Clumped or Piecewise? - Evidence on Preferences for Information*

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Abstract

In this paper we examine individuals’ attitudes towards the timing of information. We test a theoretical prediction that people prefer to get information “clumped together” rather than piecewise. We conduct a controlled lab experiment where subjects participate in a lottery and can choose between different resolutions of uncertainty (clumped or piecewise). In two treatments we analyze which kind of resolution is preferred. Two additional treatments allow us to get a quantitative measure of subjects’ preferences over different information structures. Our data does not support the prediction that piecewise information is utility-decreasing.

JEL classifications: C91, D83

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1 Introduction

The selection and processing of information is a key element in virtually all areas of economic decision-making. Individuals facing economic choices, e.g., investing in education, choosing an optimal health insurance plan, buying a house or deciding how much to save for the future, need to choose sources of potentially helpful information and process this information to be able to make an informed decision. Likewise, economic choices affect the kind, structure and timing of information decision-makers will receive. A decision to participate in a risky enterprise implies, that the decision-maker will receive news about the success or failure of the enterprise in the future. Therefore, attitudes or preferences towards information structures can be an important factor influencing choices and behavior.

Furthermore, the structuring of information can serve as a policy or managerial instrument. Policy-makers, when providing information on, e.g, the current state of political reform or consequences from a natural disaster, need to take the impact of the timing of information provision into account. Likewise, employers providing feedback to their employees can structure the feedback to their own advantage. The traditional economic approach to decision-making, however, neglects that the information an individual receives might have direct utility consequences.

Recent theories, e.g., K˝ oszegi and Rabin (2009), have tried to incorporate attitudes towards information into models of decision-making.\(^1\) A key prediction of K˝ oszegi and Rabin (2009) is that individuals are averse to piecewise information. Thus, they should prefer to receive information in one piece rather than piece by piece.\(^2\) Their model provides explanations for various phenomena such as loss aversion over wealth, overconsumption or precautionary savings. Empirically, however, little is known about preferences for clumped or piecewise information. In this paper, we use a controlled lab experiment to test the implication that people have a preference for information in one piece. As a whole, we find no support for this prediction.

\(^1\)Caplin and Leahy (2001) incorporate anticipatory emotions towards uncertainty resolution into an expected utility framework and analyze consequences, for example on portfolio choice. In another paper, Caplin and Leahy (2004), use an expected utility framework with anticipatory emotions to analyze how much information an expert should transmit to a poorly informed person.

Kőszegi and Rabin (2009) develop a dynamic model of reference-dependent preferences. A central assumption of the model is that utility depends on anticipated changes in beliefs about current and future consumption. Beliefs are rational and people are loss averse with regard to changes in their beliefs. Thus bad news decrease utility more than good news increase it. Furthermore it is assumed that people care less about changes in beliefs, the further away the time of belief change lies from the actual point of consumption. In other words, a person is assumed to be less sensitive to changes in beliefs, the more time lies in between news and the time of consumption. The model gives rise to informational preferences, i.e., preferences towards the timing of non-instrumental information. Loss aversion in belief changes leads to a preference for clumped information. Since bad news decrease utility more than good news increase it, decision-makers are averse to fluctuations in their beliefs. Consequently piecewise information is utility-decreasing.

In this paper we test the prediction that piecewise information is utility-decreasing. In the experiment, subjects can choose how they want to be informed about the outcome of a lottery. They have two options: Either they learn the outcome of the lottery in one piece, or they are sequentially informed about it. Information in this setting is non-instrumental since the lottery is an exogenous event which cannot be influenced by the subjects. Subjects’ choices allow us to analyze which information structure is preferred. Two additional treatments allow us to specify a willingness to pay, i.e., a quantitative measure. In these treatments, subjects cannot choose between clumped or piecewise information but are exposed to either one of the two. A subject’s choice in these treatments is to state a willingness to pay for participating in the lottery. Comparison of the average willingness to pay between the two treatments provides a quantitative measure for preferences over different information structures.

Summarizing our results, we find no evidence that subjects are averse to piecewise information. When subjects can directly choose between the two information conditions, only slightly more than 50 percent prefer to receive information in one piece. This is only compatible with a preference for clumped information if one is willing to allow for very high error rates. The average willingness to pay for the lottery is more than 2 Euro higher when subjects are sequentially informed about the outcome of the lottery. We can reject the null hypothesis that subjects’ willingness to pay for the lottery is higher in the piecewise condition.

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3The idea that reference points are determined by rational expectations has been developed in Kőszeği and Rabin (2006, 2007). Similar approaches can be found in the disappointment aversion models of Bell (1985), Loomes and Sugden (1986), and Gul (1991). Several recent empirical studies provide support for expectation-based reference points. See for example Abeler et al. (2011), Crawford and Meng (2011), Gill and Prowse (forthcoming) and Ericson and Fuster (forthcoming).
clumped information condition.

Our study is the first to provide a direct experimental test of whether individuals are averse to piecewise information. Moreover, our findings are important, as the assumptions that lead to the prediction we test have several implications for behavior. K˝oszegi and Rabin (2009) show that loss aversion in belief changes provides a foundation for loss aversion over total wealth as is assumed for example in prospect theory (Kahneman and Tversky (1979)). The intuition is simple. Wealth gains and wealth losses are news about current and future consumption. Consequently, loss aversion over consumption news induces gain-loss utility over wealth. In a two-period application, K˝oszegi and Rabin (2009) show how their model can generate a novel type of overconsumption. For example, in contexts where wealth is deterministic, people might deviate from ex-ante optimal consumption plans and overconsume relative to the plan, because good news about increased consumption now might outweigh bad news about future consumption due to decreasing sensitivity towards belief changes. Consequently the ex-ante optimal plan is not credible. Actual consumption in period 1 will be above the ex-ante optimal level to account for the lack of credibility of the ex-ante optimal plan. Loss aversion in belief changes also generates a new type of precautionary savings motive. In their two-period application, K˝oszegi and Rabin (2009) analyze how decision-makers respond to future wealth uncertainty (resolved in period 2). They show that decision makers respond to higher uncertainty by reducing consumption in period 1. Intuitively, future wealth uncertainty exposes decision makers to (potentially) negative belief shocks which are felt heavily due to loss aversion, but can be dampened by higher savings in period 1.

In addition, our results contribute to the experimental literature on myopic loss aversion (see Benartzi and Thaler (1995) and Gneezy and Potters (1997)). Gneezy and Potters (1997) let subjects repeatedly go through risky investment choices and vary the frequency with which they received feedback regarding the outcome and with which they could make their choices. They find that investments in the risky asset are higher when the frequency of feedback and choices is low. Haigh and List (2005) replicate this result with professional traders. One question that arises is whether these results are due to the frequency of choices or the frequency of feedback. Our results suggest that myopic loss aversion is most likely not driven by a direct preference for a clumped timing structure in the resolution of risk. Note that Bellemare et al. (2005) provide evidence in the opposite direction. They conduct an experiment similar to Gneezy and Potters (1997), with the additional twist that it allows to disentangle effects of frequency of feedback from
frequency of choices. They find that manipulating feedback is sufficient to generate myopic loss aversion. This finding is compatible with a preference for clumped information. Langer and Weber (2008), however, document the opposite. They identify frequency of choices as the relevant factor that drives myopic loss aversion.\footnote{Fellner and Sutter (2009) find that both factors (frequency of feedback and frequency of choices) are important for myopic loss aversion.}

There exists a small empirical literature on informational preferences, but no incentivized study addresses the question if subjects prefer clumped information over piecewise information. Chew and Ho (1994) and Ahlbrecht and Weber (1996) are early examples. Both use questionnaire formats to examine preferences for different resolutions of uncertainty. More recently several incentivized experiments were conducted. Eliaz and Schotter (2007) find that subjects are willing to pay for earlier reception of non-instrumental information. Eliaz and Schotter (2010) show evidence for a demand for non-instrumental information about the likelihood that a risky choice was optimal. Van Winden et al. (2011) examine how investment decisions are affected by a delay in the resolution of risk. They find a significant impact of the delay of non-instrumental information and show that emotions play a central role in explaining their results. Kocher et al. (2009) find that subjects holding a lottery ticket have a preference for delayed resolution of risk and that this preference is driven by positive anticipatory emotions.

The remainder of the paper is organized as follows. The next section describes the experimental design and states hypotheses. Section 3 shows results and section 4 concludes.

## 2 Experimental Design and Hypotheses

An environment where preferences towards the timing of information can be studied needs the following features:

1. Non-instrumentality of information: information needs to be on a predetermined event that can not be affected by subjects. For this kind of information, “standard” expected utility theory predicts indifference towards the timing of information.

2. Meaningful time delays: Kőszegi and Rabin (2009) characterize differences in the timing of information by signals arriving in different time periods, leaving open the length of a time period. In principle time periods could be seconds, minutes, days or months. When testing their predictions we need to create an environment
where the variation in the timing structure involves different time periods in the sense of Kőszegi and Rabin (2009). In particular very small variations might be problematic. Say for example that we would vary the timing structure by having signals arrive every 10 seconds. Then it could well be that subjects integrate signals that follow each other that closely into one signal, thereby perceiving piecewise as clumped information. Note however that while leaving the length of a time period open, Kőszegi and Rabin (2009) also do not exclude any specifications.

3. Absorption of information: to implement different timing structures, we need to make sure that subjects absorb information at the moment they receive it. If subjects have the possibility to delay absorption, for example by not reading information provided on a computer screen or a sheet of paper, we loose control over the timing structure.

2.1 Experimental Design

We designed an experiment that captures all features discussed above. We studied four treatments in total. In treatments 1 and 2, subjects were endowed with a lottery ticket. A central characteristic of the lottery was that it contained a natural sequence of three signals about the outcome of the lottery. Each of the three signals served as a piece of information. Since the lottery outcome could not be affected by subjects, information was non-instrumental. Subjects’ choices were about how they wanted to be informed about the outcome of the lottery. We offered two possibilities: information in one piece or sequential information. Given our goal to make variations in the resolution of uncertainty meaningful we decided to run the experiment over days. The information conditions and the different steps of the experiment are illustrated in Figure 1. If subjects preferred to receive information clumped, the three signals were collapsed into one. Subjects were informed in one piece about the final outcome of the lottery on day 2 of the experiment. If subjects chose to receive information piecewise, they were sequentially provided with the three pieces of information. They learned the first piece on the second day of the experiment. One day after they received the second signal. On day 4 they learned the third and final piece of information regarding the lottery outcome.\(^5\) In order to make

\(^5\)Note that in the clumped condition signals are collapsed into 1 signal that is received at day 2. Thus when comparing the clumped and the piecewise condition, no signals were delayed through clumping. This is important, because in Kőszegi and Rabin (2009) people only strictly prefer clumped to piecewise information if the clumped condition does not involve any delay of signals, see section 2.3 and Appendix A.
sure that subjects absorbed information by the time we revealed it, we informed them via phone calls. Via telephone we achieved full control on the timing of resolution of uncertainty about the lottery outcome.6

The only difference between treatments 1 and 2 was the lottery. In treatment 1, part of the lottery was a starting endowment of 30 Euro (one Euro was worth 1.45 US-Dollar at the time). A fair dice was thrown three times and the numbers thrown were added up. If the total sum after three throws was larger than or equal to 13, subjects won 50 Euro which were added to their starting endowment of 30 Euro. In case the total sum was smaller than 13, subjects lost 15 Euro which were deducted from their starting capital. The lottery has an expected value of about 32 Euro and a standard deviation of 28.5. Each of the three dice throws represented a piece of information, allowing subjects to update their beliefs regarding the outcome of the lottery.

In treatment 2, we changed the payoff structure of the lottery. In Kőszegi and Rabin (2009), people are loss averse with respect to anticipated belief changes. We suspected that anticipation effects might be more pronounced the more meaningful the outcome is to subjects. While in treatment 1 stakes and the payoff difference between winning and losing were already high, we decided to use a lottery in treatment 2 which has an almost 10-times higher payoff difference. Subjects could either gain 500 Euro or zero.7 The lottery worked as follows. In three rounds three dice were thrown simultaneously. Subjects won if in at least one round, all three dice showed a six. The lottery has an expected value of about 7 Euro, and a standard deviation of roughly 58.7. As in treatment 1 each of the three rounds of dice rolls represented a piece of information.

Subjects’ choices between clumped or piecewise information in treatments 1 and 2 allow us to qualitatively examine on an individual level which information structure is preferred. Treatments 3 and 4 allow us to specify a willingness to pay, i.e., a quantitative measure.8 In these treatments, subjects could not choose between the two information conditions. Instead they found themselves in one of the two conditions and were asked to state their willingness to pay to participate in the lottery. The information conditions were identical to treatments 1 and 2. Subjects in treatment 3 received information clumped, subjects in treatment 4 received information piecewise. The lottery was the same as in treatment 1.

6In section 3.2 we will present the exact procedures of the experiment in more detail.
7In addition, in treatment 2 subjects received a show-up fee of 15 Euro.
8Note that treatments 3 and 4 were conducted before treatments 1 and 2. While we do not think that this changes the interpretation or validity of our results in any way, we report this here for the sake of completeness and to avoid any misunderstandings.
The only decision subjects had to make was to choose their willingness to pay for the lottery. We used a multiple price list format to elicit certainty equivalents.\(^9\) In particular, subjects had to make 25 choices between the lottery and a certain amount which was increased from 13 Euro to 37 Euro in increments of 1 Euro. One of the 25 choices was afterwards randomly selected and implemented. If subjects behaved consistently, they (at maximum) switched once between the lottery and the fixed payment. This switching point was used as subjects’ willingness to pay for the lottery. Comparison of the average willingness to pay for the lottery between the treatments 3 and 4 allows us to analyze if and to what degree subjects preferred clumped over piecewise information.

### 2.2 Procedural Details

In all four treatments the experiment went over 5 days, starting on a Monday and ending on Friday of the same week. On Monday subjects met in the experimental lab. They were welcomed and assigned into cabins. Then instructions were passed and read aloud.\(^{10}\) Subjects were instructed in detail about the lottery and the information conditions. In treatments 1 and 2, subjects were informed about both information conditions, in treatments 3 and 4 they were only informed about the information condition of the respective treatment. Then subjects had to make their choice. In treatments 1 and 2 they decided which information condition they preferred. In treatments 3 and 4 they stated their

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\(^9\)See Holt and Laury (2002) for the multiple price list format.

\(^{10}\)Instructions are provided in the Appendix.
willingness to pay for the lottery.

In all treatments we also elicited a measure of loss aversion, following the procedure of Fehr and Goette (2007). Subjects faced two lottery choices. In choice 1 they had to decide whether they want to participate in a lottery where they could win 3 Euro with probability \( \frac{1}{2} \) or loose 2 Euro with probability \( \frac{1}{2} \). In choice 2 they had to decide if they want to participate in a lottery that consisted of four independent repetitions of the lottery in choice 1. Subjects were told that in the end of the experiment one of the two choices was randomly selected and implemented. In treatments 3 and 4 we also elicited a risk measure. Subjects faced 25 choices between a lottery and a fixed payment. The lottery was the same across choices and paid zero or 3 Euro, each with probability 0.5. The fixed amount was increased in 10 Cent increments, starting from 30 Cent and going up to 270 Cent. Again, one choice was randomly picked and implemented (see Dohmen et al. (2011)).

Note that our central measures of interest (choice between clumped and piecewise information in treatments 1 and 2 and willingness to pay for the lottery in treatments 3 and 4) were all elicited on the first day of the experiment, i.e., on Monday. When subjects left the laboratory, they received a letter which reminded them of their duties for the next days, i.e., when to call the experimenter and when to pick up the money. After all subjects had left the lab on Monday, the experimenter conducted the dice rolls. From Tuesday to Thursday subjects had to call the experimenter once a day.\(^1\) Subjects were told that failing to call would lead to the loss of all their earnings from the experiment.\(^2\) During the phone calls, subjects received information about the outcome of the lottery. In the clumped information condition, subjects were informed on Tuesday whether they won in the lottery or not and which numbers were thrown for them. In the piecewise condition, subjects received one piece of information each day. Thus they usually did not know before Thursday whether they won in the lottery or not. Note that in both conditions subjects had to call once a day from Tuesday to Thursday and that the duration of the phone calls always was approximately one minute. This was made clear to subjects in the instructions. On Friday subjects had to come to the experimenter’s office to receive their earnings from the experiment.

Note that information in this setting is non-instrumental in the sense that the lottery

\(^1\)Subjects could call from 9am to 12pm and from 2pm to 5:30pm. Alternatively they could show up personally in the experimenter’s office which only one subject chose to do.

\(^2\)In treatments 3 and 4, some subjects did not participate in the lottery but received a fixed payment, depending on the outcome of the price list format. Nevertheless these subjects still had to call from Tuesday to Thursday and this was made clear in the instructions.
is an exogenous event which cannot be influenced by the subjects. One might however argue that information has at least some instrumental value as it may allow subjects to improve their decision on whether to stop participating in the experiment or not, i.e., to stop calling or not to pick up their money, depending on their chances of winning the lottery. If this were the case, subjects should have preferred the clumped condition over the piecewise condition, because it provided them with all the information on Tuesday, allowing them to decide on Tuesday whether the revenues from the experiment outweigh the cost of calling and picking up the money. We argue that the minimum payoff from the experiment (15 Euro) is big enough for subjects to continue with the experiment, even if they know they lost in the lottery. This is supported by the low number of subjects who failed to call or to collect their revenues from the experiment and by the fact that these numbers do not differ between treatments.\textsuperscript{13} Furthermore, in case this argument were valid, it would only bias our results in favor of Kőszegi and Rabin’s model.\textsuperscript{14}

All experiments were conducted using paper and pencil. A total of 104 subjects participated in the experiment, 24 in treatments 1 and 2 respectively, 30 in treatment 3 and 26 in treatment 4. We ran 2 sessions per treatment. Subjects were students from different fields.

2.3 Hypotheses

Here we intuitively derive the predictions of Kőszegi and Rabin (2009). In Appendix A we formally derive the proposition by Kőszegi and Rabin (2009) that individuals prefer information in one piece, and derive predictions for our treatments.

A central assumption in Kőszegi and Rabin (2009) is that utility depends on anticipated changes in beliefs about current and future consumption. Beliefs are derived from rational expectations and people are loss averse with regard to changes in their beliefs. Loss aversion in belief changes implies an aversion towards gradual resolution of uncertainty. Piecewise information exposes people to fluctuations in their beliefs. Since bad news decrease utility more than good news increase it, these expected fluctuations in beliefs do not cancel in utility terms. Consequently people seek to avoid piecewise information.

\textsuperscript{13}In treatment 1, one subject failed to collect its revenues. In treatment 3 one subject failed to call, in treatment 4, 2 subjects failed to call.

\textsuperscript{14}One might also argue that information in our setting might be instrumental in the sense that early information allows subjects to improve their inter-temporal consumption smoothing. We believe that this effect is negligible in our setting, given that consumption smoothing occurs over a whole life-span. Again, if this effect were present, it would only bias our results in favor of Kőszegi and Rabin’s model.
In addition the model assumes that people care (weakly) less about changes in beliefs, the further away the time of belief change lies from the actual point of consumption. In other words, a person is assumed to be less sensitive to changes in beliefs, the more time lies in between news and the time of consumption. This implies that people (weakly) prefer to receive information sooner rather than later. Note that this assumption also has consequences for the preference for clumped information. When comparing conditions where information is clumped to piecewise information conditions, the time information arrives is necessarily affected. It is impossible to collapse different pieces of information into one piece, without changing the time the pieces of information are received. Therefore, the precise prediction of Kőszegi and Rabin (2009) is that people prefer to receive information clumped rather than piecewise, as long as no information is delayed through clumping.

Therefore, subjects in treatments 1 and 2 should strictly prefer the clumped condition over the piecewise condition and consequently select the clumped condition.

**HYPOTHESIS 1:** In treatments 1 and 2 subjects choose to receive information in one piece.

Likewise, the model predicts that the average willingness to pay for the lottery should be higher in treatment 3 (where subjects receive clumped information) compared to treatment 4 (where subjects receive information piecewise).

**HYPOTHESIS 2:** Average willingness to pay for the lottery should be higher in treatment 3 compared to treatment 4.

### 3 Results

First, consider treatments 1 and 2, where subjects could directly choose between the two information conditions. *Figure 2* summarizes results from the two treatments. In treatment 1, only 11 out of 24 subjects preferred to receive information clumped rather than piecewise. In treatment 2, 14 out of 24 preferred the clumped information condition. Comparing choices between treatments 1 and 2, we find no significant difference. Using a Fisher Exact Test we cannot reject the null-hypothesis choices do not differ between
the treatments (p-value is 0.56). Using a simple Probit regression, regressing the choice between the information conditions on a constant and a treatment dummy delivers similar results. The coefficient of the treatment dummy is not significantly different from zero (p-value =0.39).

![Figure 2: Relative frequency of choices (clumped or piecewise information) for treatments 1 and 2.](image)

Given that we find no treatment difference, we henceforth analyze pooled data for treatments 1 and 2. 25 out 48 subjects preferred to receive information in one piece. This is clearly inconsistent with Köszegi and Rabin (2009), which predicts that all subjects should prefer the clumped information condition. However, when evaluating the predictive power of the model with our data, we need to incorporate an error structure that captures possible inconsistencies and mistakes of subjects. Thus, the statistical model we evaluate is one where subjects make a mistake with probability $p_e$. Since the model predicts that all subjects prefer the clumped condition, $p_e$ denotes the likelihood that the piecewise condition is chosen. With probability $(1 - p_e)$ they make no mistake and choose the clumped condition. As a first step we simply assume $p_e = 0.2$, i.e., we evaluate the model allowing for error rates of up to 20 percent. Given that Köszegi and Rabin (2009) predict a strict preference for clumped information, we believe that an error rate of 0.2 is fairly high. We use a simple Binomial Test to test the null hypothesis that our data are generated by a preference for clumped information and an error rate of 20 percent or lower, i.e., that $p_e \leq 0.2$. We reject the null hypothesis at any conventional level (p-value < 0.00001).

In the next step we ask which error rate we would have to assume such that the data is compatible with the model’s prediction, i.e., such that we cannot reject the null hypothesis that people prefer clumped information. More precisely, we ask for which value of $p_e$ we
cannot reject the null hypothesis (at the 5 percent level) that people prefer clumped information, using a one-sided Binomial Test. We find that this threshold value of $p_e$ is 0.354. Thus, we cannot reject the null hypothesis that $p_e \leq 0.354$ (p-value = 0.0502). We conclude that our data is only compatible with the prediction of Kőszegi and Rabin (2009), if we are willing to assume that subjects make mistakes with a probability of more than 35 percent.

It might be that people are heterogeneous in their attitudes towards different resolutions of uncertainty. Thus one could ask which individual characteristics determine preferences towards the resolution of uncertainty. Obvious candidate is our measure of loss aversion. The aversion to piecewise information in Kőszegi and Rabin (2009) is driven by loss aversion in belief changes. Thus, it could be that more loss averse subjects have a preference for clumped information. We split our sample according to a high or low degree of loss aversion. For subjects with a low degree of loss aversion, 57.14 percent preferred the clumped condition over the piecewise condition. For subjects with a high degree of loss aversion, exactly 50 percent preferred to receive information clumped. Thus we do not find that subjects with a high degree of loss aversion prefer the clumped condition more frequently.

We summarize our findings from treatments 1 and 2 as follows:

RESULT 1: Putting treatments 1 and 2 together, only 25 out of 48 subjects preferred the clumped information condition. We can reject the hypothesis that people prefer clumped over piecewise information, even if we allow for error rates of 20 percent. Our results are only compatible with a preference for clumped information if we are willing to assume error rates of more than 35 percent.

Next, consider behavior in treatments 3 and 4. Average willingness to pay for the lottery is 25.93 Euro and is below the expected value of the lottery of about 32 Euro. Figure 3 shows a histogram of subjects’ willingness to pay for the lottery for both treatments. Kőszegi and Rabin (2009) predict that subjects should have a higher willingness to pay in treatment 3, where information was clumped. However, Figure 3 suggests the opposite. While about 37 percent of subjects in the clumped condition (treatment

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15Recall that we used two lottery choices to elicit a measure of loss aversion. We classify subjects who reject both gambles as having a high degree of loss aversion. Subjects who accept both gambles or reject the gamble in choice 1 and accept the gamble from choice 2 are classified as having a low degree of loss aversion. Note that a total of 5 subjects did not behave consistently in the two loss aversion choices. Inconsistency means that they reject the gamble from choice 2 but accept the gamble from choice 1.
3) report a willingness to pay of 23 Euro or lower, only about 27 percent do so in the piecewise condition (treatment 4). On the other hand, while about 27 percent in the piecewise condition report a willingness to pay of 32 Euro or higher, the fraction is only 3 percent in the clumped condition. The average willingness to pay is 24.83 in treatment 3 compared to 27.19 in treatment 4. Using an OLS regression, regressing willingness to pay for the lottery on a constant and a treatment dummy, we can reject the null hypothesis that willingness to pay is higher in the clumped information condition (p-value < 0.05). This result is robust when controlling for our measure of risk aversion or gender.\textsuperscript{17}

Figure 3: Relative frequency of willingness to pay for lottery for treatment 3 (clumped information) and treatment 4 (piecewise information).

Now consider our measure of loss aversion. Again, we split our sample according to high and low degree of loss aversion.\textsuperscript{18} For subjects with a low degree of loss aversion, average willingness to pay is 25.64 in the clumped information treatment and 28.38 in piecewise information treatment. For subjects with a high degree of loss aversion, this difference is smaller. Average willingness to pay is 24.42 in the clumped condition and 24.44 in the piecewise condition. The smaller treatment difference is somewhat in line

\textsuperscript{16}K˝ oszegi and Rabin (2009) provide a directed null hypothesis to test. Consequently we use one-sided test statistics to test their predictions.

\textsuperscript{17}Note that out of the 56 subjects, 3 failed to make consistent choices in the multiple price list format. In the analysis above we used their average switching point in the price list format. Our results are robust when using the first switching point instead, or excluding them from the sample. When using the first switching point for these three subjects, average willingness to pay for the lottery is 24.17 in treatment 3 and 26.69 in treatment 4. Regressing willingness to pay for the lottery on a constant and a treatment dummy, we can still reject the null hypothesis that willingness to pay is higher in the clumped information condition (p-value < 0.05). When we exclude the three inconsistent subjects from the sample, average willingness to pay for the lottery is 24.85 in treatment 3 and 27.16 in treatment 4. Regressing willingness to pay for the lottery on a constant and a treatment dummy, we again reject the null hypothesis that willingness to pay is higher in the clumped information condition (p-value = 0.06).

\textsuperscript{18}Note that a total of 9 subjects did not behave consistently in the two loss aversion choices.
with Kőszegi and Rabin (2009). Note however that also for subjects with a high degree of loss aversion, average willingness to pay is not higher in the clumped information condition.

RESULT 2: The average willingness to pay for the lottery is higher in treatment 4 compared to treatment 3. We reject the null hypothesis that subjects have a higher willingness for the lottery when information is clumped.

4 Conclusion

We examined individuals’ attitudes towards information regarding exogenous events. While “standard” theory predicts indifference between different types of resolutions of uncertainty, other theories propose that people care about the timing of information. In this paper we used a controlled lab experiment to test a prediction developed in Kőszegi and Rabin (2009) that people prefer to receive information in one piece rather than piece-wise. Our experimental data does not support the hypothesis that piecewise information is utility-decreasing. In the following we discuss several possible explanations.

First, there is a general problem of testing dynamic models of decision making as these models usually do not specify the length of a time period. In principle time periods could be seconds, minutes, days or months. From a theoretical perspective this makes perfect sense. In fact it seems impossible to determine exact specifications as these are likely to depend on various factors, e.g, the context of the decision-problem. From an empirical perspective this is challenging. It could be that failure to support Kőszegi and Rabin (2009) is due to failure to create timing structures that affect different time periods. Note, however, that in our experiment we made a high effort to make variations in the timing structure meaningful by running the experiment over days. Note also that while leaving the length of a time period open, Kőszegi and Rabin (2009) also do not exclude any specifications.

Second, while we did not find support for the hypothesis on an aggregate level, it might be that some subjects do have preferences for receiving information in one piece. People might be heterogenous in their preferences for different information structures and it would be interesting to analyze which individual characteristics determine these preferences. Note, however, that our data on individual degree of loss aversion does not deliver a subgroup that shows a clear preference for information in one piece.
Third, the prediction that piecewise information is utility decreasing might only hold in certain decision environments. The model by Kőszegi and Rabin (2009) requires people to anticipate utility consequences of future belief changes and incorporate them in their current choices. These anticipation effects might only be present in contexts of particular significance, e.g., news about the own health condition or that of close relatives, news about the future career or maybe news about important political events. Note, however, that expected payoffs and payoff differences between winning and losing of the lotteries in our experiment are rather large. In one treatment, the payoff difference between winning and losing was 500 Euro, which is probably more than half of the monthly income of an average student in our sample.
References


Appendix A

We now formally derive the prediction of Köszegi and Rabin (2009) we are testing in this paper. We closely follow the notation of the original model. The model is in discrete-time with $T + 1$ periods, 0 through $T$. Decision-makers consume $K$ goods. In all periods $t \geq 1$, consumption $c_t = (c_1^t, ..., c^K_t)$ is realized. At the beginning of period $t$, the decision-maker holds beliefs $F_{t-1} = \{F_{t-1,\tau}\}_\tau^{T-t}$, with $F_{t-1,\tau} = (F_{t-1,\tau,1}, ..., F_{t-1,\tau,K})$ being the belief about the consumption vector in period $\tau$. Then, some signals may arrive and the decision-maker accordingly forms new beliefs $\{F_{t,\tau}\}_\tau^{T-t}$, where no uncertainty is left regarding consumption in period $t$.

Instantaneous period-$t$ utility depends on consumption in $t$ and on belief changes in $t$ regarding contemporaneous and future consumption:

$$u_t = m(c_t) + \sum_{\tau=t}^{T} \gamma_{t,\tau} N(F_{t,\tau} | F_{t-1,\tau})$$

$m(c_t)$ denotes reference-independent consumption utility and the terms $N(F_{t,\tau} | F_{t-1,\tau})$ represent "gain-loss utility" from belief changes. $\gamma_{t,\tau} \geq \gamma_{t-1,\tau} \geq ... \geq \gamma_{0,\tau} \geq 0$ are the weights on gain-loss utilities. $\gamma_{t,t}$ is normalized to 1. The weights $\gamma$ represent the importance of new information depending on how far in advance of actual consumption the news are received. Importance decreases, the earlier new information realized.

Gain-loss utilities are specified such that decision-makers make ordered comparisons between current and previous beliefs about consumption. It is assumed that decision-makers compare the worst percentile of outcomes under current beliefs to that under previous beliefs, the second-worst percentile under current and previous beliefs and so on.

Formally we define percentile $p$ implicitly by stating that for any distribution $F$ over $\mathbb{R}$ and any $p \in (0, 1)$, the consumption level at $p$, $c_F(p)$ is defined by $F(c_F(p)) \geq p$ and $F(c) < p$ for all $c < c_F(p)$. Then we can define gain-loss utility from the change in beliefs in consumption dimension $k$ as:

$$N^k(F^k_{t,\tau} \mid F^k_{t-1,\tau}) = \int_0^1 \mu(m^k(c_{F^k_{t,\tau}}(p)) - m^k(c_{F^k_{t-1,\tau}}(p))) dp$$

$\mu()$ is a "standard" gain-loss utility function with the following properties taken from Bowman et al. (1999):
1. \( \mu(x) \) is continuous for all \( x \), twice differentiable for \( x \neq 0 \), and \( \mu(0) = 0 \).

2. \( \mu(x) \) is strictly increasing.

3. If \( y > x \geq 0 \), then \( \mu(y) + \mu(-y) < \mu(x) + \mu(-x) \).

4. \( \mu''(x) \leq 0 \) for \( x > 0 \) and \( \mu''(x) \geq 0 \) for \( x < 0 \).

5. \( \frac{\mu'(-0)}{\mu'(0)} \equiv \lambda > 1 \), where \( \mu'(0) \equiv lim_{x \to 0} \mu'(|x|) \) and \( \mu'(-0) \equiv lim_{x \to 0} \mu'(-|x|) \).

Within these properties, loss aversion is captured in properties 3 and 5, diminishing sensitivity is captured by property 4.

Total gain-loss utility in period \( t \) is now assumed to be the sum of gain-loss utilities in each dimension, i.e. \( N(F_t, \tau \mid F_{t-1}, \tau) = \sum_{k=1}^K N^k(F^k_t \mid F^k_{t-1}, \tau) \).

As a last step, it is assumed that the decision-maker wants to maximize the expected sum of instantaneous utilities, \( U_t \equiv \sum_{\tau=t}^T u_\tau \).

We now have all the ingredients necessary to make predictions about informational preferences. Following Köszegi and Rabin (2009), information here means information regarding “fixed but unknown future consumption”. In other words, information has to be on exogenous events that cannot be influenced by the decision-maker.

For simplicity, we assume that consumption takes place only in period \( T \). Decision-makers may receive information about consumption from period 1 to \( T - 1 \). \( \sigma \) be a sequence of signals, \( s_1, s_2, ..., s_J \) and \( t(s_j \mid \sigma) \) denote the time of arrival of signal \( s_j \) under \( \sigma \).

We want to make predictions about decision-makers preferences towards different information structures. For this purpose we introduce the following terminology. We call \( \sigma' \) to be \((a, b, j)\)-equivalent to \( \sigma \) if both involve the same sequence of signals, if in both \( \sigma \) and \( \sigma' \) only \( s_j \) and \( s_{j+1} \) arrive between \( a \) and \( b \) (with \( b > a \)) and if for all \( i \neq j, j + 1 \), we have that \( t(s_i \mid \sigma') = t(s_i \mid \sigma) \). Thus, if two sequences of signals are \((a, b, j)\)-equivalent, they only differ in the timing of the two signals \( s_j \) and \( s_{j+1} \).

The model of Köszegi and Rabin makes the following central prediction. Clumping information is utility-increasing as long as no information is delayed through clumping. This is captured in the following proposition.\(^{19}\)

\(^{19}\)For a proof of this proposition we refer to Köszegi and Rabin (2009).
Proposition from Kőszegi and Rabin (2009): Say that $\sigma'$ is $(t_a, t_b, j)$-equivalent to $\sigma$ and $t(s_{j+1} | \sigma') = t(s_j | \sigma) \leq t(s_j | t | \sigma) < t(s_j+1 | \sigma)$. Then we have that $U(\sigma') > U(\sigma)$ for any $\gamma_{t,T} > 0$ nondecreasing in $t$.

Applying this proposition to our treatments, we get that subjects strictly prefer the clumped information condition over the piecewise condition and subsequently choose to be informed in one piece in treatments 1 and 2. This can be easily shown by iteratively applying the proposition. Consider a hypothetical information sequence $\sigma^h$ where subjects learn the first piece of information on Tuesday and on Wednesday they learn the final outcome, i.e., whether they won or lost. Clearly, for the comparison of $\sigma^h$ with the information sequence in the piecewise condition, one can see that proposition 1 applies, stating that subjects should strictly prefer $\sigma^h$. For the comparison of $\sigma^h$ and the information sequence in the clumped condition, we can again apply proposition 1, giving us that subjects should strictly prefer the sequence of the clumped condition to $\sigma^h$. Therefore, subjects should strictly prefer the clumped condition over the piecewise condition and consequently select the clumped condition. Likewise, average willingness to pay for the lottery should be higher in treatment 3 compared to treatment 4.