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Intertemporal stability of ambiguity preferences

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Abstract

To make predictions with theories, usually we assume an individual's characteristics such as uncertainty preferences to be stable over time. In this paper, we analyze the stability of ambiguity preferences experimentally. We repeatedly elicit ambiguity attitudes towards multiple 3-color Ellsberg urns over a period of two months. In our data, 57% of the choices are consistent with stable preferences over the time of observation. This share is significantly higher than random choices would suggest, but significantly lower than the level of consistency in a control treatment without a time lag (71%). Interestingly, for subjects who are able to recall their decision after two months correctly, the share of consistent choices does not drop significantly over time.

Classification: ambiguity, stability of preferences, experiment

JEL-Codes: C91, D81

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1 Introduction

People who prefer alternatives with known probabilities over alternatives with unknown probabilities are ambiguity averse. In his seminal paper, Ellsberg (1961) described a thought experiment designed to test an individual's ambiguity aversion. Since then, the topic has received considerable attention in the literature (Etner et al. 2012). The thought experiment has been conducted many times with real subjects and incentives (see Camerer and Weber 1992 or Trautmann and Kuilen 2013). The usual result is that a majority of subjects are indeed ambiguity averse. As a consequence, ambiguity is taken into account to better explain real world phenomena and to make better predictions. Increasingly, ambiguity aversion models are applied to economic problems such as the stock market (Epstein and Schneider 2008) or climate change (see Weitzman 2009 or Millner et al. 2012).

In any model that makes predictions based on preferences, an often unmentioned, but important assumption is the stability of said preferences. To draw conclusions from previous observations to future behavior, we have to assume that the person considered chooses according to the same rules at both points in time. When designing policies, for example in the context of the choice of pension plans or climate protection, we can only observe choices today while the payoffs realize in the future, often involving uncertainty. While the literature provides some insights into the stability of risk preferences (Zeisberger et al. 2012), it is mainly quiet with respect to ambiguity attitudes. The scarcity of real life choice situations with precise probabilities stresses the importance of an extension of the analysis to preferences on ambiguity. While it is impossible to directly "read out" the preferences from the subjects mind, we compare behavior across multiple choice conditions. If subjects possess preferences for ambiguity, and if those preferences are stable, we would expect choices to be consistent. That is, we would expect subjects who chose ambiguity averse in one condition to be ambiguity averse in a second condition as well.

To test ambiguity aversion, we use a standard tool of the ambiguity literature, the Ellsberg 3-color urn. One potential worry when testing the consistency of preferences is that subjects might have preferences that are stable, but differ across different urns. To apply the strictest possible test, we use a design that allows us to obtain two measures of ambiguity aversion for one and the same, physically identical, urn.

In our main experiment, we study the stability of choices over a period of two months using the standard design. In addition, we also look at two variations with a shorter time lag. In one, we reduce the time delay between the first choice and the second choice to a few minutes only. In the second variation, choices are again made with a delay of a few minutes, but in one choice, payoffs are in the present and in the other choice, payoff are in the future.
Overall, we find that individual choices are more stable than random choices would suggest. However, far from all subjects are consistent across all choices. Moving payoffs to the future does not significantly impact stability, but separating choices by two months' time leads to lower consistency. We even find reduced consistency when moving from back-to-back decisions to decisions that are taken roughly 10 minutes apart. Interestingly, for subjects recalling their choices after two months, we do not find time effects on stability.
In section 2, we briefly review the related literature whereas section 3 explains the experimental design. In section 4 and 5 we present the results of our experiment. Finally section 6 concludes.

2 Literature

There is a large number of studies that address the general question of preference stability. With respect to preferences on uncertainty, the majority of papers deals with expected utility theory and prospect theory (see Zeisberger et al. 2012) for a more detailed survey on this literature). In one of the first studies on individual stability, Wehrung et al. (1984) elicits hypothetical investment decisions of 90 business executives twice, where the second elicitation is one year later. They find a small but highly significant positive correlation ($\rho = 0.36$) for the personal risk measures. Smidts (1997) assumes constant relative risk aversion (CRRA) and compares the estimated parameters at two different points in time. He asked Dutch farmers for certainty equivalents for 50/50 lotteries (midpoint chaining technique) concerning the market price for potatoes. He observes an even stronger correlation ($\rho = 0.44$) for the Arrow-Pratt measure of absolute risk aversion after one year. Harrison et al. (2005) conduct lab experiments and compare risk preferences according to the Holt and Laury (2002) framework at two different points in time. By using a structural maximum likelihood model, they estimate CRRA coefficients and do not find a significant difference of the aggregate parameter after 20 to 28 weeks. Note,

however, that they do not study individual stability. Andersen et al. (2008) elicit risk preferences over a 17-month period from a representative sample of the adult Danish population, using four different elicitation tasks. They find a positive and significant correlation ($\rho = 0.34$ to $\rho = 0.58$, depending on the actual task), but do not identify a general tendency for risk attitudes to change over time. In a related paper, Baucells and Villasís (2010) study the stability of risk preferences in a prospect theory framework. They analyze risk aversion both in gains and losses. They observe a stable pattern of preferences on the aggregate level, while the percentage of individuals that change their responses across sessions is quite high (63%).

There are only few studies that address the stability of ambiguity aversion. None of them systematically studies identical situations over distinct points in time. Eliaz and Ortoleva (2012) elicit multiple ambiguous decisions, one decision appears three times. Here, 71% of subjects give consistent answers while the remaining 29% change their view when faced with the decision for the second or third time.[1] However, there is no variation in the time dimension. There are some recent papers that test for the stability of ambiguity aversion across different choice situations. Stahl (2013) compares the two classical Ellsberg urn variants finding a lower number of ambiguity averse subjects in the 3-color-urn (55%) than in the 2-color-urn (70%). Moreover, he shows that the number of ambiguity averse choices drops as the relative payoffs of the ambiguous urn rises. Based on the observed choices in these different situations, he comes up with a classification of individual behavior. He reports 60% subjects to be choosing "almost random", while 26% of choice patterns are consistent with expected utility and only 12% represent ambiguity averse choices. Binmore et al. (2012) also analyze decision behavior in different conditions and test the explanatory power of different theories. They find only weak evidence for consistent ambiguity aversion and explain this result by a stricter consistency requirement as they analyze two different (but related) comparisons in choices. Dimmock et al. (2011) compare ambiguity attitudes from different elicitation tasks and found at least 35% inconsistent classifications across the tasks.

[1] In the experimental literature on ambiguity aversion, broader classifications (averse, neutral, loving) are more common than the estimation of a more specific parameter, which makes the use of a correlation coefficient less meaningful.

3 Design

The experiment is designed as a sequence of two parts to measure ambiguity preferences of the same subjects at two points in time. The first part of experimental sessions took place in November 2012 (November sessions) while the second part took place in January 2013 (January sessions). The time lag between the two parts varies from 47 to 59 days depending on the session the subject was assigned to. All sessions took place in the AWI lab at Heidelberg University. Subjects were recruited via the local ORSEE platform (Greiner 2004) and were informed in the invitation that the experiment would consist of two parts. To increase retention in the second part, we offered a €4 show up fee and fourteen different time slots in January for which the subjects received up to three invitation e-mails.
The experiment was executed in a paper and pencil design. The complete instructions were distributed at the beginning of each session and remained with the subjects for the whole experiment. All random draws were conducted with physical devices (boxes with marbles/a coin) and in the presence of the subjects.

3.1 Ambiguity measure

We elicit ambiguity preferences by using a 3-color urn as proposed by Ellsberg (1961). Consider an urn containing thirty balls. Ten balls are yellow (Y). The remaining twenty balls are either green (G) or blue (B) balls in an unknown distribution. In order to elicit the preferences, the subject faces two bets. For each bet the experimenters randomly draw a ball from the urn.[2] If the subject's bet coincides with the draw we pay €4 and otherwise €0. In the first bet the subject faces two possible choices: either to bet on Y or to bet on B. In the second bet the subject bets either on Y *or* G or on B *or* G. The above choices translate into ambiguity preferences according to table 1.

Ambiguity preference	Averse	Neutral	Neutral	Loving
Bet 1	Y	Y	B	B
Bet 2	B *or* G	Y *or* G	B *or* G	Y *or* G

Table 1: Classification of choices

[2] After each draw the ball is returned to the urn.

Note that there are no beliefs that justify strictly preferring Y in bet 1 and B *or* G in bet 2 under the assumption of expected utility maximizing behavior. Rather, by preferring Y over B and B *or* G over Y *or* G a subject opts for choices with a known number of balls over choices where the number of winning balls is ambiguous. Such a subject is called ambiguity averse. Analogously, preferring B over Y in bet 1 and Y *or* G over B *or* G in bet 2 is called ambiguity loving. Finally, Y and Y *or* G as well as B and B *or* G are the only choice combinations for which probability distributions of beliefs exist that satisfy subjective expected utility theory. Subjects showing this behavior are hence classified as ambiguity neutral.

Indifference The 3-color urn is not able to identify subjects who are indifferent in any bet. To tackle this issue, we add two non-incentivized questions to each bet. The questions are non-incentivized in order to exclude any possibility of hedging and to maintain the incentive-compatibility of the 3-color urn. In a first step, we follow Dominiak et al. (2012) and ask subjects about her confidence when making the bet.[3] This confidence measure ranges from "not confident at all" to "very confident" on a five point Likert-scale (denominated as *confidence* henceforth). Furthermore, we elicit a subject's hypothetical willingness to change the bet to the other choice (henceforth *WTA*).[4]

3.2 Main experiment

After discussing our measure for ambiguity preferences we explain the course of actions in the experiment. As pointed out above, the experiment is designed to measure ambiguity preferences at different points in time. When comparing a subject's decisions in the 3-color urn at two points in time, changes in behavior could stem from two different reasons: First, the subject could evaluate bets differently, because she is faced with a different urn and could therefore reasonably expect the two urns to be different. Second, even if the subject assumes the urns to be similar, her behavior in face of the same object might have changed. We want to measure changes and stability of ambiguity preferences. It is there-

[3]The exact wording is "How confident (from "not confident at all" to "very confident") are you with this decision?".

[4]The exact wording in the instructions is: "You will be paid-off accordingly to your decision above. But, hypothetically asked, how much should we pay you such that you change your decision above?" The answers are scaled from €0 to €4.

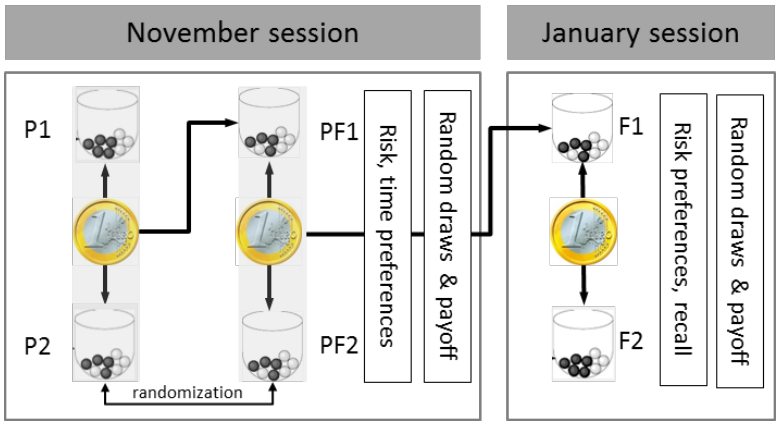

Figure 1: Course of actions

fore the second effect that we what to insulate. Changes in behavior should not be due to a change in the urn which is evaluated. That is, we want subjects to make multiple decisions for a physically identical urn. In the following we describe an incentive compatible mechanism that elicits ambiguity preferences on the physically identical urn twice. Additionally, by eliciting the ambiguity attitudes towards two urns in each choice condition, we are not only able to make statements on the stability of preferences across time but also within the smallest time interval possible: in two back-to-back decisions.

Procedures When investigating the impact of time on preferences we differentiate between three types of decisions (consider figure 1). First, a choice is made today and the payoff consequences of the choice are realized today (choice: present, payoff: present; henceforth P). Second, a choice is made today but the realization of the consequence takes place in the future (choice: present, payoff: future; henceforth PF). Finally, a choice is made in the future and the realization of the consequence takes place in the future (choice: future, payoff: future; henceforth F). Note that the F problem is structurally equivalent with the P problem but in a later point of time. Hence, the comparison of P and F is a natural comparison when investigating the stability of preferences over time.

Choice conditions Present (P): In the first part of the experiment, in P, we elicit the subject's ambiguity preferences for two urns. Choices and payoff happen in the same session. Therefore these urns are denoted as *P1* and *P2*. However, after collecting the decision sheets, a coin is flipped and only one urn

is paid out.[5] Under this condition subjects make a decision in the present for the present.

Present - Future (PF): One urn from the P condition is not paid out. This urn is used again in PF, together with a new urn. Again, subjects make choices for these two urns. However, the payoff of this second round of choices is postponed to the November sessions of the experiment in January. Therefore, the choice is made in present but the payoff is in the future. These urns are denominated as *PF1* and *PF2*. Again, after making the choices, the decision sheets are collected and a coin flip decides which of the two PF urns is paid off. Note, by moving an urn from P to PF we are able to observe incentive compatible choices for the physically identical urn under P and PF.

Future (F): The F choice condition takes place during the January sessions of the experiment (F) two months after the P and PF conditions. The non-paid urn from PF is used again for the F condition. Additionally, a new urn is brought in. These urns are denoted as *F1* and *F2*. When subjects have to make their choices, the decision sheets are collected. Again a coin flip decides which of the urns is paid out. By moving an urn from P to F we observe choices of a physically identical urn in P and F. Depending on the coin flips it is also possible to observe decisions for the physically identical urn under all three conditions. From a point of view of the November session, this decision can be considered to be made in the future for the future. However, taking the position of the January session, the F decision is comparable to the P decision as in both decisions choice and payoff take place in the same session.

Randomization In order to control for order effects within the November sessions, we counterbalanced the order in which subjects received the conditions P and PF.[6]

Credibility Since we elicit the ambiguity on a physically identical urn twice, a major concern is that subjects have to trust the experimenters that urns are not tampered. To tackle this issue, we take pictures of the urns in front of the subjects. Each picture carries a physical and unique time stamp. After finishing

[5] Subjects are informed about the complete structure of the design at the begin of each session.

[6] Note that the randomization procedure also affects the urn that is moved between the different conditions. In standard order, a P urn is moved to PF and a PF urn is moved to F. In reversed order, a PF urn is moved to P and a P urn is moved to F.

the experiment, all pictures are sent out to the subjects to verify that the urns have remained the same when moved between choice conditions.[7]

3.3 Treatment *single session*

In order to establish a strict test for the time effect, we run also a between subject treatment comparable to the main experiment but omitting the time lag of two months. Applying the above coin flip procedure, we elicit ambiguity attitudes four times in a *single session*.

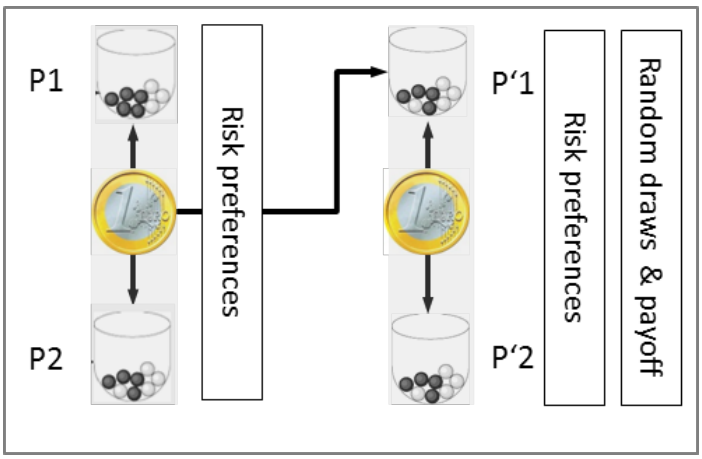

Figure 2: *Single session*: Course of actions

The structure is similar to the main experiment. First, we elicit ambiguity preferences on two urns denoted by *P1* and *P2* (see figure 2). After the decision is made, a coin flip decides which urn is paid out. The urn not chosen for payment is moved to the next choice condition *P'* which is identical to the first condition *P*: again, both choices and payoffs are realized today. *P'* represents a second elicitation of immediately paid choices and hence replaces *F* from the main experiment.[8] However, in contrast to the main experiment, between *P* and *P'* approximately ten minutes elapse whereas between *P* and *F* there is a time span of two months. Therefore, comparing consistency levels between *P* and *P'* to those between *P* and *F* in the main experiment serves as a test for the effect of time.

[7] Examples for these pictures can be found in the appendix.

[8] Note that in *single session* there is no counterpart to the *PF* condition with deferred payments as all choices and payments take place in the same session.

3.4 Further measures

We elicit several additional variables to control for their potential impact on ambiguity preferences and their temporal stability.

Risk preferences In both experiments, after eliciting the ambiguity preferences, subjects complete a risk preference measure in a multiple price list design (Holt and Laury 2002). Each subject is asked to take ten decisions on paired lotteries (option A and option B). From the first to the tenth decision, the expected value of both lotteries is increasing while option A has a lower variance for all decisions. Therefore, the subject faces a trade-off between variance and expected earnings. A subject with monotone and rational preferences starts choosing option A and switches to option B if the marginal willingness to accept risk is reached. A random draw determines one of the ten decisions which is paid out. Eliciting the risk preference in P and in F allows us to compare the stability of risk preferences to the stability of ambiguity preferences. In the following we refer to this elicitation mechanism as the *HL* task.

Time preferences Moreover, in the November sessions, subjects are given a choice list that involves deferred payoffs (see figure 3). Option A pays €2 at date P for all ten decisions. Option B is paid out in the January sessions with payoffs ranging from €2 in the first decision to €3 in the tenth decision. A random draw chooses one payoff relevant decision. Any subject who discounts the future chooses option A in the first decision. Depending on their time preference, they will switch to B in later rows, or even stay with A all along for extreme time preferences.

	Option A			Option B	
row	Payoff today	A	or	B	Payoff in January
1	2,00 €	O		O	2,00 €
2	2,00 €	O		O	2,05 €
3	2,00 €	O		O	2,10 €
4	2,00 €	O		O	2,15 €
5	2,00 €	O		O	2,20 €
6	2,00 €	O		O	2,30 €
7	2,00 €	O		O	2,40 €
8	2,00 €	O		O	2,60 €
9	2,00 €	O		O	2,80 €
10	2,00 €	O		O	3,00 €

Figure 3: Elicitation of time preferences

Sociodemographic information In both experiments, as a last task, we survey sociodemographic information of the subjects including gender, age, body height, studentship and whether statistics, econometrics, or game theory classes had been taken.

Recall questions In the January sessions, two urns of the November sessions play a role: The *PF* urn which is chosen for payment and - depending on the order - the *PF* or *P* urn which was moved to the *F* condition (see figure 1). Therefore, in January, we elicit a subject's ability to recall the choices made in the November session. This task is incentivized as we pay €0.25 for each choice that is recalled correctly.

4 Main results

4.1 General information

In the November sessions of the main experiment 110 subjects participated of which 105 returned to the January sessions which amounts to a retention rate of 95%.[9] In the *single session* experiment 35 subjects participated. Fourteen subjects participated in both experiments.[10] The sample is balanced on gender (51% males) while 95% of the subjects are students. The average payoff was €6.87 in November, €17.34 in January and €13.44 in the *single session* treatment.

Averaged over all ambiguity tasks, we find 53.7% ambiguity averse, 37.4% neutral and 9.9% ambiguity loving choices. These numbers are in line with results other studies have found before (see Camerer and Weber 1992 or Oechssler and Roomets 2013).

In terms of recall capacity, we find 58.1% of the subjects remembering their preferences for the payoff relevant *PF* urn correctly (*recall* henceforth). This share is higher than in the case of random answers (N=103, $p < 0.001$, binomial

[9] Due a mistake in the instructions we had to drop ten observations in one session. Other observations are dropped on a case by case basis for some tests when decision sheets or questionnaires were returned incomplete.

[10] We invited subjects from *single session* to the main experiment with the intention of creating within subject comparisons. Due to the low rate of retention from *single session* to the main experiment, we drop this analysis. We successfully added additional incentives to increase subject retention in the main experiment. In the regressions, we cluster on the subject level.

test) and shows that subjects were able to recall their previous answers.[11]

4.2 Descriptives: consistency

Our main interest is the share of consistent choices with respect to the revealed ambiguity attitude. We define two choices to be consistent if they reveal the same ambiguity attitude in two different choice situations.[12]

Figure 4 shows the consistency levels for choices when comparing different situations (e.g. *PF*-*F* compares condition *PF* with condition *F*). Here, we discuss differences in consistency while econometric tests are provided in the next section.

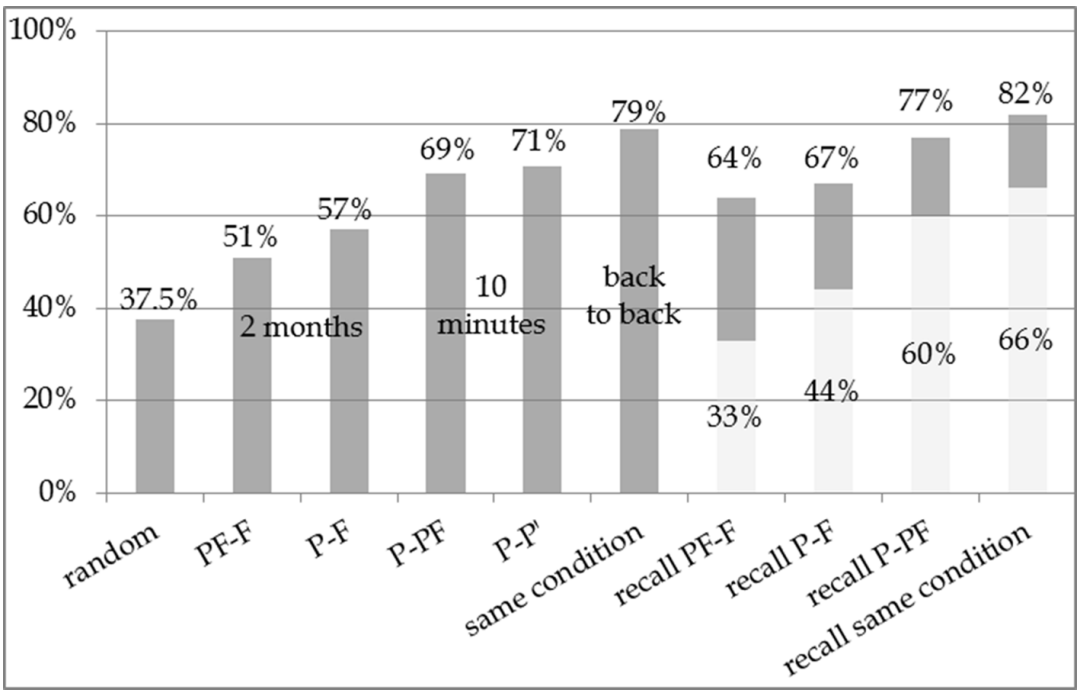

Figure 4: Consistency over choice conditions
Last four bars: dark (light) bars for subjects that recall correctly (incorrectly). "2 months" etc.: time lag between decisions.

[11]For the remainder of the paper we focus on the recall of the *PF* urn given its payoff relevance. In the other recall task, subjects performed similarly. 52.5% remember their preferences of the *P* urn that is moved to January. Also here, this share is statistically different from 25% which should be expected for random answers (N=59, p <0.001, binomial test). Moreover, the correlation between both measures turns out to be $\rho = 0.48$.

[12]Note that there are two different choice combinations which are classified as ambiguity neutral (see table 1). For being consistent we do not require the same choices but the same preferences in two conditions.

First, note that our subjects are in general more consistent than one would expect under random choice (37.5%, bar *random*). However, they are also not fully consistent in their choices. Consistency varies with the time interval between decisions. Deferring the payoffs is less relevant for consistency.
Moreover, we can compare choices with different time lags. Here, the main difference is between decisions taken in the same session, with a delay of 10 minutes, and those taken in two different sessions, with a two months lag in between. For the longer time lag we compare decisions in the November session with the decisions taken in the January session. Here, we find low levels of consistency represented by the bars *PF-F* (51%) and *P-F* (57%).
The level of consistency is higher when we consider decisions taken only 10 minutes apart. Bar *P-PF* depicts the consistency levels across decisions taken during the November session (69%). A second within session measure, bar *P-P'*, comes from the *single session* treatment and shows a very simliar level (71%). Last we can analyze a third, even shorter time lag between decisions in the experiment. Remember that, in each choice condition, we asked subjects to state their preferences for two Ellsberg urns. This was done on a single decision sheet. That is, these decisions where taking back-to-back without any time delay.[13] For back-to-back decisions we find even higher levels of consistency (bar *same condition*[14], 79%). It seems that even a small time delay between decisions reduces consistency in behavior.
A very good predictor of consistent decision making is the subjects' ability to recall their previous decisions after two months. Bars *recall PF* and *recall P-PF* report the consistency levels for *PF-F*, *P-F* and *P-PF* when splitting the sample in subjects who remember their previous decision (light bars) and subjects who do not (dark bars). Recall ability especially affects consistency in decisions with 2 months time delay. Subjects who, after 2 months, do not recall their previous decisions, have a consistency level similar to random behavior.

4.3 Econometric analysis

Data structure and consistency measures Before presenting the econometric results, we briefly describe the data structure. When assessing the consistency of choices in two conditions, we need to keep in mind that the subjects

[13]Since subjects could change their first urn decisions after answering for the second urn, one could also argue that the decisions where simultaneous.
[14]Pooled over all conditions (*P, PF, F, P'*).

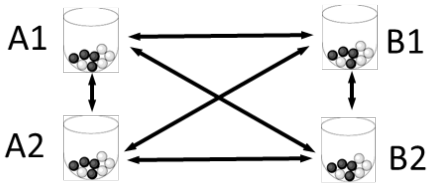

Figure 5: Data structure

were asked to decide for two Ellsberg urns in each condition. Hence, denoting the two conditions A and B, this involves four urns: *A1*, *A2*, *B1* and *B2*. Therefore, there are four possible comparisons between A and B corresponding to the horizontal and diagonal arrows in figure 5. We use all of these four comparisons in our regressions. That is, for each subject and each combination of conditions, we have four observations of the dependent variable *consistent*, set to 1 if the revealed ambiguity attitudes for the two corresponding urns coincide and 0 otherwise.

Further, our experimental design guarantees that subsequent choice conditions always share one identical urn (compare figures 1 and 2). Therefore, when comparing subsequent choice conditions, one out of the four arrows in figure 5 represents a comparison of decisions for a physically identical urn.[15] In this case, the dummy variable *ident* is equal to 1. The dummy variable *reverse order* is set to one if *PF* choices were elicited first to counterbalance the order in the November sessions. Finally, we can compare the ambiguity attitude between the two urns within one condition (the vertical arrows in figure 5). These decisions are not part of comparisons across conditions. Instead, they form the comparison group *same condition*.

All consistency comparisons are necessarily within subject. We can compare conditions P to F, P to PF and PF to F, since subjects made decisions for all three cases P, F and PF. Hence, we gain multiple observations for each subject. As the independent unit of observation is the subject in the regression models below, we cluster standard errors on the subject level.[16]

An exception is the treatment *single session*, which was done as a different experiment and therefore provides an across subject comparison. Here we evaluate the differences between P and P' (figure 2). Since most subjects in *single*

[15]Note that it is possible that the urn that is moved from the first to the second condition is there selected for payoff. In this case, we do not observe a choice for physically identical urns in all three conditions.

[16]The results are qualitatively robust when using random effects models for the estimation.

session did not participate in the main experiment we do not calculate consistency levels relative to conditions from the main experiment.
As a robustness check, in section 5.1, we define consistency as having the same ambiguity attitude in all four urns (that is, being consistent along all arrows in figure 5 connecting A and B). In this stronger form of consistency, we can no longer consider *same condition* separately from the comparisons across conditions.

Regressions We begin by testing whether subjects behave more consistent than under random choice. Since there are four possible choice patterns for each urn (one ambiguity averse, one ambiguity loving, two ambiguity neutral, see section 3.1), we would expect a consistency level of 37.5% if choices were random. We use a binomial test to compare behavior to this benchmark. It rejects random behavior at the 0.1% level (N=1800, p <0.001). We receive a similar result when testing consistency against random behavior for each condition comparison separately. Even in our comparison with the lowest consistency level, in bar *PF-F*, we reject random behavior (N=416, p <0.001).[17]
We test for differences in consistency levels across time lags via the regressions in table 2. In a probit model, with standard errors clustered on subjects, we explain *consistent* behavior, coded as a binary variable. Independent variables in our main model (1) are dummy variables representing different pairs of choice conditions *PF-F, P-PF, P-P'* and *same condition*. The omitted category is *P-F*. We add the *ident* dummy to test the effect of being consistent across two decisions for a physically identical urn whereas the *reverse order* dummy accounts for a possible order effect.
The significance of the coefficients confirms the visual impressions from the previous chapter. *P-F* and *PF-F* both feature a time lag of two months and are not significantly different from each other. However, *P-F* is significantly different both from comparisons with a time lag of 10 minutes (at 1% level comparing to *P-PF* and at 5% level comparing to *P-P'*) and from the comparisons without a time lag (0.1% level comparing to *same condition*). We run additional Wald tests (see table 7 in the appendix) to test the non-omitted categories against each other. We find a similar result as for *P-F* for the second condition with a

[17] These results are robust when testing each choice condition separately on a subject level. Only when conditioning on recall abilities we cannot always reject random behavior: Consistency levels of subjects who cannot remember their earlier decisions were not significantly different from random for comparisons PF-F (N=174, p=0.21) and P-F (N=174, p=0.10).

	(1)	(2)	(3)	(4)	(5)	(6)
P-F omitted	PROBIT	PROBIT	OLS	OLS	PROBIT RECALL	PROBIT RECALL
Dep. Var.	*consistent*	*consistent*	*consistent*	*consistent*	*consistent*	*consistent*
PF-F	-0.13	-0.12	-0.056	-0.05	-0.29*	-0.31*
	0.072	0.077	0.029	0.03	0.13	0.14
P-PF	0.35**	0.35**	0.13**	0.12*	0.41	0.42
	0.13	0.13	0.047	0.049	0.21	0.23
P-P'	0.47*	0.48*	0.15**	0.14*		
	0.19	0.22	0.056	0.065		
same condition	0.57***	0.59***	0.19***	0.20***	0.61***	0.66**
	0.11	0.12	0.037	0.04	0.19	0.2
recall P-F					0.59**	0.67**
					0.2	0.21
recall PF-F					0.81***	0.96***
					0.2	0.2
recall P-PF					0.48*	0.57*
					0.21	0.23
recall same condition					0.45*	0.52*
					0.19	0.2
ident	-0.044	-0.0074	-0.016	-0.00049	-0.057	-0.025
	0.072	0.073	0.027	0.027	0.082	0.083
reverse order		0.045		0.017		-0.095
		0.15		0.055		0.16
HL		-0.027		-0.012		-0.13
		0.36		0.13		0.37
HL_missing		0.026		0.0093		0.016
		0.045		0.016		0.043
yearofbirth		-0.011		-0.0039		-0.02
		0.017		0.0058		0.019
male		-0.095		-0.032		-0.00069
		0.23		0.077		0.24
semester		-0.015		-0.0052		-0.031
		0.018		0.0063		0.018
game		-0.0063		-0.0033		-0.19
		0.19		0.067		0.2
econmajor		-0.0076		-0.0016		-0.019
		0.2		0.072		0.2
statistics		-0.23		-0.081		-0.15
		0.17		0.061		0.17
econometrics		0.3		0.11		0.39
		0.24		0.084		0.24
height		0.014		0.0049		0.012
		0.011		0.0037		0.01
confidence		0.15*		0.054*		0.19*
		0.066		0.023		0.08
WTA		-0.032		-0.011		-0.047
		0.06		0.021		0.06
Constant	0.16	-1.59	0.57***	-0.053	-0.15	-0.73
	0.099	2.25	0.038	0.75	0.14	2.22
Observations	1,800	1,644	1,800	1,644	1,590	1,511

* $p<0.05$; ** $p<0.01$; *** $p<0.001$, robust standard errors clustered at subjects' level

Table 2: Differences in consistency

two months' time lag, *PF-F*: It is significantly different from *P-PF* (p <0.001), from *P-P'* (p =0.003), and from *same condition* (p <0.001). *P-PF*, with a time lag of 10 minutes, is not significantly different from *P-P'*, also with a time lag of 10 minutes (p =0.573), but is significantly different from *same condition*, which has no time lag (p =0.021). The only comparison which is not different across time delays is *P-P'*, with a time lag of 10 minutes, versus *same condition*, no time lag, which are not significantly different (p =0.625).

Surprisingly to us, the *ident* variable is not significant. When evaluating subjects' consistency, the fact whether the two decisions are made for one and the same urn or for two different urns does not matter. Hence, subjects do not seem to treat different urns differently when the information on the urn is kept constant. In our experimental design, we spend considerable effort to come up with a comparison of physically identical urns.[18] Our result on *ident* is important for future experiments: The effort to compare physically identical urns is not necessary, as it suffices to use urns with the same information structure.

In model (2) we add sociodemographic measures (year of birth, being male, number of semesters studied, having participated in a game theory or statistics course, being an economics major and body height in cm.[19] Furthermore, we add the subjects risk preferences elicited by the HL task (*HL_ missing* carries a 1 if HL is missing or non-monotonic preferences were returned).[20] Neither of these variables is significant, nor do they change the significant results of our condition variables.

Finally, we add the variables *confidence* and *WTA*. Both of them are the *confidence* measures introduced in section 3.1. Measuring consistency between two urns generates data on four bets. The variables reported are the averages over these four bets. In the results we find a significant and positive effect of the *confidence* variable in all models. Therefore, subjects who show higher levels of *confidence* in their choices are also more likely to show consistent behavior. However, we do not detect a relevant effect for the *WTA* variable. It is insignificant in all models. This could be due to fact that this question is of higher complexity. As a robustness check, we repeat model (1) and (2) in an OLS

[18]Note that, had we known this result in advance, we could have used a considerably shorter design.

[19]Since Dohmen et al. (2011) find correlations between height, age and risk aversion, this raises the issue of multicolinearity. By testing the variance inflation factors do not detect such effects in any model.

[20]For the HL task we take the first row a subject switches from option A to B. Lower values represent a higher risk tolerance.

specification, see model (3) and (4). The results stay qualitatively unchanged. Overall, whenever the time lag between two compared choice conditions is different, also the level of consistency is significantly different - with one exception, *P-P'* versus *same condition*. And when the time lag between two compared conditions is similar, also consistency is not significantly different. This shows nicely how consistency depends on the time lag between decisions, even when the amount of time passed is only 10 minutes.

Since time differences are a driving force behind different levels of consistency, we look into the effect of being able to recall past decisions. To measure recall, we asked subjects in the main experiment to recall their decision on that Ellsberg urn in choice condition *PF*, which was selected to be paid in the January session. In *single session* no such question was asked as we did not reinvite subjects. Subjects did have an incentive to recall their own decisions, since this allowed them to verify their payment in the Janaury session. If a subject correctly recalled all past own decisions in the *PF* condition, the variable recall takes the value 1, and 0 otherwise. In models (5) and (6) we test whether subjects who recalled their previous decisions correctly differ from those who did not. To do so, we reduce the sample to observations from the main experiment and add interaction terms of *recall* with all available comparisons.[21] The results show that subjects who are able to recall past own actions are more consistent in condition *P-F*, with a two months' time lag, than those how are not. Performing a Wald test for the *PF-F* dummy versus its interaction with recall shows that the same holds true for decisions in this comparison ($p < 0.001$). So, for both consistency values with a two months' time lag, we find a significant effect of recall. In fact, subjects who do not recall their previous actions act not significantly different from random (see footnote 17). What about consistency levels with a time lag of 10 minutes (*P-PF*) or with no time lag (*same condition*)? While we see some difference in figure 4, the effect is not significant ($p = 0.860 / p = 0.604$). This is not surprising: Recall is measured over a time period of two months. Recalling actions over 10 minutes must be considerably easier, such that we would not expect a strong difference between groups here. We can also test whether subjects who are able to correctly remember previous choices are still affected by the different time lags. Interestingly, based on the estimates in model (5), not a single difference across choice conditions is still

[21] Note that we do not control for *P-P'* as this comparison is only available for *single session*.

significant![22] That is, for those subjects who, after two months, still recall their decisions, we do not detect a time effect on consistency. Again, adding sociodemographics and risk aversion in model (6) does not alter these results in terms of significance.[23]

5 Robustness and further results

5.1 Consistency over four Ellsberg urns

In the above section we analyzed consistency based on pairwise comparisons of urns. In the following we present a robustness check by applying a stricter measure for consistency. Here, we consider a subject to be consistent if the attitude towards ambiguity is the same in all four decisions associated with immediate payment, corresponding to the P and F decisions in the main experiment and to P and P' in *single session*.[24] This approach yields an alternative dependent variable *cons_all*, consisting of one observation for each subject which is set to 1 if all choices are consistent and 0 otherwise. Overall, we find a consistency level of 40.8% in the main experiment and a level of 62.9% in the *single session* treatment.

[22] Wald test p-values for the comparisons are 0.686 (*P-F* vs. *P-PF*), 0.146 (*P-F* vs. *PF-F*), 0.568 (*P-F* vs. *same condition*), 0.164 (*PF-F* vs. *P-PF*), 0.152 (*PF-F* vs. *same condition*) and 0.881 (*P-PF* vs. *same condition*).

[23] See table 7 in the appendix.

[24] We do not consider the PF data, as we do not have corresponding observations in *single session*.

	(1)	(2)	(3)	(4)	(5)	(6)
	PROBIT	PROBIT	OLS	OLS	PROBIT	PROBIT
Dep. Var.	*cons_all*	*cons_all*	*cons_all*	*cons_all*	*cons_all*	*cons_all*
single session	0.56*	0.76*	0.22*	0.28*	1.06***	1.32***
	0.24	0.31	0.093	0.11	0.3	0.4
recall					0.81**	1.01***
					0.27	0.3
reverse order		0.19		0.072		0.029
		0.27		0.099		0.28
HL		0.96		0.32		1.14
		0.66		0.23		0.72
HL_missing		0.095		0.03		0.11
		0.071		0.025		0.079
yearofbirth		-0.088*		-0.025**		-0.10**
		0.039		0.0084		0.035
male		0.063		0.014		0.04
		0.34		0.12		0.35
semester		-0.065		-0.02		-0.076*
		0.034		0.01		0.03
game		0.52		0.18		0.52
		0.32		0.12		0.32
econmajor		0.14		0.056		0.15
		0.32		0.12		0.33
statistics		-0.16		-0.061		-0.071
		0.27		0.099		0.28
econometrics		-0.12		-0.044		-0.14
		0.39		0.14		0.39
height		0.017		0.0066		0.022
		0.018		0.0065		0.018
Constant	-0.23	3.88	0.41***	1.26	-0.73***	3.91
	0.13	4.62	0.049	1.15	0.21	4.17
Observations	138	137	138	137	138	137
R-squared			0.037	0.141		

* $p<0.05$; ** $p<0.01$; *** $p<0.001$, robust standard errors clustered at subjects' level

Table 3: Consistency over four urns

In table 3, we present estimates from different models using *cons_all* as dependent variable and including controls similiar to the analysis in section 4.3. In line with the findings in section 4.3, we find a higher level of consistency in the *single session* treatment as the significant coefficient in all six models shows. This proves that, also under the stricter specification, consistency decreases

when decisions are separated by a longer time interval.
We argued in the above section that consistency is not affect by time for subjects that remember their decisions. Here, we tackle this issue in model (5) and (6) by including the subject's ability to correctly *recall* previous decisions. We detect a highly significant effect (at 1% in model (5) and 0.1% in model (6)) in the expected direction. Again, subjects recalling their decisions are more likely to be consistent. Additionally, a Wald test reveals that the *single session* variable is not statistically different from the *recall* variable (p =0.36). This shows that subjects in the main experiment that are able to remember past decisions are as consistent over two months as the average subject is in a setting with a delay of 10 minutes only.
As a further result these models bring up a mild age effect. All models including the *yearofbirth* variable show a significant coefficient on the 5%-level. Younger subjects are less likely to be consistent. When computing the marginal effects (p =0.017 for model 2), the probability of being consistent decreases for every year by 3.2%. Restrictively, the age variation is quite small since we observe 95% students in our sample. Nonetheless, the effect is a pure age effect as we control for the seniority at university with the *semester* variable. Similar to the models in table 2, *reverse order* and the risk preferences (*HL*) have no effect on consistency.
To sum up, this robustness check bolsters the results from section 4.3. With an even stricter measure of consistency, we confirm both the general time effect on consistency and the mitigating role of the individual recall capacity. Furthermore, we find a slightly positive age effect on consistency.

5.2 Ambiguity preferences

Preferences in aggregate After having analyzed the individual consistency of preferences, we take a look at the overall distributions of ambiguity attitudes in the different choice conditions. As figure 6 shows, the distribution of ambiguity attitudes is broadly similar over the different choice conditions. Although we find that time has an effect on the individual consistency above, this does not imply that the preferences change in the aggregate. Observe, however, that finding differences over a period of two months would suggest an extreme effect of aging.

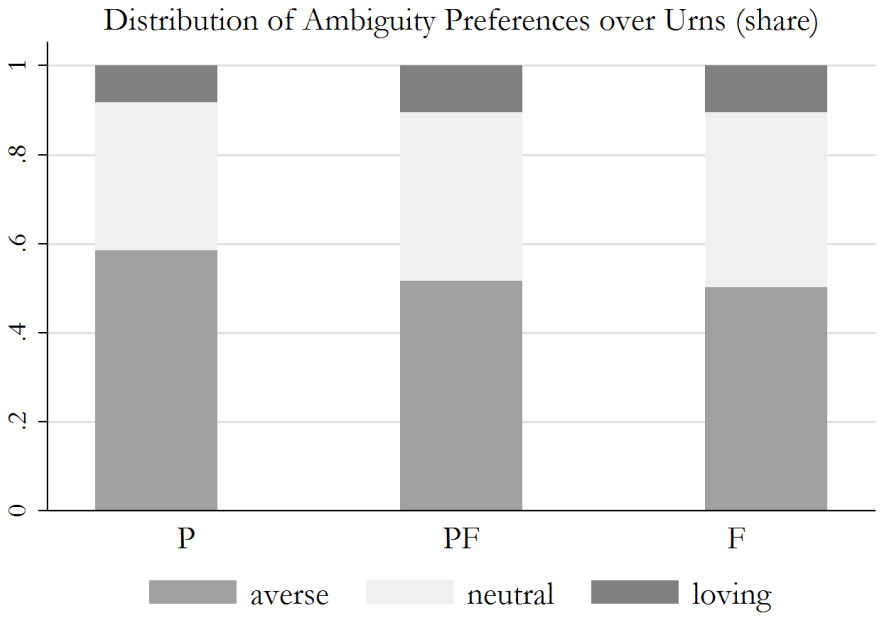

Figure 6: Ambiguity preferences over choice conditions

Ambiguity preferences and demographics In table 4 we present six probit models for the different types of ambiguity preferences. The underlying data is organized and stacked by urns and we consider data from the main experiment only. Depending on the retention to the January sessions, each subject decides on up to six urns corresponding to up to six observations for each subject in the dataset. The models are computed with standard errors clustered on the subject level to control for multiple observations.

The dependent variable is a binary variable that carries a one if the subject shows the respective preference in the urn. Model (1) and (4) investigate ambiguity averse (AA), (2) and (5) ambiguity neutral (AN) and (3) and (6) ambiguity loving (AL) attitudes.

For the explanatory part we include two different sets of variables. First, in order to evaluate the time effects on the ambiguity attitudes, we include binary variables to control for the choice conditions (PF, F). The omitted category is P. While model (1) to (3) are probit models, models (4) to (6) are estimated by OLS as a robustness check. Second, similiar to regressions in the previous section, we include several personal control variables.

	(1)	(2)	(3)	(4)	(5)	(6)
P omitted	PROBIT	PROBIT	PROBIT	OLS	OLS	OLS
Dep. Var.	AA	AN	AL	AA	AN	AL
PF	-0.25*	0.17	0.19	-0.088*	0.061	0.026
	0.11	0.1	0.19	0.04	0.036	0.027
F	-0.23	0.15	0.23	-0.081	0.05	0.031
	0.15	0.15	0.2	0.053	0.053	0.031
HL	0.14*	-0.13*	-0.0001	0.050*	-0.049*	-0.001
	0.061	0.053	0.065	0.021	0.019	0.012
HL_missing	0.46	-0.81	0.5	0.17	-0.3	0.13
	0.55	0.54	0.52	0.19	0.21	0.12
reverse order	0.29	-0.16	-0.33	0.11	-0.057	-0.051
	0.19	0.19	0.19	0.07	0.068	0.029
time	0.017	-0.01	-0.014	0.0057	-0.0031	-0.0025
	0.028	0.025	0.03	0.01	0.0091	0.0045
yearofbirth	-0.01	-0.001	0.13*	-0.0037	-0.0004	0.0041
	0.015	0.012	0.054	0.0055	0.0046	0.0022
male	-0.17	0.046	0.31	-0.058	0.014	0.045
	0.27	0.26	0.29	0.098	0.092	0.046
semester	-0.004	-0.012	0.10*	-0.0014	-0.0045	0.0059
	0.021	0.022	0.039	0.008	0.0078	0.0043
game	0.074	0.012	-0.33	0.02	0.0024	-0.022
	0.26	0.24	0.28	0.096	0.09	0.042
econmajor	-0.41	0.33	0.23	-0.14	0.12	0.022
	0.26	0.23	0.28	0.096	0.088	0.044
statistics	0.079	-0.087	0.07	0.034	-0.033	-0.0005
	0.21	0.21	0.2	0.078	0.077	0.033
econometrics	0.042	-0.02	0.019	0.015	-0.0077	-0.0074
	0.34	0.31	0.33	0.13	0.12	0.051
height	0.024	-0.011	-0.035*	0.0086	-0.0039	-0.0047*
	0.012	0.012	0.014	0.0045	0.0044	0.002
confidence	0.1	-0.066	-0.044	0.037	-0.023	-0.013
	0.095	0.092	0.099	0.035	0.034	0.02
WTA	-0.006	0.016	-0.0028	-0.0009	0.006	-0.0051
	0.087	0.083	0.089	0.031	0.031	0.016
Constant	-4.17	2.62	-7.17	-1	1.44	0.56
	2.46	2.32	5.62	0.85	0.8	0.32
Observations	607	607	607	607	607	607
R-squared				0.117	0.062	0.07

* p <0.05; ** p <0.01; *** p <0.001, robust standard errors clustered at subjects' level

Table 4: Ambiguity attitudes and demographics

As figure 6 suggests, there are no large effects on the distribution of ambiguity attitudes. When considering the tests in the regressions in model (1) and model (4) in table 4, we find a mild reduction of ambiguity aversion in *PF*. This finding is in line with Onay et al. (2012).

We detect mild correlations between demographics and ambiguity preferences while *time* preferences do not have a significant impact. Furthermore, the models show a correlation between the risk task and ambiguity attitudes. For ambiguity averse choices we find a significant correlation with risk averse behavior whereas ambiguity neutral choices are positively associated with risk tolerance. For ambiguity lovers we do not find significant effects. In general, these results coincide with the findings of Lauriola and Levin (2001) and Chakravarty and Roy (2008) who find ambiguity and risk aversion positively associated. However, this relationship is not undisputed since Di Mauro and Maffioletti (2004) find only a low correlation and Cohen et al. (1985) no relationship at all. The *time* coefficients are insignificant in all models.

5.3 Consistency of uncertainty: Risk and ambiguity

Above, we argue that the ability to recall choices correlates with consistent ambiguity preferences. In the following we will explore two questions: First, whether the ability to recall also affects consistency in risk preferences. Second, whether having consistent ambiguity attitudes correlates with consistent risk preferences.

In the experiment, we elicited risk preferences in the P and the F session. Therefore we are able to investigate the P-F consistency for ambiguity as well as for risk preferences.

For this analysis, we construct a binary variable that carries a one if a subject is consistent between both risk tasks ($cons\_HL$). Hence, we consider a subject to be consistent, if the deviation in rows switching from option A to B between the two tasks is smaller or equal than one. Using this variable, we find a consistency level of 85% between the two risk tasks.[25] This is considerably higher compared to the 57% we find for ambiguity preferences for (P-F, see figure 4).[26]

[25] By using a structural maximum likelihood model (Harrison 2006) we do not find significant differences in CRRA coefficients (assuming $u(x) = x^{\alpha}$) between November (0.88) and January (0.89) in aggregate. This is in line with Andersen et al. (2008).

[26] The results do not change change qualitatively or in significance if we use an alternative measure of consistency for risk preferences: A subject is considered to be consistent when showing risk averse, neutral or loving preferences in both HL tasks. Here we find a consistency

Model	(1) PROBIT	(2) PROBIT	(3) OLS	(4) OLS
Dep. Var.	*cons_HL*	*cons_HL*	*cons_HL*	*cons_HL*
consistent	-0.014	-0.097	-0.004	-0.0046
	0.44	0.5	0.11	0.12
recall	0.22	0.32	0.053	0.07
	0.34	0.4	0.084	0.091
reverse order		-0.062		-0.013
		0.36		0.083
yearofbirth		0.0091		0.0032
		0.036		0.01
male		0.086		0.03
		0.44		0.11
semester		-0.0076		-0.00085
		0.043		0.012
game		-0.66		-0.15
		0.42		0.11
econmajor		0.12		-0.014
		0.37		0.1
statistics		-0.39		-0.093
		0.36		0.091
econometrics		1.21		0.27
		0.67		0.14
height		-0.0091		-0.0022
		0.028		0.0071
confidence		0.032		0.007
		0.23		0.048
WTA		-0.33		-0.061
		0.2		0.045
Constant	0.91**	2.82	0.82***	1.11
	0.3	5.11	0.077	1.37
Observations	91	90	91	90
R-squared			0.005	0.099

* p <0.05; ** p <0.01; *** p <0.001
robust standard errors clustered at subjects' level

Table 5: Ambiguity attitudes and demographics

In table 5 we present two binary choice models investigating the relationship between the consistency in risk and ambiguity preferences. The dependent variable measures the consistency in risk preferences over the choice conditions P and F (*cons_HL*).[27] The independent variable of interest is our previous measure for consistent ambiguity preferences (*consistent*). Additionally, model (1) controls for subjects who remember their decision in the PF urn whereas model

level of 87.9%.

[27] We restrict the analysis to *P-F* since we do not observe a HL decision with a delayed payment. However, a comparable setting is tested by Noussair and Wu (2006) who find that subjects are less averse toward future risks.

(2) includes a set of demographic variables.[28] Model (3) and (4) are robustness checks estimated by OLS. We find no significant relationship between the consistency of risk and ambiguity preferences since *consistent* is insignificant. The fact that subjects remember their decision in the ambiguity task has also no effect on the consistency of risk preferences as *recall* is significant.
Hence, although we find a correlation between risk and ambiguity preferences, we do not find a correlation in the corresponding levels of consistency.

5.4 Order effects

urn_nb_4	(1)	(2)	(3)	(4)	(5)	(6)
omitted	PROBIT	PROBIT	PROBIT	OLS	OLS	OLS
Dep. Var.	AA	AN	AL	AA	AN	AL
urn_nb_1	0.01	0.09	-0.23	0.004	0.033	-0.037
	0.12	0.12	0.21	0.049	0.045	0.034
urn_nb_2	-0.023	0.15	-0.29	-0.0092	0.055	-0.046
	0.12	0.11	0.21	0.049	0.042	0.033
urn_nb_3	-0.082	0.042	0.087	-0.032	0.015	0.017
	0.09	0.099	0.16	0.036	0.036	0.032
Constant	0.15	-0.44***	-1.23***	0.56***	0.33***	0.11***
	0.12	0.12	0.16	-.048	0.045	0.03
Observations	438	438	438	438	438	438
R-squared				0.001	0.002	0.008

* p <0.05; ** p <0.01; *** p <0.001, robust standard errors clustered at subjects' level

Table 6: Order effects on multiple elicitations

A concern when eliciting multiple urns per subject is that subjects decide may differently in repeated tasks. The models in table 6 investigate whether the sequence in which urns are presented does affect the subjects ambiguity preference. The independent variables consist of dummy variables indicating the position in the sequence of presentation regardless of the choice condition. For example, *urn_nb_1* carries a one for the first urn in the experiment and a zero otherwise. The dependent variables are also on a binary scale and show a one if the subject's preference is ambiguity averse (model 1), neutral (model 2) or loving (model 3). While models (1) to (3) are probit estimations, (4) to (6) are OLS models which are presented for robustness. The results show that there are no significant and systematic order effects. This confirms that we did not

[28] See section 4.3 for the description

miss out relevant information when focusing on choice conditions instead of urn order in our main analysis.[29]

6 Conclusion

In an experiment designed to test the stability of subjects' ambiguity preferences, we find that the consistency of choices is well above the benchmark of random behavior. Consistency decreases as the time lag between choices increases, from 79% for back-to-back choices to 57% for two months. The decrease in consistency over time is mitigated by subjects' ability to recall their previous choices. For subjects who successfully recall their previous choices, there is no significant difference between longer and shorter time lags. Overall, the consistency results leave a mixed picture: Subjects are consistent to some degree, but not fully. A large amount of individual inconsistency can remain hidden when only aggregate results are taken into account.

Apart from the observed levels of consistent choice, we were also interested in drivers of stability. Here, we could reject our initial concern that the comparison across different urns might introduce a bias: Subjects' consistency over the same urn is not different from the consistency for physically not identical urns. This suggests that it is acceptable to forgo the effort of constructing experiments where one and the same urn is used multiple times in an incentive compatible way. Moreover, we could identify two correlates of stability. One is self-reported confidence in the choice which turned out to be a significant predictor of stability. Hence, including a question like the one used in our experiment might be helpful in predicting individual behavior. Second, subjects who recall their behavior are associated with more consistent behavior, in particular as the time span increases. These subjects might deliberately chose consistent with their previous choices, either to appear consistent, or to avoid having to make up their minds again. However, since we only find a correlation, other causal effects are also possible. The subjects using easy to remember heuristics (Gigerenzer and Gaissmaier 2011) could lead to a reverse direction of causality: Subjects are consistent because they use the same heuristic at both times. And they are able to recall their previous decisions not because they remember the action, but remember using the same heuristic before.

[29] In an alternative test we include urn_nb in the models of table 4. While losing the January observations in these regressions we again do not find an order effect.

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A Appendix: Tables

P-values for Wald tests for joint significance for models in table 2

H_0:	(1)	(2)	(3)	(4)	(5)	(6)
samecndtn=PF-F	0.000	0.000	0.000	0.000	0.0001	0.000
samecndtn=P-PF	0.002	0.0017	0.045	0.034	0.17	0.12
PF-F=P-PF	0.000	0.000	0.000	0.000	0.000	0.000
P-P'=PF-F	0.003	0.007	0.0017	0.0047		
P-P'=P-PF	0.57	0.63	0.72	0.87		
P-P'=samecndtn	0.62	0.59	0.54	0.4		
recall P-F=recall P-PF					0.69	0.73
recall P-F=recall PF-F					0.15	0.087
recall P-F=recall samesit					0.57	0.56
recall P-F=recall P-PF					0.16	0.12
recall PF-F=recall samecndtn					0.88	0.099
recall P-PF=recall samecndtn					0.000	0.8
P_ PF=recall P-PF					0.86	0.73
PF_ F=recall PF-F					0.000	0.000
samecndtn=recall samecndtn					0.6	0.64

Table 7: Consistency: Wald tests on joint significance

B Pictures for credibility

Urn content with time identifier

Presentation of urns

Table 8: Pictures of urns

C Instructions

Instructions – First experimental session

Dear participant,

Welcome to our experiment. Your participation in this experiment supports our scientific work. At the same time, your actions allow you to earn money.
Scientifically responsible for this experiment are Peter Dürsch, Daniel Römer, and Benjamin Roth (Alfred-Weber-Institute for Economics, Heidelberg University).

Course of action of the experiment

Firstly, please turn off your mobile phone, and keep it off during the entire experiment. Do not talk to other participants. If you have any questions, please stay calm and raise a hand. Someone of our experimental staff will answer your question.

Your payoff depends on the choices you make during the experiment.

The experiment consists of two experimental sessions. The first session is taking place today. The second session is going to take place in January 2013. For the experiment it is essential that you participate in both sessions.

Today's session consists of five parts. These five parts are labeled in the instructions as "A", "B", "C", "D", and "E". The instructions at hand explain today's entire experimental session, and are identical for all participants. The experiment starts with part A, then part B, and part C, followed by part D. E is the last part. You can keep the instructions, and read them during the experiment, at any time.

Part A

In part A, you need to make choices for two different boxes („Box 1“ and „Box 2“). Both boxes are located in this room, and each of them contains 30 marbles. Each box contains **10 yellow marbles**. The remaining **20 marbles are either blue, or green**, in an arbitrary proportion.

We will hand out decision sheets A. On decision sheet A you have to make two choices for each of the boxes. Each choice determines your payoff and depends on the marble’s color that will be drawn from the corresponding box.

You make your choices for **both boxes**. You are paid-off for the choices you made for **one box**. In the end of this experimental session, a flip of a coin decides which of the two boxes will be considered for today’s session’s payoff. Afterwards, two independent draws (the marble is put back into the box after each draw) determine your individual payoff according to your choices you made on decision sheet A. To do so, first of all, one marble will be drawn, its color will be notated, and afterwards, the marble will be put back into the box. For the second draw this procedure will be repeated. The other box will be used in part B.

Part B

Again, you have to make your choices for two boxes ("Box 3" and "Box 4"). **Box 3 is the same box from part A which was not considered for the determination of the payoffs**. Box 4 is a new box. Both boxes are located in this room, and each of them contains 30 marbles. Each box contains **10 yellow marbles**. The remaining **20 marbles are either blue, or green**, in an arbitrary proportion.

We will hand out decision sheet B. On decision sheet B you have to make two choices for each of the boxes. Each choice determines your payoff and depends on the marble's color that will be drawn from the corresponding box.

You make your choices for **both boxes**. You are paid-off for the choices you made for **one box**. In the end of this experimental session, a flip of a coin decides which of the two boxes will be considered for today's session's payoff. **Please be aware of that, contrary to part A, the draws from this box, as well as the corresponding payoff will take place in the second experimental session in January 2013**. In the second experimental session in January 2013, two independent draws (the marble is put back into the box after each draw) determine your individual payoff according to your choices you made on decision sheet B. To do so, in January, one marble will be drawn, its color will be notated, and afterwards, the marble will be put back into the box. For the second draw this procedure will be repeated.

Note: The box which was determined for the coming drawing in January will remain unchanged. For this purpose, we will take a picture of the content of the box, together with an identifier for this session, in this room, right before the drawing. This picture will be sent to you via e-mail after the second session in January. In the January session we will take a picture of the content of the box, too, such that you will have the possibility to check that the content of the box has been remained unchanged.

Part C

We will hand out decision sheet C. On decision sheet C you will find the following table. In this table, we ask you for ten choices. In each row you have two alternatives: Option A and Option B. You have to decide for one alternative in each row (**Option A or Option B**).

Example: In the first row you can decide between two options.

- If you choose **Option A**, you will receive with a probability of 10% a payoff of 2.00€ and with a probability of 90% a payoff of 1.60€.

- If you choose **Option B**, you will receive with a probability of 10% a payoff of 3.85€ and with a probability of 90% a payoff of 0.10€.

(This is just an example table. You do not need to cross anything!)

Option A						Option B			
Row	Payoff	Probability	Payoff	A	or	B	Payoff	Probability	Payoff
1	2 €	10% / 90%	1,60 €	o		o	3,85 €	10% / 90%	0,10 €
2	2 €	20% / 80%	1,60 €	o		o	3,85 €	20% / 80%	0,10 €
3	2 €	30% / 70%	1,60 €	o		o	3,85 €	30% / 70%	0,10 €
4	2 €	40% / 60%	1,60 €	o		o	3,85 €	40% / 60%	0,10 €
5	2 €	50% / 50%	1,60 €	o		o	3,85 €	50% / 50%	0,10 €
6	2 €	60% / 40%	1,60 €	o		o	3,85 €	60% / 40%	0,10 €
7	2 €	70% / 30%	1,60 €	o		o	3,85 €	70% / 30%	0,10 €
8	2 €	80% / 20%	1,60 €	o		o	3,85 €	80% / 20%	0,10 €
9	2 €	90% / 10%	1,60 €	o		o	3,85 €	90% / 10%	0,10 €
10	2 €	100%	1,60 €	o		o	3,85 €	100%	0,10 €

Your actual payoff in part C will be determined in the end of this experiment. Which one of the ten rows determines the payoff will be determined by chance (rolling a **ten-sided** dice). For this row, only the option you have chosen by crossing will be of relevance (Option A or Option B). The ten-sided dice will be rolled one further time in order to determine whether the amount highlighted in gray will be paid out, or the amount in the white area.

Example: If the dice indicates a 1 after the first rolling, this means that row 1 is determined. Consider therefore the **first row** in the table. If the dice indicates again a 1 after the second rolling, this means that the amount highlighted in gray (not the white area) will be paid out. Hence, you will receive 2€ if you have crossed Option A, and 3.85€ if you have crossed Option B. If the dice had indicated a number between 2 and 10 after the second rolling, you would have received 1.60€ for Option A and 0.10€ for Option B.

Part D

We will hand out decision sheet D. On decision sheet D you will find the following table. In this table, we ask you for ten choices. In each row you have two alternatives: Option A and Option B. You have to decide for one alternative in each row (**Option A or Option B**).

Example: In the second row you can decide between the following two options.

- If you choose **Option A**, you will receive a payoff of 2.00€ in today's session.
- If you choose **Option B**, you will receive a payoff of 2.05€ in the next session in January.

(This is just an example table. You do not need to cross anything!)

	Option A			**Option B**
Row	Payoff today	A	or B	Payoff in January
1	2,00 €	O		O 2,00 €
2	2,00 €	O		O 2,05 €
3	2,00 €	O		O 2,10 €
4	2,00 €	O		O 2,15 €
5	2,00 €	O		O 2,20 €
6	2,00 €	O		O 2,30 €
7	2,00 €	O		O 2,40 €
8	2,00 €	O		O 2,60 €
9	2,00 €	O		O 2,80 €
10	2,00 €	O		O 3,00 €

Your actual payoff in part D will be determined in the end of this experiment. Which one of the ten rows determines the payoff will be determined by chance (rolling a **ten-sided** dice). For this row, only the option you have chosen by crossing will be of relevance (Option A or Option B).

Example: If the dice indicates a 2, this means that row 2 is determined. Consider therefore the **second row** in the table. You will receive 2€ today if you have crossed option A, or 2.05€ in January if you have crossed option B.

Part E.

We will hand out a questionnaire. Please state some general information on this questionnaire.

Total payment

In the end of today's session, you will receive the sum of your payoffs from part A, C, and if so from part D. You will receive your payoff in cash and in private. Please remain patient. The distribution the payoffs can take some time.

Please wait until we announce your number and then step forward. Please remain calm and do not talk to other participants.

The drawings and payoff of part B will take place in the second experimental session in January 2013.

Decision sheet A **Seat number: _____**

BOX 1

Choice 1.1: What do you prefer? (Please mark with a cross)

- ○ You will receive 4€, if the drawn marble is yellow. or
- ○ You will receive 4€, if the drawn marble is blue.

How confident (from not at all confident to very confident) are you about this decision?

not at all confident ○ ○ ○ ○ ○ *very confident*

You will be paid-off accordingly to your decision above. But, hypothetically asked, how much should we pay you such that you change your decision above?
(Please mark with an „X“ the amount in the following scale)

```
|----+----|----+----|----+----|----+----|
0€        1€        2€        3€        4€
```

Choice 1.2: What do you prefer? (Please mark with a cross)

- ○ You will receive 4€, if the drawn marble is yellow or green. or
- ○ You will receive 4€, if the drawn marble is blue or green.

How confident (from not at all confident to very confident) are you about this decision?

not at all confident ○ ○ ○ ○ ○ *very confident*

You will be paid-off accordingly to your decision above. But, hypothetically asked, how much should we pay you such that you change your decision above?
(Please mark with an „X“ the amount in the following scale)

```
|----+----|----+----|----+----|----+----|
0€        1€        2€        3€        4€
```

BOX 2

Choice 2.1: What do you prefer? (Please mark with a cross)

- ○ You will receive 4€, if the drawn marble is yellow. or
- ○ You will receive 4€, if the drawn marble is blue.

How confident (from not at all confident to very confident) are you about this decision?

not at all confident ○ ○ ○ ○ ○ *very confident*

You will be paid-off accordingly to your decision above. But, hypothetically asked, how much should we pay you such that you change your decision above?
(Please mark with an „X“ the amount in the following scale)

```
|----+----|----+----|----+----|----+----|
0€        1€        2€        3€        4€
```

Choice 2.2: What do you prefer? (Please mark with a cross)

- ○ You will receive 4€, if the drawn marble is yellow or green. or
- ○ You will receive 4€, if the drawn marble is blue or green.

How confident (from not at all confident to very confident) are you about this decision?

not at all confident ○ ○ ○ ○ ○ *very confident*

You will be paid-off accordingly to your decision above. But, hypothetically asked, how much should we pay you such that you change your decision above?
(Please mark with an „X“ the amount in the following scale)

```
|----+----|----+----|----+----|----+----|
0€        1€        2€        3€        4€
```

Decision sheet B **Seat number: _____**

BOX 3

Choice 3.1: What do you prefer? (Please mark with a cross)

- ○ You will receive 4€, if the drawn marble is yellow. or
- ○ You will receive 4€, if the drawn marble is blue.

How confident (from not at all confident to very confident) are you about this decision?

not at all confident ○ ○ ○ ○ ○ *very confident*

You will be paid-off accordingly to your decision above. But, hypothetically asked, how much should we pay you such that you change your decision above?
(Please mark with an „X“ the amount in the following scale)

|----+----|----+----|----+----|----+----|
0€ 1€ 2€ 3€ 4€

Choice 3.2: What do you prefer? (Please mark with a cross)

- ○ You will receive 4€, if the drawn marble is yellow or green. or
- ○ You will receive 4€, if the drawn marble is blue or green.

How confident (from not at all confident to very confident) are you about this decision?

not at all confident ○ ○ ○ ○ ○ *very confident*

You will be paid-off accordingly to your decision above. But, hypothetically asked, how much should we pay you such that you change your decision above?
(Please mark with an „X“ the amount in the following scale)

|----+----|----+----|----+----|----+----|
0€ 1€ 2€ 3€ 4€

BOX 4

Choice 4.1: What do you prefer? (Please mark with a cross)

- ○ You will receive 4€, if the drawn marble is yellow. or
- ○ You will receive 4€, if the drawn marble is blue.

How confident (from not at all confident to very confident) are you about this decision?

not at all confident ○ ○ ○ ○ ○ *very confident*

You will be paid-off accordingly to your decision above. But, hypothetically asked, how much should we pay you such that you change your decision above?
(Please mark with an „X“ the amount in the following scale)

```
|----+----|----+----|----+----|----+----|
0€        1€        2€        3€        4€
```

Choice 4.2: What do you prefer? (Please mark with a cross)

- ○ You will receive 4€, if the drawn marble is yellow or green. or
- ○ You will receive 4€, if the drawn marble is blue or green.

How confident (from not at all confident to very confident) are you about this decision?

not at all confident ○ ○ ○ ○ ○ *very confident*

You will be paid-off accordingly to your decision above. But, hypothetically asked, how much should we pay you such that you change your decision above?
(Please mark with an „X“ the amount in the following scale)

```
|----+----|----+----|----+----|----+----|
0€        1€        2€        3€        4€
```

Decision sheet C Seat number: _____

Below, you will find a table. We ask you for ten choices in this table. In each row of this table you have to decide between two alternatives: Option A and Option B. You have to decide for one alternative in each row (**Option A or Option B**).

TABLE (Please choose now for each row <u>either A or B</u>!)

Option A						Option B			
Row	Payoff	Probability	Payoff	A	or	B	Payoff	Probability	Payoff
1	2 €	10% / 90%	1,60 €	o		o	3,85 €	10% / 90%	0,10 €
2	2 €	20% / 80%	1,60 €	o		o	3,85 €	20% / 80%	0,10 €
3	2 €	30% / 70%	1,60 €	o		o	3,85 €	30% / 70%	0,10 €
4	2 €	40% / 60%	1,60 €	o		o	3,85 €	40% / 60%	0,10 €
5	2 €	50% / 50%	1,60 €	o		o	3,85 €	50% / 50%	0,10 €
6	2 €	60% / 40%	1,60 €	o		o	3,85 €	60% / 40%	0,10 €
7	2 €	70% / 30%	1,60 €	o		o	3,85 €	70% / 30%	0,10 €
8	2 €	80% / 20%	1,60 €	o		o	3,85 €	80% / 20%	0,10 €
9	2 €	90% / 10%	1,60 €	o		o	3,85 €	90% / 10%	0,10 €
10	2 €	100%	1,60 €	o		o	3,85 €	100%	0,10 €

Decision sheet D Seat number: _____

Below, you will find a table. We ask you for ten choices in this table. In each row of this table you have to decide between two alternatives: Option A and Option B. You have to decide for one alternative in each row (**Option A or Option B**).

TABLE (Please choose now for each row <u>either A or B</u>!)

	Option A			Option B	
Row	Payoff today	A	or	B	Payoff in January
1	2,00 €	O		O	2,00 €
2	2,00 €	O		O	2,05 €
3	2,00 €	O		O	2,10 €
4	2,00 €	O		O	2,15 €
5	2,00 €	O		O	2,20 €
6	2,00 €	O		O	2,30 €
7	2,00 €	O		O	2,40 €
8	2,00 €	O		O	2,60 €
9	2,00 €	O		O	2,80 €
10	2,00 €	O		O	3,00 €

Questionnaire E **Seat number: _____**

Year of birth: _____

Sex: ○ female ○ male

Studies

○ currently not studying

○ currently studying

Field of study: _____

Semester: _____

Specific subjects

I took part in lectures in the following subjects:

○ Game Theory

○ Statistics

○ Econometrics

Height:

Height in cm: _____

Instructions – Second experimental session

Dear participant,

Welcome to our experiment. Your participation in this experiment supports our scientific work. At the same time, your actions allow you to earn money.
Scientifically responsible for this experiment are Peter Dürsch, Daniel Römer, and Benjamin Roth (Alfred-Weber-Institute for Economics, Heidelberg University).

Course of action of the experiment

Please turn off your mobile phone, and keep it off during the entire experiment. Do not talk to other participants. If you have any questions, please stay calm and raise a hand. Someone of our experimental staff will answer your question.

Your payoff depends on the choices you make during the experiment.

The experiment consists of two experimental sessions. The first session is took place in November 2012. Today the second session takes place.

Today's session consists of five parts. These five parts are labeled in the instructions as "A", "B", "C", "D", and "E". The instructions at hand explain today's entire experimental session, and are identical for all participants. The experiment starts with part A, then part B, and part C, followed by part D. E is the last part. You can keep the instructions, and read them during the experiment, at any time.

Part A

In part A, you have to make choices for two different boxes („Box 5“ and „Box 6“). Both boxes are located in this room, and each of them contains 30 marbles. Each box contains **10 yellow marbles**. The remaining **20 marbles are either blue, or green**, in an arbitrary proportion.

Please note: Box 5 is the box for which you have already made a decision in the first session but was not chosen for payment. Box 6 is new.

We will hand out decision sheet A. On decision sheet A you have to make two choices for each of the boxes. Each choice determines your payoff and depends on the marble's color that will be drawn from the corresponding box.

You make your choices for **both boxes**. You are paid-off for the choices you made for **one box**. A flip of a coin decides which of the two boxes will be considered for today's session's payoff. Afterwards, two independent draws (the marble is put back into the box after each draw) determine your individual payoff according to your choices you made on the decision sheet. To do so, first of all, one marble will be drawn, its color will be notated, and afterwards, the marble will be put back into the box.

Note: The content of box 5 from the last session stayed unchanged. For this purpose, we will take a picture of the content of the box, together with an identifier for this session, in this room, right before the drawing. This picture will be sent to you via e-mail after the last session (presumably on 25.02.2013) such that you will have the possibility to check that the content of the box has been remained unchanged.

Part B.

Please answer all questions on the questionnaire. For each correct answer we pay €0.25

Part C.

Please answer all questions on the questionnaire. For each correct answer we pay €0.25

Part D.

We will hand out a questionnaire. Please state some general information on this questionnaire.

Part E

We will hand out decision sheet C. On decision sheet C you will find the following table. In this table, we ask you for ten choices. In each row you have two alternatives: Option A and Option B. You have to decide for one alternative in each row (**Option A or Option B**).

Example: In the first row you can decide between two options.

- If you choose **Option A**, you will receive with a probability of 10% a payoff of 2.00€ and with a probability of 90% a payoff of 1.60€.

- If you choose **Option B**, you will receive with a probability of 10% a payoff of 3.85€ and with a probability of 90% a payoff of 0.10€.

(This is just an example table. You do not need to cross anything!)

Option A						Option B			
Row	Payoff	Probability	Payoff	A	or B	Payoff	Probability	Payoff
1	2 €	10% / 90%	1,60 €	O	O	3,85 €	10% / 90%	0,10 €
2	2 €	20% / 80%	1,60 €	O	O	3,85 €	20% / 80%	0,10 €
3	2 €	30% / 70%	1,60 €	O	O	3,85 €	30% / 70%	0,10 €
4	2 €	40% / 60%	1,60 €	O	O	3,85 €	40% / 60%	0,10 €
5	2 €	50% / 50%	1,60 €	O	O	3,85 €	50% / 50%	0,10 €
6	2 €	60% / 40%	1,60 €	O	O	3,85 €	60% / 40%	0,10 €
7	2 €	70% / 30%	1,60 €	O	O	3,85 €	70% / 30%	0,10 €
8	2 €	80% / 20%	1,60 €	O	O	3,85 €	80% / 20%	0,10 €
9	2 €	90% / 10%	1,60 €	O	O	3,85 €	90% / 10%	0,10 €
10	2 €	100%	1,60 €	O	O	3,85 €	100%	0,10 €

Your actual payoff in part C will be determined in the end of this experiment. Which one of the ten rows determines the payoff will be determined by chance (rolling a **ten-sided** dice). For this row, only the option you have chosen by crossing will be of relevance (Option A or Option B). The ten-sided dice will be rolled one further time in order to determine whether the amount highlighted in gray will be paid out, or the amount in the white area.

Example: If the dice indicates a 1 after the first rolling, this means that row 1 is determined. Consider therefore the **first row** in the table. If the dice indicates again a 1 after the second rolling, this means that the amount highlighted in gray (not the white area) will be paid out. Hence, you will receive 2€ if you have crossed Option A, and 3.85€ if you have crossed Option B. If the dice had indicated a number between 2 and 10 after the second rolling, you would have received 1.60€ for Option A and 0.10€ for Option B.

Part E.

We will hand out a questionnaire. Please state some general information on this questionnaire.

Total payment

At the end of today's session, you will receive the sum of your payoffs from part A, B C, D and if so from part E. We also pay you a show-up fee of € 4 for today's session. The payment will be cash and in private. Please remain patient since payment can take some time.

Please wait until we announce your number and then step forward. Please remain calm and do not talk to other participants.

Decision sheet A **Seat number: _____**

BOX 5

Choice 5.1: What do you prefer? (Please mark with a cross)

- ○ You will receive 4€, if the drawn marble is yellow. or
- ○ You will receive 4€, if the drawn marble is blue.

How confident (from not at all confident to very confident) are you about this decision?

not at all confident ○ ○ ○ ○ ○ *very confident*

You will be paid-off accordingly to your decision above. But, hypothetically asked, how much should we pay you such that you change your decision above?
(Please mark with an „X“ the amount in the following scale)

```
|----+----|----+----|----+----|----+----|
0€        1€        2€        3€        4€
```

Choice 5.2: What do you prefer? (Please mark with a cross)

- ○ You will receive 4€, if the drawn marble is yellow or green. or
- ○ You will receive 4€, if the drawn marble is blue or green.

How confident (from not at all confident to very confident) are you about this decision?

not at all confident ○ ○ ○ ○ ○ *very confident*

You will be paid-off accordingly to your decision above. But, hypothetically asked, how much should we pay you such that you change your decision above?
(Please mark with an „X“ the amount in the following scale)

```
|----+----|----+----|----+----|----+----|
0€        1€        2€        3€        4€
```

BOX 6

Choice 6.1: What do you prefer? (Please mark with a cross)

- ○ You will receive 4€, if the drawn marble is yellow. or
- ○ You will receive 4€, if the drawn marble is blue.

How confident (from not at all confident to very confident) are you about this decision?

not at all confident ○ ○ ○ ○ ○ *very confident*

You will be paid-off accordingly to your decision above. But, hypothetically asked, how much should we pay you such that you change your decision above?
(Please mark with an „X“ the amount in the following scale)

```
|----+----|----+----|----+----|----+----|
0€        1€        2€        3€        4€
```

Choice 6.2: What do you prefer? (Please mark with a cross)

- ○ You will receive 4€, if the drawn marble is yellow or green. or
- ○ You will receive 4€, if the drawn marble is blue or green.

How confident (from not at all confident to very confident) are you about this decision?

not at all confident ○ ○ ○ ○ ○ *very confident*

You will be paid-off accordingly to your decision above. But, hypothetically asked, how much should we pay you such that you change your decision above?
(Please mark with an „X“ the amount in the following scale)

```
|----+----|----+----|----+----|----+----|
0€        1€        2€        3€        4€
```

Questionnaire B **Seat number: _____**

In this part you will receive 0.25€ for each right answer.

Assume that a participant has made the following choices for a bag:

Choice 1: What do you prefer? (Please mark with a cross)	
X	You will receive 2€, if the drawn marble is yellow. or
○	You will receive 2€, if the drawn marble is blue.
Choice 2: What do you prefer? (Please mark with a cross)	
X	You will receive 2€, if the drawn marble is yellow or green. or
○	You will receive 2€, if the drawn marble is blue or green.

Assume that in the corresponding bag are exactly **10 yellow marbles, 5 blue marbles, and 15 green marbles.**

Please state how many marbles have to be in the bag such that the participant's payoff is 2€.

For the draw for Choice 1:

In the bag are _____ marbles such that the payoff is 2€.
In the bag are _____ marbles such that the payoff is not 2€.

For the draw for Choice 2:

In the bag are _____ marbles such that the payoff is 2€.
In the bag are _____ marbles such that the payoff is not 2€.

Questionnaire C Seat number: _____

The following questions refer to the first experimental session in November. During the first session you have made decisions in two boxes from which on is paid out today. The other was not chosen for payment. For this box you have made a decision today (box 5).

The following questionnaire will evaluate whether you are able to recall your decisions on these two boxes.

Every correct answer pays €0.25.

A. The box that was chosen for payment today in the first session.

Choice A.1: What do you prefer? (Please mark with a cross)

- ○ You will receive 4€, if the drawn marble is yellow. or
- ○ You will receive 4€, if the drawn marble is blue.

Choice A.2: What do you prefer? (Please mark with a cross)

- ○ You will receive 4€, if the drawn marble is yellow or green. or
- ○ You will receive 4€, if the drawn marble is blue or green.

Hoe confident are you with your recall in the above decisions?

How confident (from not at all confident to very confident) are you about this decision?

not at all confident ○ ○ ○ ○ ○ *very confident*

B. The box that was not chosen for payment. (Box 5 of today's session)

Choice B.1: What do you prefer? (Please mark with a cross)

- ○ You will receive 4€, if the drawn marble is yellow. or
- ○ You will receive 4€, if the drawn marble is blue.

Choice B.2: What do you prefer? (Please mark with a cross)

- ○ You will receive 4€, if the drawn marble is yellow or green. or
- ○ You will receive 4€, if the drawn marble is blue or green.

Hoe confident are you with your recall in the above decisions?

How confident (from not at all confident to very confident) are you about this decision?

not at all confident ○ ○ ○ ○ ○ *very confident*

Questionnaire D **Seat number: _____**

Additional Questions on the Boxes

Remember: All boxes contain 30 marbles. 10 are yellow; the remaining 20 are either blue or green, in an arbitrary mix.

1. On box 5 and 6, have you made the same decisions?

○ Yes ○ No

2. Why do have decided differently?

_____

_____

_____

3. Do you think box 5 and 6 are filled the same?

○ Yes ○ No

4. How do you think is the share of blue and green marbles in box 5?

○ There are more blue than green marbles in box 5.
○ There are more green than blue marbles in box 5.
○ There are equally many blue and green marbles in box 5.

5. How do you think is the share of blue and green marbles in box 6?

○ There are more blue than green marbles in box 6.
○ There are more green than blue marbles in box 6.
○ There are equally many blue and green marbles in box 6.

6. You neither know the content of box 5 nor of box 6. Have treated the boxes differently?

○ Yes ○ No

Explain why:

_____

_____

_____

7. Remember: In the first session you had to decide for boxes that were paid out in the future but also for boxes which were paid out immediately. For none of the boxes you have known the exact content. Have you treated the boxes differently?

○ Yes ○ No

Explain why:

_____

_____

_____

8. Remember: Today and in the first session you decided on boxes that were paid out in the same session. For none of the boxes you have known the exact content. Have you treated the boxes differently?

○ Yes ○ No

Explain why:

_____

_____

_____

Decision sheet E Seat number: _____

Below, you will find a table. We ask you for ten choices in this table. In each row of this table you have to decide between two alternatives: Option A and Option B. You have to decide for one alternative in each row (**Option A or Option B**).

TABLE (Please choose now for each row <u>either A or B</u>!)

Option A						Option B			
Row	Payoff	Probability	Payoff	A	or	B	Payoff	Probability	Payoff
1	2 €	10% | 90%	1,60 €	O		O	3,85 €	10% | 90%	0,10 €
2	2 €	20% | 80%	1,60 €	O		O	3,85 €	20% | 80%	0,10 €
3	2 €	30% | 70%	1,60 €	O		O	3,85 €	30% | 70%	0,10 €
4	2 €	40% | 60%	1,60 €	O		O	3,85 €	40% | 60%	0,10 €
5	2 €	50% | 50%	1,60 €	O		O	3,85 €	50% | 50%	0,10 €
6	2 €	60% | 40%	1,60 €	O		O	3,85 €	60% | 40%	0,10 €
7	2 €	70% | 30%	1,60 €	O		O	3,85 €	70% | 30%	0,10 €
8	2 €	80% | 20%	1,60 €	O		O	3,85 €	80% | 20%	0,10 €
9	2 €	90% | 10%	1,60 €	O		O	3,85 €	90% | 10%	0,10 €
10	2 €	100%	1,60 €	O		O	3,85 €	100%	0,10 €

Instructions

Dear participant,

Welcome to our experiment. Your participation in this experiment supports our scientific work. At the same time, your actions allow you to earn money.
Scientifically responsible for this experiment are Peter Dürsch, Daniel Römer, and Benjamin Roth (Alfred-Weber-Institute for Economics, Heidelberg University).

Course of action of the experiment

Please turn off your mobile phone, and keep it off during the entire experiment. Do not talk to other participants. If you have any questions, please stay calm and raise a hand. Someone of our experimental staff will answer your question.

Your payoff depends on the choices you make during the experiment.

Today's session consists of five parts. These five parts are labeled in the instructions as "A", "B", "C", "D", and "E". The instructions at hand explain today's entire experimental session, and are identical for all participants. The experiment starts with part A, then part B, and part C, followed by part D. E is the last part. You can keep the instructions, and read them during the experiment, at any time.

In the following, we start with part A.

Part A

In part A, you need to make choices for two different linen bags („Bag 1“ and „Bag 2“). Both bags are located in this room, and each of them contains 30 marbles. Each bag contains **10 yellow marbles**. The remaining **20 marbles are either blue, or green**, in an arbitrary proportion.

We will hand out decision sheet A. On decision sheet A you have to make two choices for each of the bags. Each choice determines your payoff and depends on the marble’s color that will be drawn from the corresponding bag.

After recollecting the decision sheets, a flip of a coin decides which of the two bags will be considered for the payoff. In the end of the experiment, two independent draws from this bag (the marble is put back into the bag after each draw) determine your individual payoff according to your choices you made on decision sheet A. The other bag will be used in part B.

Part B

Again, you have to make your choices for two linen bags (“Bag 3” and “Bag 4”). **Bag 3 is the same bag from part A which was not considered for the determination of the payoffs**. Bag 4 is a new bag. Both bags are located in this room, and each of them contains 30 marbles. Each box contains **10 yellow marbles**. The remaining **20 marbles are either blue, or green**, in an arbitrary proportion.

We will hand out decision sheet B. On decision sheet B you have to make two choices for each of the bags. Each choice determines your payoff and depends on the marble’s color that will be drawn from the corresponding bag.

After recollecting the decision sheets, a flip of a coin decides which of the two bags will be considered for the payoff. In the end of the experiment, two independent draws from this bag (the marble is put back into the bag after each draw) determine your individual payoff according to your choices you made on decision sheet B. The other bag will not be used.

Part C

We will hand out decision sheet C. On decision sheet C you will find two times the following table. In each one of the tables, you have two alternatives: Option A and Option B. You have to decide for one alternative in each row (**Option A or Option B**).

Example: In the first row you can decide between two options.

- If you choose **Option A**, you will receive with a probability of 10% a payoff of 2.00€ and with a probability of 90% a payoff of 1.60€.

- If you choose **Option B**, you will receive with a probability of 10% a payoff of 3.85€ and with a probability of 90% a payoff of 0.10€.

(This is just an example table. You do not need to cross anything!)

Option A						Option B			
Row	Payoff	Probability	Payoff	A	or	B	Payoff	Probability	Payoff
1	2 €	10% / 90%	1,60 €	O		O	3,85 €	10% / 90%	0,10 €
2	2 €	20% / 80%	1,60 €	O		O	3,85 €	20% / 80%	0,10 €
3	2 €	30% / 70%	1,60 €	O		O	3,85 €	30% / 70%	0,10 €
4	2 €	40% / 60%	1,60 €	O		O	3,85 €	40% / 60%	0,10 €
5	2 €	50% / 50%	1,60 €	O		O	3,85 €	50% / 50%	0,10 €
6	2 €	60% / 40%	1,60 €	O		O	3,85 €	60% / 40%	0,10 €
7	2 €	70% / 30%	1,60 €	O		O	3,85 €	70% / 30%	0,10 €
8	2 €	80% / 20%	1,60 €	O		O	3,85 €	80% / 20%	0,10 €
9	2 €	90% / 10%	1,60 €	O		O	3,85 €	90% / 10%	0,10 €
10	2 €	100%	1,60 €	O		O	3,85 €	100%	0,10 €

Your actual payoff in part C will be determined in the end of this experiment. The payoff will be either for **Table 1 or Table 2**. In the end of this experiment, a flip of a coin decides which table will be considered for the payoff. Which one of the ten rows of the considered table determines the payoff will be determined by chance (rolling a **ten-sided** dice). For this row, only the option you have chosen by crossing will be of relevance (Option A or Option B). The ten-sided dice will be rolled one further time in order to determine whether the amount highlighted in gray will be paid out, or the amount in the white area.

Example: If the dice indicates a 1 after the first rolling, this means that row 1 is determined. Consider therefore the **first row** in the table. If the dice indicates again a 1 after the second rolling, this means that the amount highlighted in gray (not the white area) will be paid out. Hence, you will receive 2€ if you have crossed Option A, and 3.85€ if you have crossed Option B. If the dice had indicated a number between 2 and 10 after the second rolling, you would have received 1.60€ for Option A and 0.10€ for Option B.

Part D

We will hand out a questionnaire. Please answer the questions on this questionnaire. For each right answer you receive 0.25€.

Part E

We will hand out a questionnaire. Please state some general information on this questionnaire.

Total payment

In the end of the experiment, you will receive the sum of your payoffs from part A, B, C, and D. You will receive your payoff in cash and in private. Please remain patient since distributing the payoffs can take some time.

Please wait until we announce your number and then step forward. Please remain calm and do not talk to other participants.

After the experiment, each participant has the opportunity to examine the bags.

Decision sheet A **Seat number: _____**

BAG 1

Choice 1.1: What do you prefer? (Please mark with a cross)

- ○ You will receive 4€, if the drawn marble is yellow. or
- ○ You will receive 4€, if the drawn marble is blue.

How confident (from not at all confident to very confident) are you about this decision?

not at all confident ○ ○ ○ ○ ○ *very confident*

You will be paid-off accordingly to your decision above. But, hypothetically asked, how much should we pay you such that you change your decision above?
(Please mark with an „X“ the amount in the following scale)

```
|----+----|----+----|----+----|----+----|
0€        1€        2€        3€        4€
```

Choice 1.2: What do you prefer? (Please mark with a cross)

- ○ You will receive 4€, if the drawn marble is yellow or green. or
- ○ You will receive 4€, if the drawn marble is blue or green.

How confident (from not at all confident to very confident) are you about this decision?

not at all confident ○ ○ ○ ○ ○ *very confident*

You will be paid-off accordingly to your decision above. But, hypothetically asked, how much should we pay you such that you change your decision above?
(Please mark with an „X“ the amount in the following scale)

```
|----+----|----+----|----+----|----+----|
0€        1€        2€        3€        4€
```

BAG 2

Choice 2.1: What do you prefer? (Please mark with a cross)

- ○ You will receive 4€, if the drawn marble is yellow. or
- ○ You will receive 4€, if the drawn marble is blue.

How confident (from not at all confident to very confident) are you about this decision?

not at all confident ○ ○ ○ ○ ○ *very confident*

You will be paid-off accordingly to your decision above. But, hypothetically asked, how much should we pay you such that you change your decision above?
(Please mark with an „X“ the amount in the following scale)

```
|----+----|----+----|----+----|----+----|
0€        1€        2€        3€        4€
```

Choice 2.2: What do you prefer? (Please mark with a cross)

- ○ You will receive 4€, if the drawn marble is yellow or green. or
- ○ You will receive 4€, if the drawn marble is blue or green.

How confident (from not at all confident to very confident) are you about this decision?

not at all confident ○ ○ ○ ○ ○ *very confident*

You will be paid-off accordingly to your decision above. But, hypothetically asked, how much should we pay you such that you change your decision above?
(Please mark with an „X“ the amount in the following scale)

```
|----+----|----+----|----+----|----+----|
0€        1€        2€        3€        4€
```

Decision sheet B **Seat number: _____**

BAG 3

Choice 3.1: What do you prefer? (Please mark with a cross)

- ○ You will receive 4€, if the drawn marble is yellow. or
- ○ You will receive 4€, if the drawn marble is blue.

How confident (from not at all confident to very confident) are you about this decision?

not at all confident ○ ○ ○ ○ ○ *very confident*

You will be paid-off accordingly to your decision above. But, hypothetically asked, how much should we pay you such that you change your decision above?
(Please mark with an „X“ the amount in the following scale)

|----+----|----+----|----+----|----+----|
0€ 1€ 2€ 3€ 4€

Choice 3.2: What do you prefer? (Please mark with a cross)

- ○ You will receive 4€, if the drawn marble is yellow or green. or
- ○ You will receive 4€, if the drawn marble is blue or green.

How confident (from not at all confident to very confident) are you about this decision?

not at all confident ○ ○ ○ ○ ○ *very confident*

You will be paid-off accordingly to your decision above. But, hypothetically asked, how much should we pay you such that you change your decision above?
(Please mark with an „X“ the amount in the following scale)

|----+----|----+----|----+----|----+----|
0€ 1€ 2€ 3€ 4€

BAG 4

Choice 4.1: What do you prefer? (Please mark with a cross)

- ○ You will receive 4€, if the drawn marble is yellow. or
- ○ You will receive 4€, if the drawn marble is blue.

How confident (from not at all confident to very confident) are you about this decision?

not at all confident ○ ○ ○ ○ ○ *very confident*

You will be paid-off accordingly to your decision above. But, hypothetically asked, how much should we pay you such that you change your decision above?
(Please mark with an „X“ the amount in the following scale)

```
|----+----|----+----|----+----|----+----|
0€        1€        2€        3€        4€
```

Choice 4.2: What do you prefer? (Please mark with a cross)

- ○ You will receive 4€, if the drawn marble is yellow or green. or
- ○ You will receive 4€, if the drawn marble is blue or green.

How confident (from not at all confident to very confident) are you about this decision?

not at all confident ○ ○ ○ ○ ○ *very confident*

You will be paid-off accordingly to your decision above. But, hypothetically asked, how much should we pay you such that you change your decision above?
(Please mark with an „X“ the amount in the following scale)

```
|----+----|----+----|----+----|----+----|
0€        1€        2€        3€        4€
```

Questionnaire D **Seat number: _____**

Additional assessment of the bag

In this part you will receive 0.25€ for each right answer.

Assume that a participant has made the following choices for a bag:

Choice 1: What do you prefer? (Please mark with a cross)

X You will receive 4€, if the drawn marble is yellow. or
O You will receive 4€, if the drawn marble is blue.

Choice 2: What do you prefer? (Please mark with a cross)

X You will receive 4€, if the drawn marble is yellow or green. or
O You will receive 4€, if the drawn marble is blue or green.

Assume that in the corresponding bag are exactly **10 yellow marbles, 5 blue marbles, and 15 green marbles.**

Please state how many marbles have to be in the bag such that the participant's payoff is 4€.

For the draw for Choice 1:

In the bag are _____ marbles such that the payoff is 4€.
In the bag are _____ marbles such that the payoff is not 4€.

For the draw for Choice 2:

In the bag are _____ marbles such that the payoff is 4€.
In the bag are _____ marbles such that the payoff is not 4€.

Decision sheet C **Seat number: _____**

Below, you will find Table 1 and Table 2. We ask you for ten choices in each table. In each row of this table you have to decide between two alternatives: Option A and Option B. You have to decide for one alternative in each row (**Option A or Option B**).

TABLE 1(Please choose now for each row either A or B!)

Option A						Option B			
Row	Payoff	Probability	Payoff	A	or B	Payoff	Probability	Payoff
1	2 €	10% / 90%	1,60 €	O	O	3,85 €	10% / 90%	0,10 €
2	2 €	20% / 80%	1,60 €	O	O	3,85 €	20% / 80%	0,10 €
3	2 €	30% / 70%	1,60 €	O	O	3,85 €	30% / 70%	0,10 €
4	2 €	40% / 60%	1,60 €	O	O	3,85 €	40% / 60%	0,10 €
5	2 €	50% / 50%	1,60 €	O	O	3,85 €	50% / 50%	0,10 €
6	2 €	60% / 40%	1,60 €	O	O	3,85 €	60% / 40%	0,10 €
7	2 €	70% / 30%	1,60 €	O	O	3,85 €	70% / 30%	0,10 €
8	2 €	80% / 20%	1,60 €	O	O	3,85 €	80% / 20%	0,10 €
9	2 €	90% / 10%	1,60 €	O	O	3,85 €	90% / 10%	0,10 €
10	2 €	100%	1,60 €	O	O	3,85 €	100%	0,10 €

TABLE 2(Please choose now for each row either A or B!)

Option A						Option B			
Row	Payoff	Probability	Payoff	A	or B	Payoff	Probability	Payoff
1	2 €	10% / 90%	1,60 €	O	O	3,85 €	10% / 90%	0,10 €
2	2 €	20% / 80%	1,60 €	O	O	3,85 €	20% / 80%	0,10 €
3	2 €	30% / 70%	1,60 €	O	O	3,85 €	30% / 70%	0,10 €
4	2 €	40% / 60%	1,60 €	O	O	3,85 €	40% / 60%	0,10 €
5	2 €	50% / 50%	1,60 €	O	O	3,85 €	50% / 50%	0,10 €
6	2 €	60% / 40%	1,60 €	O	O	3,85 €	60% / 40%	0,10 €
7	2 €	70% / 30%	1,60 €	O	O	3,85 €	70% / 30%	0,10 €
8	2 €	80% / 20%	1,60 €	O	O	3,85 €	80% / 20%	0,10 €
9	2 €	90% / 10%	1,60 €	O	O	3,85 €	90% / 10%	0,10 €
10	2 €	100%	1,60 €	O	O	3,85 €	100%	0,10 €

Questionnaire E **Seat number: _____**

Year of birth: _____

Sex: ○ female ○ male

Studies

○ currently not studying

○ currently studying

Field of study: _____

Semester: _____

Specific subjects

I took part in lectures in the following subjects:

○ Game Theory

○ Statistics

○ Econometrics

Height:

Height in cm: _____