider the representation given in Theorem 1 of Ortoleva (2010).[23] If the decision maker exhibits status quo bias in favor of R in the choice between R and A_1 then the following must be true:

$$\frac{1}{9}\sum_{s\in S} E_{A_1(s)}(u) > E_R(u) \tag{1}$$

$$\exists \pi \in \Pi \text{ such that } \sum_{s\in S} \pi(s) E_{A_1(s)}(u) < E_R(u) \tag{2}$$

Where E is the expectation operator. According to inequality (1), act A_1 delivers higher expected utility than R using the uniform prior, i.e., without an endowment. However when R is given as an endowment, the decision maker behaves cautiously using the larger set of priors. If a status quo bias is present in favor of R it must be that, according to one prior in the set, act A_1 delivers lower utility than R.

We let $\underline{\pi} = \underset{\pi\in\Pi}{\operatorname{argmin}} \sum_{s\in S} \pi(s) E_{A_1(s)}(u)$ be the prior in Π that minimizes the value of act A_1.
Since the payoffs of a white ball are larger, and using the fact that the set of prior is symmetric around the uniform prior, a simple linear programming exercise shows that for all monotonic utility functions u, $\underline{\pi}(s_{i,j})$ is given as follows:

$$\underline{\pi}(s_{i,j}) = \begin{cases} \frac{1}{9} - \nu & \text{if} \quad i = 2 \\ \frac{1}{9} & \text{if} \quad i = 1 \\ \frac{1}{9} + \nu & \text{if} \quad i = 0 \end{cases}$$

where $\nu = \frac{\epsilon}{\sqrt{6}}$. That is, starting from the uniform prior, $\underline{\pi}$ is obtained by shifting probability mass in equal proportions from the 3 states where there are two white balls in bag 1 to the 3 states where there are zero white balls in bag 1. Setting $\nu = \frac{\epsilon}{\sqrt{6}}$ ensures the prior lies within the set Π. Next notice that from inequality (2) it must be:

$$\sum_{s\in S} \underline{\pi}(s) E_{A_1(s)}(u) < E_R(u). \tag{3}$$

In order to complete the proof, we need to show that the decision maker exhibits status quo bias in favor of A_2 when choosing between the two ambiguous acts. It is sufficient to show that:

[23] The version given at http://gtcenter.org/Archive/Conf07/Downloads/Conf/Ortoleva498.pdf.

$$\frac{1}{9}\sum_{s\in S} E_{A_1(s)}(u) > \frac{1}{9}\sum_{s\in S} E_{A_2(s)}(u) \tag{4}$$

$$\sum_{s\in S} \underline{\pi}(s) E_{A_1(s)}(u) < \sum_{s\in S} \underline{\pi}(s) E_{A_2(s)}(u) \tag{5}$$

Inequality (4) follows from (1) and the fact that $E_R(u) = \sum_{s\in S} \frac{1}{9} E_{A_2(s)}(u)$. For (5) first notice that $\sum_i \underline{\pi}(i,j) = \frac{1}{3}$ for all $j \in \{0,1,2\}$. Therefore $\sum_{s\in S} \underline{\pi}(s) E_{A_2}(u) = E_R(u)$ and together with (3) leads to this inequality.

■

C Corners

The limits imposed on the number of questions we ask carry the consequence of some subjects not exhibiting a switching point from the endowment to the alternative set in some parts of the experiment, a situation we dub as a "corner". A corner is the case where a subject always chooses the $(10, 4)$ gamble or always chooses the alternative gambles in one or both subsets of ordered alternatives. To understand the role of corners, the reader could imagine extending the range of alternative options. It is conceivable that if we keep decreasing the expected payoff of the alternative gambles all subjects would eventually prefer the $(10, 4)$ gamble. Similarly, all subjects would eventually switch to the alternative gamble if the expected payoffs of the latter are made large enough. Hence we interpret corners as cases in which a subject's switching point is not captured by the selected range of alternative gambles. Corners have the potential to generate a bias in our measure of the status quo effect. However, we can exploit the pattern of choice exhibited in proximity to the end of the range of questions to assess whether the finite grid is more likely to induce an overestimation or underestimation of status quo bias.

In this section we give an account of the emergence of corners across treatments. We show that in each treatment the status quo bias measure is affected to a similar extent by instances of potential overestimation and underestimation. If anything, underestimation is slightly more likely in the two asymmetric treatments, which are the two cases where we do observe a statistically significant status quo bias. Thus, it seems that adjusting for corners would only strengthen the pattern of our findings.

Table 6 reports examples of subjects' corners. The 0 entry represents a choice of the $(10, 4)$ gamble in the question comparing the $(10, 4)$ gamble to alternative a_j. An entry of 1 represents the choice of the alternative gamble. The alternatives are monotonically ordered, that is a_j first order stochastically dominates a_{j-1}. As already mentioned, most subjects satisfied transitivity and monotonicity in most questions and thus exhibited a switching points. That is, if they chose gamble a_j over the $(10, 4)$ gamble they also preferred gamble

Table 6

TYPES OF CORNERS

(a) Right corner in part 2

	a_1	a_2	a_3		a_N
Part 1	0	0	1	...	1
Part 2	0	0	0	...	0

(b) Right corner in part 1

	a_1	a_2	a_3		a_N
Part 1	0	0	0	...	0
Part 2	0	0	1	...	1

(c) Left corner in part 1

	a_1	a_2	a_3		a_N
Part 1	1	1	1	...	1
Part 2	0	0	1	...	1

(d) Left corner in part 2

	a_1	a_2	a_3		a_N
Part 1	0	0	1	...	1
Part 2	1	1	1	...	1

a_{j+1} over the $(10, 4)$ gamble. This means that for most subjects all the 0 entries (if any) are located to the left of the 1 entries. This observation allows us to group corners into two categories, right and left corners. A right corner is represented by a full line of 0 entries. In this case the subject would eventually switch to the alternative gamble if offered an attractive enough alternative gamble. However, our finite grid of alternatives does not capture the switching point. Similarly a left corner occurs when, under a certain frame, a subject always chooses gambles from the alternative set. In this case the switching point is located to the left of the grid of alternatives and all entries are 1. Right and left corners may lead to overestimation or underestimation of the bias depending on the frame under which they occur. To see this consider the case described in table $5(a)$. The subject exhibits an interior switching point in part 1 and a right corner in part 2. Due to monotonicity, if we were to add an additional gamble to the right of the grid it would turn either into an additional choice exhibiting status quo bias, or into a switch to the alternative gamble in part 2. In the former case, our measure would underestimate the true level of the bias while in the latter it would be accurate. For this reason we say that, in example $5(a)$, the truncation of the grid is more likely to have produced an underestimation of the bias, rather than an overestimation. Using a similar reasoning the truncation represented in Table $5(b)$ led more likely to an overestimation of the bias. The list below outlines all possible cases of underestimation and overestimation due to corners for subjects exhibiting a switching point.

- Left corner in part 1 and/or right corner in part 2: Potential underestimation.
- Right corner in part 1 and/or left corner in part 2: Potential overestimation.
- Left corner hit in both part 1 and part 2: Neutral.
- Right corner hit in both part 1 and part 2: Neutral.

Table 7

CORNERS BY TREATMENT

	R-R	R-A	A-R	A-A
Underestimation	4.55 (3)	19.7 (17)	12.9 (8)	6.9 (5)
Overestimation	3 (2)	16.2 (14)	4.8 (3)	6.9 (5)
Difference	1.55	3.5	8.1	0
No. obs.	33	43	31	36

NOTES: The table reports the percentage of subjects who exhibit corners in each treatment (the number of subjects are reported in parenthesis). The corners are categorized into instances of over and underestimation.

Table 7 categorizes corners into instances of overestimation and underestimation and report the occurrence of corners in all the treatments. Notice that percentages of potential overestimation and underestimation are fairly balanced in each treatment. Underestimation appears slightly more prominent than overestimation in the two asymmetric treatments (especially in treatment A-R). This implies that if we were to correct our analysis to account for corners, our main result would only be strengthened.

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