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ABSTRACT

Beliefs and Utility: Experimental Evidence on Preferences for Information*

Beliefs are a central determinant of behavior. Recent models assume that beliefs about or the anticipation of future consumption have direct utility-consequences. This gives rise to informational preferences, i.e., preferences over the timing and structure of information. Using a novel and purposefully simple set-up, we experimentally analyze preferences for information along four dimensions. We find evidence that the majority of subjects prefers receiving information sooner. This preference, however, is not uniform but depends on context. When the environment allows subjects to not focus attention on (negative) consumption events, later information becomes more attractive. We also identify an aversion towards piecemeal information. Variations in prior distributions do not seem to affect information preferences.

JEL Classification: C91, D03, D12, D83

Keywords: beliefs, anticipatory utility, news utility, information preferences, attention, reference-dependent preferences, experiments

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1 Introduction

Imagine a private investor learning that the value of her assets doubled over night. Quite likely, a substantial portion of the total utility generated from this event will not arise from the actual increase in future consumption, but from the pleasureful *anticipation* of higher future consumption. Likewise, an employee fearing to be laid-off by her company will probably experience disutility long before the actual act of dismissal, via negative anticipation. In other words, beliefs about future consumption or life outcomes are likely to be of direct relevance for utility. Indeed, Loewenstein (1987) provides survey-evidence consistent with this idea. Moreover, evidence from fMRI-studies as well as physiological measures underscore the utility-relevance of anticipating future outcomes.[1]

Starting with Loewenstein (1987), recent theoretical work has made substantial progress in modeling the notion that beliefs about or the anticipation of future consumption can have direct utility-consequences and has analyzed implications for behavior (see, e.g., Caplin and Leahy (2001, 2004), Brunnermeier and Parker (2005), Kőszegi (2006b), Epstein (2008), Kőszegi and Rabin (2009), Dillenberger (2010), Bénabou (2013), Stralecki (2013), Golman and Loewenstein (2015), Golman, Loewenstein and Gurney (2016), Ely et al. (2015)). Empirical evidence, however, remains scarce and lags behind these theoretical advances. In this paper we study anticipatory utility by exploiting its implications for informational preferences, using a novel and simple experimental set-up (see, e.g., Ganguly and Tasoff (forthcoming), Zimmermann (2015)).[2] Our research strategy is to analyze preferences for information along different dimensions, suggested in the models cited above. More specifically - for each of these dimensions - we test key motives related to anticipatory utility and information preferences that have been brought forward in the literature.

An investigation of information preferences presents several challenges, calling for a tightly controlled environment. First, the provision and timing of information needs to be precisely controlled. Second, information should ideally be non-instrumental, to shut down instrumental motives for a demand for early information. In addition, information needs to be meaningful to participants, in the sense that it plausibly triggers anticipatory utility. In our experiment, subjects can choose how they want to be informed about the outcome of a lottery. The lottery determines whether subjects will experience real (negative) consumption - a series of electric shocks. In this set-up, information is of no instrumental value and the consumption event causes (negative) anticipatory feelings.

[1] See for instance Berns et al. (2006) and Schmitz and Grillon (2012).

[2] In section 4 we review the emiprical literature on preferences for information in more detail and highlight key differences to our paper.

In all our experimental conditions, we have full control over the timing of information provision. This design allows us to obtain a comprehensive picture on information preferences and to test key motives in a unified framework.

We analyze preferences for information along four dimensions. First, subjects simply choose between receiving information sooner or later. This will serve as an important benchmark for the analysis of one of the other dimensions. In addition, however, observed behavior from this dimension is also informative as such. Preferences for sooner versus later information for instance received substantial attention in a literature that analyzes how doctors should inform patients about a diagnosis in the presence of belief-based utility.[3] Most theories predict that individuals prefer receiving information sooner (e.g., Kőszegi and Rabin (2009)), with the model by Brunnermeier and Parker (2005) being a notable exception. A key implication of their model is that individuals should avoid non-instrumental information because, once fully informed, they can no longer manipulate their beliefs in a self-serving manner.

Second, we investigate the intuition that the level of attention on future consumption affects information demand. Recently, the role of attention has been formalized in theories of consumer choice and belief formation.[4] Here, we ask whether attention is also a critical factor for understanding information demand. A natural way to reduce attention on the aversive stimulus is to offer a distracting activity that draws attention away from the stimulus towards the activity. In the respective treatments we therefore manipulate the experimental environment by offering subjects a distracting activity during the experiment, and study effects on preferences over sooner or later information. Golman and Loewenstein (2015) formalize a connection between attention and information preferences. They model the intuition that incoming information potentially affects the level of attention on future consumption such that, given anticipatory utility, subjects might use the timing of information to steer attention away from unpleasant future consumption. In the presence of a distracting activity the role of information for managing attention becomes stark. Golman and Loewenstein (2015) predict that in such environments, later information becomes more attractive, as this allows individuals to manage their level of attention, away from the unpleasant consumption event towards distracting activities.

[3]Caplin and Leahy (2004) address this question theoretically, assuming that some patients prefer sooner while others prefer later information (see also Schweizer and Szech (2013)). There is also an interesting related literature at the intersection of medicine and psychology that asks to what extend preparatory information about imminent surgeries can reduce patients' stress levels (see, e.g., Miller and Mangan (1983) and Morgan et al. (1998)).

[4]See, e.g., Schwartzstein (2012), Bordalo et al. (2013), Kőszegi and Szeidl (2013), Gabaix (2014), Taubinsky (2014) and Bushong et al. (2015).

Third, we explore attitudes towards piecemeal information. Subjects can select between receiving information in one piece or piece by piece. The key implication of piecemeal information is that it exposes individuals to fluctuations in their beliefs. Such fluctuations are pervasive in many contexts, e.g., financial markets, entrepreneurial activities, political news, but little is known about whether people like or dislike such fluctuations. Importantly, variations in whether information is provided clumped together or piece by piece necessarily imply variations in whether information is provided sooner or later. Therefore, we compare choices between clumped and piecemeal information with choices from the benchmark condition (sooner versus later information). This comparison allows us to isolate specific attitudes towards information piece by piece. A central motive in the model of Kőszegi and Rabin (2009) is that individuals are averse to belief fluctuations. This aversion is generated from loss aversion with respect to changes in beliefs.[5] On the other hand, obtaining information piece by piece could be perceived as more entertaining and exciting. Ely et al. (2015) theoretically show that if individuals like feelings of suspense, they should prefer piecemeal information.

Finally, we systematically vary the prior probability of the consumption event, both for decisions between sooner or later and for decisions between clumped or piecemeal information. The ex-ante likelihood of events is an important contextual feature. Some contexts are typically associated with a low prior probability of the bad outcome realizing (e.g., medical diagnosis), while others are characterized by a low likelihood of the good outcome (e.g., casino gambling). Most models predict that the qualitative pattern of information preferences does not depend on prior probabilities. An exception is Epstein (2008). He models anticipatory feelings such as anxiety or hope in an axiomatic framework and shows that preferences for sooner or later revelation of uncertainty can depend on priors. More specifically, he formalizes the intuition that individuals prefer early information if the good outcome is very likely ex-ante while preferring delayed information when the bad outcome is very likely.

Our findings can be summarized as follows. The large majority of subjects prefers sooner to later information. Importantly, however, this preference is not uniform across contexts. In the presence of a distracting activity, later information becomes more attractive, and a much larger fraction of subjects prefers delayed information. Concerning clumped versus piecemeal information, we identify a distinct aversion towards

[5] Palacios-Huerta (1999) also develops an argument why people might prefer clumped information based on the model of disappointment aversion by Gul (1991). Relatedly, Dillenberger (2010) studies a general class of recursive, non-expected preferences over compound lotteries and shows equivalence between a preference for clumped information and the so-called "certainty effect" (Kahneman and Tversky (1979)).

information piece by piece. Finally, neither choices between early and late resolution of uncertainty, nor choices between piecemeal information and information in one piece seem to depend on the ex-ante likelihood of the consumption event.

Our results highlight two key motives. First, they underscore the important role of attention for information demand. Our finding that the presence of a distracting activity makes later information more attractive is consistent with a central intuition of Golman and Loewenstein (2015), according to which information can generate attention. This implies that individuals can use their demand for information to manage attention. Second, our findings reveal a distinct aversion to piecewise information. Thus, subjects appear to dislike fluctuations in their beliefs. This provides direct empirical support for central assumptions and implications of the model by Kőszegi and Rabin (2009).[6] Their theory offers an explanation for important phenomena such as precautionary savings or overconsumption and has been applied in different contexts, such as life-cycle consumption (Pagel (2014)), portfolio choice (Pagel (2016)) or moral hazard (Macera (2013)).

Apart from informing existing modeling approaches, our findings contribute to a better understanding of belief-based utility and information preferences more generally. Our pattern of results may prove useful in predicting how information preferences shape behavior. For instance, the observation that subjects are averse to piecewise information suggests that, when choosing between different economic activities, people shy away from activities that imply piecemeal information revelation. This could provide an explanation for myopic loss aversion (see Benartzi and Thaler (1995) and Gneezy and Potters (1997)) as we argue in more detail in section 4. Our results also contribute to a better understanding of individuals' demand for information. Markets where information is traded are ubiquitous, but empirically little is known about the factors that influence the demand for information. Our findings suggest that preferences towards the timing of information are important determinants. Relatedly, Ambuehl and Li (2015) study demand for instrumental information and its relation to belief updating. They find that subjects' willingness to pay for information is too high for rather uninformative information, and too low for very informative information.

Results from our attention treatments also highlight the role of context for information preferences. We demonstrate that preferences for sooner or later information are not uniform. In environments that cause high attention on future consumption events,

[6] In their model, utility originates from anticipated belief changes about future consumption. In particular, decision-makers are loss averse with respect to anticipated belief changes. Information piece by piece exposes people to fluctuations in their beliefs and these expected belief fluctuations do not cancel in utility terms, because bad news weigh stronger than good news.

individuals seem to prefer to be informed right away. Instead, if the context allows subjects to not constantly think about future outcomes (and when the nature of the future event is such that individuals prefer not to think about it), more individuals prefer receiving information later. The latter seems particularly likely when attention can be focused on alternative activities (as is the case in our attention treatment) or when the consumption event lies in the distant future. This provides a potential explanation for why many people prefer to not be informed about possible negative events such as diseases, and therefore avoid being tested. For example, there is evidence that many people at risk of developing Huntington disease in the future prefer not to be tested (see Oster et al. (2013)). Not being tested might allow individuals to not think about and anticipate negative future outcomes.[7]

More generally, our results contribute to a small but growing theoretical literature that is incorporating attention and focus into economic decision-making (e.g., Gennaioli and Shleifer (2010), Bordalo et al. (2013), Kőszegi and Szeidl (2013) and Bushong et al. (2015) and Bordalo et al. (forthcoming)). In these models, attention is shaped by the environment, for instance the set of available alternatives. Our findings underscore the importance of attention for belief-based utility and support the idea that individuals can actively manage attention in a self-serving way, to increase or decrease anticipation. Intuitively, utility from anticipating future outcomes requires high levels of attention on these future outcomes. This makes attention a central determinant of anticipatory utility and opens a channel through which individuals can influence and manipulate their anticipation.

The next section introduces our experimental design. Section 3 contains our results, and section 4 concludes.

2 Design and Predictions

An environment allowing for the proper study of information preferences in a clean and unambiguous way ideally requires the following features: (i) Non-instrumentality of information: information preferably is on a predetermined event that can not be affected by subjects, to shut down instrumental motives for information demand. (ii) Full control over the timing of information: In particular, one needs to make sure that subjects realize the information at the moment they receive it. (iii) A consumption event where the act and timing of consumption can be controlled and that plausibly triggers anticipatory utility.

[7] See Golman et al. (forthcoming) for a comprehensive review on information avoidance.

2.1 Experimental Design

Our design accommodates these features. In the experiment subjects obtained information about whether or not they would receive an aversive stimulus. This stimulus consisted of a series of 30 electric shocks, which were administered using a standard electronic device frequently applied in pain stimulation studies in medicine. In case a subject received the stimulus, two electrodes were attached to the subject's wrist and the series of 30 shocks was delivered in random time intervals within a time span of four minutes (see section 2.2 and Appendix A for details). These shocks are medically harmless, but painful. The electric shocks are ideal for our purposes as they are likely to trigger (negative) anticipatory utility and permit the implementation of real consumption in a tightly controlled way.[8]

Table 1 summarizes the eight main treatments and five additional control treatments we conducted. In the eight main treatments, a lottery determined whether subjects received the aversive stimulus or not. Lotteries were implemented as follows: at the beginning of the experiment, the experimenter placed ten sealed envelopes in front of the subject. In all conditions, five envelopes contained a red card and five envelopes contained a blue card. Subjects were asked to pick five of the ten envelopes and hand them over to the experimenter. The outcome of the lottery was determined by the number of red cards contained in the five envelopes the subject selected. In four conditions (SLmedium, CPmedium, AttMain and AttControl), subjects received the shocks if at least three of the five selected envelopes contained a red card. The likelihood for this event is exactly 50%. In conditions SLhigh and CPhigh, subjects received the stimulus if at least one envelope contained a red card, implying an ex-ante probability of getting shocked of more than 99%. In conditions SLlow and CPlow, subjects received the series of shocks if all five envelopes contained red cards, leading to a likelihood of getting shocked below 1%.

Subjects could choose how they wanted to be informed about the lottery outcome. The timing of information and subsequent (potential) consumption followed a fixed and precise protocol. Appendix A provides graphs capturing the timelines for all the different treatments. The timeline *in minutes* was as follows: in t=0 subjects decided how to be informed about whether they would receive a series of shocks that would start at t=15. They could always select between two alternatives. In the SL-treatments, our benchmark treatments, the choice was between receiving information sooner or later.

[8]In fact, evidence on both neural and physiological responses to the prospect of receiving an electric stimulus suggests that electric shocks indeed trigger negative anticipatory feelings (see, e.g., Berns et al. (2006) and Schmitz and Grillon (2012)).

Table 1: Experimental Treatments

Treatment	Decision	Prior Probability of Event	# Observations
SLmedium	Sooner or Later	50%	30
SLhigh	Sooner or Later	>99%	30
SLlow	Sooner or Later	<1%	32
AttMain	Sooner or Later	50%	30
AttControl	Sooner or Later	50%	30
CPmedium	Clumped or Piecewise	50%	32
CPhigh	Clumped or Piecewise	>99%	30
CPlow	Clumped or Piecewise	<1%	31
AttMainMoney	Sooner or Later	50%	29
AttControlMoney	Sooner or Later	50%	29
ControlWTA	Willingness to Accept Stimulus	NA	25
ControlPerception	Perception of Stimulus	NA	24
ControlCalibration	Highest Tolerable Shock Level	NA	24

If a subject opted for sooner information, at t=0 the experimenter would directly (and secretly) open the five selected envelopes, and reveal the five contained cards in one piece to the subject.[9] In case of later information, the experimenter would open the five selected envelopes at t=12, and show the cards to the subject.

In the CP-treatments, the two alternatives were information in one piece or piecemeal information. A subject deciding for clumped information would obtain information exactly as in the sooner information condition. At t=0 the experimenter would secretly open the five selected envelopes, and then reveal the five cards in one piece to the subject. If information was transmitted piece by piece, every three minutes the content of one envelope was revealed to subjects. More specifically, at t=0, the experimenter would open the first envelope and show the respective card to the subject. At t=3, the second card would be revealed, and so on, until at t=12 the fifth and last card would be shown. Notice that piecewise information in our set-up also implies a delay of information.[10] Therefore, to identify specific attitudes towards piecemeal information, we need to take potential preferences for sooner or later information into account. For that purpose,

[9] By letting the experimenter directly transmit information to subjects face-to-face, we ensured that subjects would realize the information by the time it was revealed.

[10] We chose this implementation because theories predicting an aversion towards piecewise information require that no information is delayed through clumping (see Kőszegi and Rabin (2009)).

we will use choices from the SL-conditions as a benchmark. In other words, we will compare choices between clumped and piecemeal information to choices between sooner and later information. This comparison allows us to "fix" preferences for early (or late) resolution of uncertainty and thus to identify if piecemeal information has a distinct effect on information demand.

To investigate the intuition that the level of attention on the aversive stimulus affects information demand, we conducted treatments AttMain and AttControl. Our goal was to manipulate the level of attention in the time period after the choice between sooner and later information (i.e., between t=0 and t=12) and ensure that subjects are aware of the exougenously manipulated attention level when making their choice. In the baseline SL-treatments (SLmedium, SLhigh, SLlow), by design attention was likely to be focused on the consumption event (regardless of the timing of information) since subjects were not provided any means to distract attention from the electric stimulus (see also the discussion in section 2.3.2). In AttMain we changed this feature of the experimental environment by offering subjects a distracting activity. In other words, we created an environment where attention was not always focused on the consumption event. Specifically, the treatment was building on treatment SLmedium except for one key difference. In AttMain subjects had to perform a multiple choice quiz task. Subjects were asked general knowledge questions from various fields such as sports, geography, history, arts, music etc. To further strengthen the distracting effect of the quiz, it was administered at a different computer next to the main computer device, such that subjects could not see the shocking device or the electrodes while answering the quiz questions (see Appendix A for a picture). In addition we paid subjects for quiz performance such that subjects had incentives to focus on the quiz.[11] The timeline in AttMain was as follows. Before choosing how to be informed about the outcome of the lottery, the quiz was running for four minutes. This was done to familiarize subjects with the quiz and to make them realize that the quiz could potentially distract them from the consumption event. Then the quiz was interrupted (t=0) and subjects could choose if they wanted to be informed now or at t=12. After the interruption the quiz continued for 12 minutes. In other words, subjects could choose if they wanted to be informed at t=0 (during the interruption of the quiz) or at t=12 (after the quiz was finished).[12] The entire timeline was known to subjects ex-ante.

[11]The quiz had a total of six levels and earnings increased convex in level. Level 1 = 0 euros, level 2 = 1 euro, level 3 = 2 euros, level 4 = 4 euros, level 5 = 8 euros, level 6 = 16 euros.

[12]Note that the length of the interruption was fixed and calibrated such that there was sufficient time for subjects to make their choice and to potentially receive the information. Thus, subjects could not affect the length of the interruption with their information choice.

In order to be able to cleanly identify potential effects of the level of attention on information choice, we implemented a control condition that was as similar as possible to AttMain, with the exception that between the information choice (t=0) and t=12 there would be no scope for distraction from the electric stimulus. Accordingly, in AttControl subjects went through four minutes of the same quiz as in AttMain. Then the quiz was interrupted (t=0) and subjects could decide whether they wanted information now or in 12 minutes. The length of the interruption was the same as in AttMain. However, in contrast to AttMain, in treatment AttControl the quiz did not continue after the interruption. Between t=0 and t=12, subjects (like in the baseline SL-treatments) had to sit in front of the main computer with the shocking device, electrodes etc., with no means to distract attention from the electric stimulus. Subjects knew that the quiz was only resumed at the very end of the experiment, after subjects (potentially) had received the electric stimulus. Comparison of choices between AttMain and AttControl allows for a clean identification of the effect of attention on information choices.[13]

Finally, we systematically manipulated the ex-ante likelihood of getting shocked, both for choices between sooner and later information and choices between clumped and piecemeal information. Priors are varied between low (implying a less than 1% likelihood of getting shocked), medium (50% likelihood of getting shocked) and high (more than 99% likelihood of getting shocked). Comparison of information choices for different priors allows to identify potential effects of the prior on information preferences.

The experiment was administered in two separate office rooms of the BonnEconLab. In each room there were two desks with a computer, a set of instructions and the electronic pain stimulation device (see Appendix A for pictures).[14] Subjects were invited to the lab such that only two subjects would participate at the same time (one per room). In some cases, it happened that consecutive experimental sessions overlapped, due to subjects arriving too early or too late. In case this happened, there were two subjects present in one room for some time. To avoid potential spillover effects should

[13]A potential concern might be that treatment differences between AttMain and AttControl could merely reflect a motive to stay focused on the quiz. People might not want to obtain *any* information in the interruption of the quiz in AttMain, because they want to concentrate on the quiz. Even though we made sure that the interruption of the quiz was sufficiently long to digest the information (see also footnote 12), such a motive could nonetheless be present. To address this potential concern, we conducted treatments AttMainMoney and AttControlMoney. The two treatments were identical to AttMain and AttControl, except that we removed the electric shock component. Instead, information was on whether subjects won or lost in a monetary lottery. If the quiz generates a general motive to avoid information because information distracts from the quiz, such a motive should also be present when information is about winning or losing in a monetary lottery. See section 3 for details.

[14]In treatments AttMain and AttControl there were two computers per desk. The additional computer was used to administer the quiz, and was placed sufficiently distant from the other computer, such that while doing the quiz, subjects could not see the other computer and the shocking device.

this occur, the two desks in each room were separated with partition walls. Moreover, in all treatments subjects were asked to wear noise-canceling headphones while reading instructions and taking their decisions.

There was always one experimenter assigned to one subject. The experimenter welcomed the subject and asked him or her to read and sign a consent form. Afterwards, subjects were randomly assigned to treatments. Experimental instructions were provided to subjects on computer screens. Subjects were instructed in detail about the structure and timing of the respective information conditions they could select from and were given the opportunity to ask questions. Then subjects made their choice on the computer screen. The order in which the two choice alternatives were presented to subjects on the computer screen (left or right) was randomized between sessions. After subjects had made their choice, the experimenter started an electronic time clock that counted down 15 minutes (the time after which subjects potentially would receive the shock series). We wanted to keep the number of times the experimenter interacted with the subject fixed between information conditions, in particular between clumped and piecemeal information. Therefore, every three minutes, the experimenter informed subjects about the time elapsed so far. In case a subject opted for piecewise information, the pieces of information were transmitted during these interactions. This was also done in treatments SLmedium, SLhigh and SLlow, to ensure comparability with choices in the CP-treatments. Note that this was not done in treatments AttMain and AttControl. Remember that the purpose of these treatments was to investigate attention management of subjects. Therefore, in these two treatments, we refrained from having the experimenter interrupt subjects every three minutes. In all treatments all this was known to subjects ex-ante.

In case the lottery determined that a subject received the series of electric shocks, the experimenter attached the two electrodes and a calibration phase began. Calibrating the shock intensity was required by the ethics committee and is standard and necessary for using electric pain stimulation, because individual pain perception and tolerance is very heterogenous and depends on various factors such as body weight or the exact position of the electrodes. During the calibration phase, the shock level was increased in consecutive steps (starting from a very low level), and subjects could indicate the shock level that was just tolerable for them. This level then determined the intensity of the series of shocks.

This entire calibration procedure was known to subjects ex-ante. Therefore one might worry that subjects might misreport their own tolerance level in order to receive very low, i.e., less painful shocks. Notice that, if this were true, it would be orthogonal to all our treatment comparisons and would only reduce the intensity and therefore the anticipatory utility of the negative consumption event, making it less likely for information preferences to manifest themselves. Nonetheless, to further investigate the issue of a potential downward bias in reported tolerance levels, we conducted treatment ControlCalibration. In this treatment, subjects only went through the calibration phase, but without receiving any further shocks. Therefore, there were no strategic incentives to misreport tolerance levels. Reported tolerance levels did not differ significantly between that treatment and calibrations in the main treatments. More specifically, the average tolerance level elicited in ControlCalibration was 10.46 compared to 9.61 in the eight main treatments.[15] Testing for differences between elicited tolerance levels from the main treatments and tolerance levels from ControlCalibration yields no significant effects (t-test, $t = -0.85$, $p = 0.40$; Ranksum-test, $z = -0.77$, $p = 0.44$).[16]

In addition to Control Calibration, we conducted two further control treatments, ControlWTA and ControlPerception. In these experiments we were interested in how subjects experience and evaluate the consumption event we implemented. In ControlWTA, we used a price list format to elicit the amount of money we would have to pay subjects to be willing to experience the series of 30 shocks. Subjects faced 20 decisions, where they could choose between receiving the series of 30 shocks plus a fixed amount of money (that was increased in 1 euro increments from 1 euro to 20 euros) and receiving no stimulus but also no additional money. In ControlPerception, subjects experienced the series of shocks and were subsequently asked to rate how unpleasant they perceived the stimulus on a scale from 1 (not at all unpleasant) to 7 (very unpleasant). In ControlWTA, we find that the average amount subjects requested in order to experience the shock series was 8.3 euros (median = 8, std. dev. = 5.4). In ControlPerception the average rating was 5.6 (median = 5, std. dev. = 1.2). Thus, taken together, the perception of the consumption event was (as expected) quite negative and the amount of money subjects demanded to experience the event was substantial.

[15] A total of 116 subjects from the eight main treatments received the aversive stimulus and thus went through the calibration phase.

[16] This result is consistent with recent evidence for lying aversion. Specifically, there by now exist a number of studies in different contexts that reveal a pronounced preference for truth-telling (see, e.g., Gneezy (2005), Fischbacher and Heusi (2013), Abeler et al. (2014)). Such preferences are likely to be particularly strong in the face-to-face interaction we are implementing and might create incentives to report pain perception truthfully.

2.2 Procedural Details

A total of 376 subjects participated in our study. Participants were recruited from the regular subject pool of the BonnEconLab (University of Bonn) using the online recruitment system by Greiner (2003) and received a show-up fee of 20 euros.[17] The experiment was computerized using the software Presentation. The electric shocks were administered using "Pain Stimulation Shockers" (SHK1), developed and produced by the company Psychlab. These devices are specialized for scientific use in laboratory environments. Appendix A provides further details and pictures of these devices. Instructions subjects received, including the consent form and instructions for the calibration phase are provided in Appendix D.

2.3 Predictions

We derive predictions for Kőszegi and Rabin (2009), Golman and Loewenstein (2015), Brunnermeier and Parker (2005), Ely et al. (2015) and Epstein (2008)) in the dimensions they apply. In the following, for each dimension, we highlight main motives that these theories have formalized, focusing on intuitions. In Appendix B, we derive formal predictions for all models. Table 2 provides a summary of all dimensions and the corresponding model predictions.

Table 2: Predictions

Model	Sooner/Later	Attention Management	Clumped/Piecewise	Variation in Prior
Kőszegi and Rabin	$\sigma_S \succsim \sigma_L$	no difference between treatments	$\sigma_C \succ \sigma_P$ fraction choosing $\sigma_C >$ fraction choosing σ_S	no difference between treatments
Golman and Loewenstein	$\sigma_S \succ \sigma_L$	fraction choosing σ_S larger in AttMain than in AttContr	$\sigma_C \succ \sigma_P$ no difference between treatments	no difference between treatments
Brunnermeier and Parker	$\sigma_L \succ \sigma_S$	no difference between treatments	$\sigma_P \succ \sigma_C$ no difference between treatments	no difference between treatments
Ely, Frank and Kamenica	$\sigma_S \sim \sigma_L$	no difference between treatments	$\sigma_P \succ \sigma_C$ fraction choosing $\sigma_P >$ fraction choosing σ_L	no difference between treatments
Epstein (RDEU)	NA	NA	NA	fraction choosing σ_S larger in SLlow than in LShigh

[17] In treatments AttMain and AttControl subjects could earn additional money during the quiz, which is why we reduced the show-up fee to 15 euros.

2.3.1 Framework

Our experiment can be captured in a simple framework. We consider a situation with 6 periods, $t = 1$ through 6.[18] There is one consumption good (the aversive stimulus) which is consumed in $t = 6$. Consumption c is binary, i.e., the subject either receives the aversive stimulus or not (for simplicity say $c \in \{0, 1\}$ where $c = 0$ reflects receiving the aversive stimulus and $c = 1$ reflects not receiving it). At the beginning of period t, the subject holds beliefs F_{t-1} about consumption in $t = 6$, where π_{t-1} denotes the probability that $c = 1$. In periods 1 through 5, some signals may arrive. Given a signal realization in period t, the subject updates accordingly and forms new beliefs F_t. There is a set of five signals, $\{s_1, s_2, s_3, s_4, s_5\}$, and when all five signals are realized all uncertainty is always resolved, i.e., $\pi = 0$ or $\pi = 1$.

Subjects receive all the five signals, but can choose between different timing structures in the way they obtain the information. We denote an information structure by σ. To be able to characterize such a structure, $t(s_i|\sigma)$ denotes the period in which signal s_i realizes in information structure σ. Choices are always between two different information structures.

2.3.2 Sooner Versus Later Information

Choices in the SL-treatments can be characterized as follows: When choosing between sooner and later information, all five signals are collapsed and provided in one period. In information structure sooner (σ_S), all five signals are provided at $t = 1$, i.e., $t(s_i|\sigma_S) = 1, \forall i$. For later information (σ_L), all five signals are provided at $t = 5$, i.e., $t(s_i|\sigma_L) = 5, \forall i$.

Kőszegi and Rabin (2009): in Kőszegi and Rabin (2009), people obtain utility from anticipated changes in beliefs about future consumption. Beliefs correspond to rational expectations and people are assumed to be loss averse with regard to changes in their beliefs. As a consequence, receiving news is always utility-decreasing in expectation. In addition, the model assumes that people care at least weakly less about changes in beliefs, the further away the time of belief change lies from the actual point of consumption. This implies that people (weakly) prefer to receive information sooner rather than later.

For choices in the SL-treatments, Kőszegi and Rabin (2009) predict that subjects weakly prefer sooner over later information, i.e., assuming that indifferent subjects

[18] We define periods based on the CP-treatments. In periods 1 through 5, subjects (potentially) receive pieces of information, in period 6, consumption is realized.

randomize, the fraction of subjects choosing σ_S should lie in the interval $[0.5, 1]$.

Golman and Loewenstein (2015): they model two conflicting motives that impact the demand for information, curiosity and managing attention on future outcomes. In the situation we are implementing in the SL-treatments, several exogenous factors, e.g., the abstract lab environment as such, the constant presence and visibility of the electronic device and the lack of opportunities to distract attention, are likely to cause high levels of attention on the consumption event and make it difficult to manage and reduce attention. Thus, the curiosity motive should dominate, implying the prediction that subjects should prefer early information.

For choices in the SL-treatments, Golman and Loewenstein (2015) predict that subjects should prefer σ_S over σ_L.

Brunnermeier and Parker (2005): they build a model where individuals can choose their beliefs freely, and experience anticipatory utility based on these chosen beliefs. Information limits the ability to choose beliefs. More specifically, once fully informed, individuals are unable to manipulate their beliefs. A direct implication of this is that individuals should display an aversion towards receiving (non-instrumental) information, because such information prevents them from manipulating their beliefs in a self-serving way. Applied to our set-up, this implies that subjects should prefer receiving information later, as this maximizes the amount of time they can hold self-serving beliefs.

For choices in the SL-treatments, Brunnermeier and Parker (2005) predict that subjects should prefer σ_L over σ_S.

2.3.3 Attention Management

Recall that in this dimension we are interested in the effects of an exogenous reduction in attention (by offering a distraction activity) on choices between σ_S and σ_L.

Golman and Loewenstein (2015): they formalize the connection between attention and information demand. Specifically, they model the intuition that incoming information can influence (increase) attention on future consumption outcomes. Given anticipatory (dis)utility, individuals do not want to focus attention on bad outcomes and they can use the choice of later information to reduce the level of attention on the bad outcome. In addition, however, individuals are assumed to be curious. Thus, in treatment AttMain, Golman and Loewenstein (2015) predict that both curiosity and managing attention on future outcomes impact information choices, with the two motives operating in different directions. While curiosity implies demanding sooner information, later information helps reduce attention on the bad consumption outcome. In contrast, in treatment AttControl, we took away the distracting activity. As a consequence, attention is by design focused on the consumption event, with little scope for managing attention. Therefore, in AttControl (similar to the SL-treatments) the curiosity motive should dominate. Accordingly, Golman and Loewenstein (2015) predict that more subjects choose sooner information in treatment AttControl, compared to AttMain.

An additional motive that is closely related to the one above and consistent with Golman and Loewenstein (2015) is that the distracting activity increases subjects' desire to not focus on the aversive stimulus. Intuitively, some portion of anticipatory disutility in general is likely to arise from negative anticipation ruining the utility of other activities. For instance, constantly thinking about an imminent surgery is likely to decrease the pleasure of meeting friends or of spending time with the family. In our case in AttMain, thinking about the shocks might reduce the potential utility of enjoying the quiz. Thus, introducing the quiz might not only allow subjects to manage their attention, it might also increase their motivation to do so. Following Golman and Loewenstein (2015), the means to reduce attention on the aversive stimulus is later information, implying that later information becomes more attractive.

Golman and Loewenstein (2015) predict that the fraction of subjects preferring σ_L over σ_S is higher in AttMain compared to AttControl.

None of the other models formalize a specific role of attention for information demand.

2.3.4 Clumped Versus Piecemeal Information

In the CP-treatments, subjects choose between a clumped and a piecemeal information structure. In the clumped structure (σ_C), all five signals are collapsed into one and provided at $t = 1$, i.e., $t(s_i|\sigma_C) = 1, \forall i$. In the piecemeal structure (σ_P), one signal is revealed throughout periods 1 to 5. In other words, in the piece by piece structure we have that $t(s_i|\sigma_P) = i, \forall i$.

Kőszegi and Rabin (2009): Kőszegi and Rabin (2009) assume that decision-makers are loss aversion in belief changes. This novel type of loss aversion implies a dislike of gradual resolution of uncertainty, since piecewise information exposes people to fluctuations in their beliefs. These expected fluctuations in beliefs do not cancel in utility terms, because bad news weigh stronger than good news.

Recall that variations in terms of clumped versus piecewise information necessarily imply variations in terms of sooner versus later information. In our CP-treatments, piecewise implies delayed information. Therefore, in our experiment we isolate attitudes towards information piece by piece from preferences for sooner or later information by using choices in the SL-treatments as a benchmark. In other words, the key comparative static we exploit is comparing choices in the CP-treatments to choices in the SL-treatments. For that comparison, Kőszegi and Rabin (2009) predict that the fraction of subjects choosing sooner information in the SL-treatments should be in the interval $[0.5, 1]$, while the fraction choosing clumped information in the CP-treatments should be 1. In other words, the fraction preferring clumped over piecewise information should be larger than the fraction preferring sooner over later information.[19]

Kőszegi and Rabin (2009) predict that subjects strictly prefer σ_C over σ_P. Furthermore, the fraction of subjects choosing σ_C in the CP-treatments is larger than the fraction choosing σ_S in the SL-treatments.

Ely et al. (2015): they formalize the idea that obtaining information piece by piece might be perceived as entertaining and exciting. They theoretically analyze information demand if individuals like the feeling of suspense. In their model, suspense is indeed higher for piecemeal than for clumped information.[20]

Ely et al. (2015) predict that subjects prefer σ_P over σ_C. The fraction of subjects preferring σ_P should be higher than the fraction of subjects choosing σ_L.[21]

None of the other models predict specific attitudes towards piecemeal information.

2.3.5 Variations in Prior Probabilities

Both for choices between σ_S and σ_L and between σ_C and σ_P we vary the prior belief F_0.
Epstein (2008): He models anticipatory feelings such as anxiety or hope in an axiomatic preference framework. He demonstrates that such a preference model can generate intuitive patterns of information demand. We make use of one of his examples where he combines his general framework with rank-dependent utility to show that individuals might prefer early information if the good outcome is very likely ex-ante and prefer delayed information if the bad outcome is very likely ex-ante.

[19]Notice that (trivially) this comparative static prediction does not hold in case all subjects in the SL-treatments would choose sooner information. However, findings from the SL-treatments reveal that this is not the case in our experiment.

[20]In their paper they model demand for non-instrumental information such as international news and sports events. They formalize the idea that such information creates entertainment value, and analyze how information should be provided if individuals want to maximize suspense or surprise.

[21]Notice that this prediction is derived under the assumption that subjects like suspense. Thus, this constitutes a joint test of the assumption that subjects like suspense and the mechanics of the model.

Epstein RDEU[22] *predicts that the fraction of subjects preferring* σ_S *should be higher in treatment SLlow compared to treatment SLhigh. Likewise, the fraction of subjects preferring* σ_C *should be higher in treatment CPlow compared to treatment CPhigh.*

No other model we are aware of generates the prediction that information preferences depend on prior probabilities.

3 Results

Figure 1 summarizes the key findings from our eight main treatments. We start by analyzing choices in our benchmark conditions, the SL-treatments. Next, we turn to the investigation of choices between sooner or later information in treatments AttMain and AttControl. We then analyze choices between clumped and piecemeal information and in particular focus on whether we can identify a specific attitude towards piecemeal information, independent of preferences for sooner or later information. Finally, we explore whether information preferences depend on priors.

Sooner Versus Later Information

Pooling observations from our benchmark conditions, we find that 76% of subjects prefer to receive information early. Using a binomial test we reject the null hypothesis that choices of sooner and later information are equally likely, pointing towards a distinct preference for early information in these conditions ($p < 0.01$). Looking at each of the SL-treatments separately, Figure 1 (left panel) reveals that the fraction of subjects preferring sooner over later information is above 73% in all three treatments. Performing binomial tests (again testing the null hypothesis that choices of sooner and later information are equally likely) separately for each SL-treatment confirms the result from the pooled data (SLmedium, $p = 0.016$; SLhigh, $p < 0.01$; SLlow, $p < 0.01$).

RESULT 1: *The majority of subjects in the SL-treatments prefers sooner over later information.*

Attention Management

Turning to the attention treatments, Figure 1 (middle panel) shows that 80% of subjects prefer sooner information in treatment AttControl, similar to the respective fractions

[22]We call this the "Epstein RDEU" prediction, since it is not a general prediction of his model, but is generated from combining his general model framework with RDEU. Also notice that the key contribution of Epstein (2008) is to show that certain patterns of information demand can be generated in an axiomatic framework, rather than to offer clear-cut behavioral predictions.

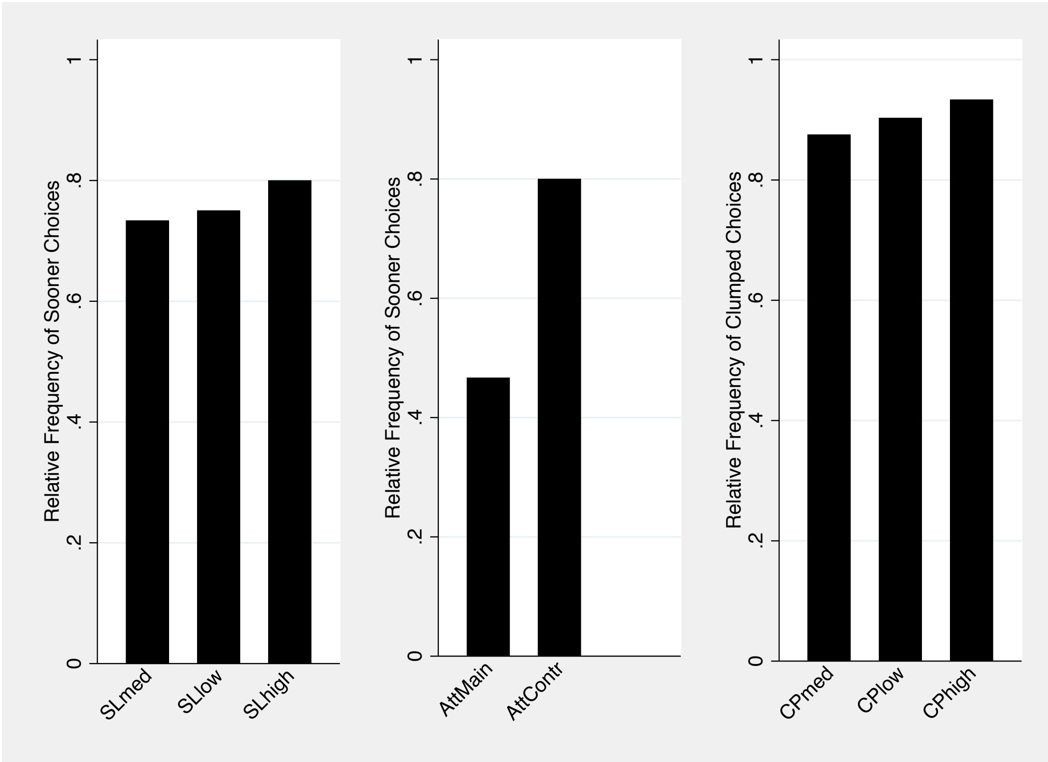

Figure 1: Left Panel: Fractions of subjects choosing sooner information in the SL treatments. Middle Panel: Fractions of subjects choosing sooner information in the Attention treatments. Right Panel: Fractions of subjects choosing clumped information in the CP treatments.

of subjects in the SL-treatments. In treatment AttMain, however, only about 48% of subjects prefer sooner information. Regression analysis in Table 3 reveals that this drop in choices of sooner information is significant. In columns 3 and 4, information choice is regressed on a treatment dummy being equal to 1 for observations from treatment AttMain. In column 4, additional controls are included. In all specifications, the proportion of subjects choosing later information is significantly higher in AttMain.

RESULT 2: *A manipulation of the level of attention on the aversive stimulus affects information choices. When attention is reduced (treatment AttMain), significantly more subjects prefer later information (compared to treatment AttControl).*

Notice that the choice fractions in AttMain are very close to 50-50. This can be interpreted in two ways, both consistent with the model by Golman and Loewenstein (2015). Recall that in their model, lower attention on the consumption event increases the attractiveness of later information. This, however does not necessarily imply that later information becomes the preferred option (relative to early information). In the first interpretation, preference heterogeneity among subjects led to a situation where for some subjects in AttMain, sooner information remains preferred over later information, while other subjects now prefer later information. In the second interpretation, the increased attractiveness of later information (by chance) led to indifference between sooner and later information for all subjects in AttMain. The following piece of evidence suggests that the latter interpretation is unlikely. Recall that in all our treatments we randomized which choice alternative appeared on which side of the decision screen. In addition, always the left option on the screen was "preselected". In other words, if subjects wanted to implement the left option, they could simply stick to the preselected option and press Enter. If they wanted to implement the right option, they first had to select the right option using the cursor and then confirm by pressing Enter. Thus, in case of indifference between the two options, one would expect that the presentation of the choice alternatives would matter for actual choices. When we introduce the order of the choice alternatives on the screen as an explanatory variable for information choices in the AttMain treatment, we find no evidence that this ordering mattered for subjects' choices ($z = 0.72$, $p = 0.47$, Probit regression).

As a side note, given that information preferences in general are potentially easily malleable by framing or ordering effects, we also investigate in all our other treatments whether the mere order of choice alternatives affected choice behavior. Specifically, in columns 2, 4, 6 and 8 of Table 3 we include the order of the choice alternatives on the screen as an additional control variable in our regression analysis. Also in these regressions we do not find any evidence that the ordering of the choice alternatives had any systematic impact on behavior.

A potential concern might be that the treatment difference we have identified between AttMain and AttControl could merely reflect a desire to remain focused on the quiz. Subjects might not want to obtain *any* information during the interruption of the quiz in AttMain, because they want to remain concentrated on the quiz. Recall that, to address this potential concern, we conducted treatments AttMainMoney and AttControlMoney. The two treatments were identical to AttMain and AttControl, except that we removed the electric shock component. Instead, information was on whether subjects won or lost in a monetary lottery. Winning the lottery implied an additional payment of 2 euros. The prior likelihood was 50-50 and the lottery was implemented using envelopes, exactly as in the other treatments. The key idea behind these additional treatment conditions was that, if the quiz generates a general motive to avoid information in AttMain because information distracts from the quiz, this motive should also be present when information is about winning or losing in a monetary lottery. If, instead, the treatment difference between AttMain and AttControl is tied to the anticipatory disutility that stems from the electric shocks, then this effect should not be present between AttMainMoney and AttControlMoney. Table 6 in Appendix C summarizes corresponding regression results. We find no significant differences between information choices in AttMainMoney and AttControlMoney. While in AttControlMoney, 62% of subjects preferred sooner information, 69% preferred sooner information in AttMainMoney. Thus, in contrast to treatments AttMain and AttControl, sooner information is even chosen slightly more frequently in the main condition (see columns (1) and (2) in Table 6). In columns (3) and (4) of Table 6, we show the results of a difference-in-difference estimation using all attention treatments, regressing information choice on a treatment dummy (main versus control), a monetary lottery dummy (money versus electric shock) and an interaction term. The point estimate of the interaction term is significantly different from zero in both specifications (with and without additional controls), indicating that the treatment effect we identified between conditions AttMain and AttControl significantly differs from that in AttMainMoney and AttControlMoney.

Taking findings from the SL-treatments and treatments AttMain and AttControl together, subjects seem to prefer sooner information. However, this preference is not uniform, but rather depends on specific contextual features. In contexts where the nature of the environment does not induce constant focus on the (negative) consumption event, later information becomes relatively more attractive.

Clumped versus Piecemeal Information

Looking at choices between clumped and piecemeal information, pooling data from all three corresponding treatments, we find that about 90% of subjects prefer clumped information. A binomial tests rejects the null hypothesis that subjects randomized with equal probability between clumped and piecemeal information ($p < 0.01$). Figure 1 (right panel) also reveals a pronounced preference for information in one piece. In all CP-treatments, more than 87% of subjects choose clumped information. Performing binomial tests separately for the three CP-treatments confirms the result from the pooled data (CPmedium, $p < 0.01$; CPhigh, $p < 0.01$; CPlow, $p < 0.01$).

Recall that variations in whether information is provided in one piece or piece by piece necessarily imply variations in whether information is provided sooner or later. In other words, preferences for sooner or later information inevitably affect choices between clumped or piecemeal information. In the CP-treatments, piecemeal information implied a delay in information. Thus, an aversion to delayed information could contribute to our finding that most subjects choose clumped over piecemeal information. To identify a specific aversion to piecemeal information, we compare choices in the CP-treatments with choices in the SL-treatments.[23] Figure 1 reveals, that the fraction of subjects choosing clumped information in the CP-treatments is higher compared to the fraction preferring sooner information in the SL-treatments.

This is confirmed by our regression analysis in Table 3. We demonstrate that the clumped information option in the CP-treatments is chosen more frequently than the sooner information option in the SL-treatments. To identify this effect, in columns 7 and 8 of Table 3 we pool observations from the SL- and the CP-treatments. We categorize information choices such that choices of clumped and sooner information respectively are categorized as 1, and choices of piecemeal and delayed information are categorized as 0. Information choices are regressed on a treatment dummy being equal to 1 for observations from the SL-treatments and equal to 0 for observations from the CP-treatments. In column 8, additional controls are included. The negative coefficient of the treatment dummy reveals that the fraction of subjects preferring clumped information is significantly higher than the fraction of subjects preferring sooner information, providing evidence for a distinct aversion towards piecemeal information.

RESULT 3: *The majority of subjects prefer clumped over piecemeal information. The fraction of subjects preferring clumped information in the CP-treatments is significantly higher than the fraction of subjects preferring sooner information in the SL-treatments.*

Effects of Prior Probabilities

In columns 1 and 2 of Table 3 we analyze if choices in the SL-treatments are affected by changes in the prior likelihood of the consumption event. Information choices in the SL-treatments are regressed on a set of dummy variables capturing variations in the prior. In column 2, additional control variables are added. We find that information choices when choosing between sooner or later information are not affected by differences in the prior. None of the treatment coefficients is significantly different from zero. Joint Wald-tests do

[23] To reiterate, if an aversion against delayed information would be the sole driver of behavior in the CP-treatments, then the fraction of subjects choosing clumped information in the CP-treatments should be similar to the fraction of subjects choosing early information in the SL-treatments. A specific aversion towards piecemeal information instead should cause a higher fraction of subjects preferring clumped information (as we demonstrated when deriving the Kőszegi and Rabin (2009) predictions in section 2.3.4). Also notice that in fact, the delay from piecemeal information in the CP-treatments in expectations was less severe than the delay caused by later information in the SL-treatments. If information was provided later, subjects learned after 12 minutes whether they would receive the aversive stimulus or not. Instead, if information was provided piece by piece, (depending on the treatment) it could happen that subjects already knew after the first pieces of information whether they receive the aversive stimulus and under no circumstances was the delay in information larger than 12 minutes. More specifically, in treatments CPhigh and CPlow, if information was transmitted piece by piece, it could happen that subjects knew already after the first piece of information (delay of zero minutes) whether they would get shocked or not. In CPmed, subjects could sometimes reach certainty about the outcome after three pieces of information (delay of six minutes).

Table 3: Probit Estimates of Information Choices

	SL-treatments		Attention treatments		CP-treatments		SL- and CP-treatments	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
SLmed	-.219	-.107						
	(0.360)	(0.367)						
SLlow	-.167	-.069						
	(0.357)	(0.365)						
AttMain			-0.925***	-0.965***				
			(0.350)	(0.353)				
CPmed					-.351	-.334		
					(0.455)	(0.476)		
CPlow					-.201	-.552		
					(0.472)	(0.462)		
SL							-.591**	-.619***
							(0.230)	(0.220)
Additional Controls	No	Yes	No	Yes	No	Yes	No	Yes
Implementation left/right		.254		-0.137		-.569		-.054
		(0.295)		(0.378)		(0.370)		(0.220)
Constant	.842***	1.873	0.842***	0.155	1.501***	-.182	1.300***	1.805
	(.262)	(1.435)	(0.263)	(1.527)	(.354)	(2.947)	(.179)	(1.188)
Observations	92	92	60	60	93	93	185	185
(Pseudo R^2)	0.004	0.037	0.094	0.109	0.010	0.201	0.041	0.054

Probit estimates, robust standard errors in parentheses. In regressions (1) and (2), choice between sooner or later information is regressed on a set of dummy variables capturing variations in priors in the SL-treatments (where SLhigh is the omitted category). In columns (3) and (4) respectively, we regress information choice from treatments AttMain and AttControl on a treatment dummy taking the value 1 for treatment AttMain. In regressions (5) and (6), choice between clumped or piecemeal information is regressed on a set of dummy variables capturing variations in priors in the CP-treatments (where CPhigh is the omitted category). In columns (7) and (8), we regress information choices from the SL- and the CP-treatments (where choices of clumped or sooner information respectively are categorized as 1, and choices of piecemeal or delayed information are categorized as 0) on a dummy variable being equal to 1 for observations from the SL-treatments and equal to 0 for observations from the CP-treatments. Additional controls include age and gender. In regressions (7) and (8), controls also include a set of dummy variables capturing variations in priors. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

not reject the null hypothesis of zero treatment differences (column (1): $chi2(2) = 0.40$, $p = 0.820$; column (2): $chi2(2) = 0.09$, $p = 0.958$). Columns 5 and 6 of Table 3 repeat the exercise for the CP-treatments. Choices in the CP-treatments are regressed on a set of dummy variables capturing variations in the prior and additional controls (column 6). The respective coefficients reveal that, similar to the SL-treatments, behavior in the CP-treatments does not depend on priors. Furthermore, joint Wald-tests do not reject the null hypothesis of zero treatment differences (column (5): $chi2(2) = 0.60$, $p = 0.743$; column (6): $chi2(2) = 1.44$, $p = 0.487$).

We implemented the lotteries using envelopes, in order to make the ex-ante probabilities salient and easy to comprehend for subjects. For the treatments where the ex-ante likelihood was high (low) we also directly told subjects in the instructions that receiving the shocks was rather (un)likely. Still, a possible concern might be that our finding that information choices are not significantly affected by variations in prior probabilities is due to possible misperceptions of these probabilities on the side of the subjects. In other words, it could be that information demand is not influenced by differences between priors in our experiment, because subjects failed to perceive these differences. To address this concern, we elicited perceived probabilities for a subset of subjects.[24] In Appendix C we analyze corresponding results. Two findings suggest that the empirical validity of the concern is low. First, we show that our variations in priors were effective in the sense that they strongly influence subjects' *perceived* priors. Second, we show that information choices are not significantly affected by these perceived priors (confirming our finding that choices are not affected by objective priors).

RESULT 4: *Neither choices between sooner and later information, nor choices between clumped and piecemeal information are affected by variations in the prior likelihoods.*

4 Discussion and Concluding Remarks

In this paper we investigate individuals' preferences for information. We implement a real (negative) consumption event in a controlled lab environment and vary information structures along four dimensions. Our experimental design allows precise control over the timing of information and the consumption event and ensures non-instrumentality of information. Our findings highlight two main motives, formalized in Golman and Loewenstein (2015) and Kőszegi and Rabin (2009) respectively: First, our results reveal an aversion to piecemeal information. Second, we find evidence that attention plays a crucial for information demand. Variations in prior probabilities of the consumption event, however, do not affect choices.

This pattern of observations improves our understanding of how the connection between beliefs and utility and resulting preferences for information shape behavior. For instance, our results suggest that when choosing between different economic activities, people shy away from activities that imply piecemeal information revelation, relating to the literature on myopic loss aversion (see Benartzi and Thaler (1995) and Gneezy and Potters (1997)). Gneezy and Potters (1997) let subjects go through a series of risky investment choices and manipulate the frequency with which they received feedback regarding the outcome and with which they could make their choices in a between-subjects design. They find that investments in the risky asset are higher when the frequency of

[24] At the end of the experiment, we asked the following question: "In this experiment, a lottery determined whether you would receive a series of electric shocks, or not. What do you think, what was the exact probability to receive the electric shocks? Please provide your answer in percent."

feedback and choices is low. Our results suggest that an aversion to piecemeal resolution of risk might contribute to myopic loss aversion.[25]

Our findings relate to a small experimental literature studying preferences for information. This literature mostly focuses on preferences for sooner versus later information (see, e.g., Eliaz and Schotter (2010), van Winden et al. (2011), Kocher et al. (2014), Ganguly and Tasoff (forthcoming)). Zimmermann (2015) analyzes the theoretical prediction that people are averse to piecewise information. Using information about winning or losing in a monetary lottery, he finds no evidence for such an aversion. Our study differs from and adds to these studies in several important ways. First, in our study information is on a precisely controlled consumption event, while in previous studies information has been about monetary earnings.[26] This is important for testing existing theories, as in most of these theories beliefs and information are about future consumption events. Second and relatedly, most existing theories are meant to capture situations where beliefs and information are meaningful to subjects, thus plausibly creating anticipatory utility. Examples are results from medical tests or career information for employees. In a lab environment situations of such meaning are potentially difficult to create. We argue that the consumption event we implement (an aversive stimulus) is ideally suited to trigger anticipatory utility in a lab context. Third, while previous studies have focused on specific aspects of individuals' preferences for information, we explore a large range of variations in the information structure, permitting a comprehensive picture on information preferences. Finally, in terms of results, to the best of our knowledge, this paper is the first to identify an aversion to piecewise information and to empirically underscore the important role of attention for information preferences.[27]

[25]Bellemare et al. (2005) provide evidence in this direction. They build on the design by 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. Fellner and Sutter (2009) find that both factors (frequency of feedback and frequency of choices) are important for myopic loss aversion. Also related is a study by Hilgers and Wibral (2014). Analyzing myopic loss aversion in a within-subjects design, their data suggest that myopic loss aversion is most likely not preference-driven but due to a mistake.

[26]Ganguly and Tasoff (forthcoming) also conducted a non-monetary experiment in addition to their experiment in the money domain. They analyze if lab participants want to be tested for (and subsequently be informed about by a physician) sexually transmitted diseases. They find that many subjects prefer to not be tested and informed. This set-up, however, differs from ours in that it is not about the timing of information (i.e., how and when to be informed), but about whether or not to be informed at all.

[27]More broadly, our finding that subjects are averse towards piecemeal information relates to a vibrant recent literature on expectations-based reference-dependent preferences. In this literature, individuals are assumed to be loss averse with regard to *actual* consumption, and the reference point is generated from (rational) expectations (see, e.g., Bell (1985), Loomes and Sugden (1986), Gul (1991), Kőszegi and

As a final remark, one may wonder if our results extend to the positive consumption domain. With respect to potential domain-specific effects, it is important to emphasize that most model predictions do not depend on whether consumption is in a positive or negative domain (with the exception of the role of attention). The intuition is that regardless of the specific domain, there always exist good and bad news. In our experiment, learning that one does not receive the electric shocks is good news. Likewise, during a stay in your favorite hotel, learning that the pool area is closed may be bad news. Furthermore, empirically, at least one factor renders the comparison of our findings with the positive domain difficult. Recall that a key advantage of using the electric stimulus paradigm is that there exists evidence that it indeed triggers anticipatory feelings (see footnote 1). We are not aware of comparable evidence for a positive consumption event that could be implemented in a lab environment.

Rabin (2006, 2007). Several empirical studies provide support for expectation-based reference points in actual consumption. See for example Abeler et al. (2011), Crawford and Meng (2011), Gill and Prowse (2012) and Ericson and Fuster (2012). More recent experimental work has identified limitations of expectation-based reference dependence (see for example Heffetz and List (2014) or Gneezy et al. (forthcoming)).

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Appendix A

Pictures of Lab Environment

Picture of desk for the SL and CP treatments.

Picture of desk for treatments AttMain and AttControl, including the two computers. The right computer administered the quiz. Note that the two computers in AttMain and AttControl were placed such that, while performing the quiz, subjects could not see the other computer.

The Electric Stimulus

The electric stimulus was administered with devices (SHK 1) manufactured by the company Psychlab. These devices are specifically tailored for scientific purposes. Electric stimulation is frequently used to induce pain or fear (see, e.g., Brooks et al. 2010 and Cohn et al. 2015) and neural as well as physiological evidence suggests that the expectation of receiving an electric stimulus indeed triggers negative anticipatory feelings (see, e.g., Berns et al. (2006) and Schmitz and Grillon (2012)).

If a subject received the electric stimulus, two electrodes were attached to the subject's wrist (see below for a picture of an electronic device including electrodes). The electrodes delivered focused and centered electric shocks. After the calibration phase, subjects received a series of 30 shocks which were delivered in random time intervals within a total time span of four minutes, and each individual stimulus had a length of 0.1 seconds.

Picture of electronic device, electrodes, noise-cancelling headphones.

Timeline of Different Treatments

SL-Treatments

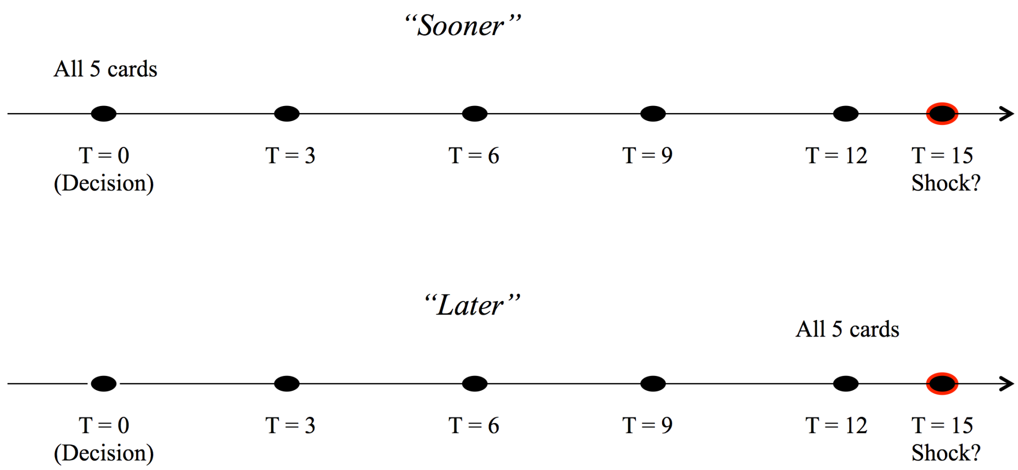


Figure 2: Timeline in the SL-treatments (in minutes). Subjects decide at $t = 0$. The upper panel shows the timeline if the option "Sooner" is chosen. The lower panel displays the timeline if "Later" is chosen.

Attention Treatments

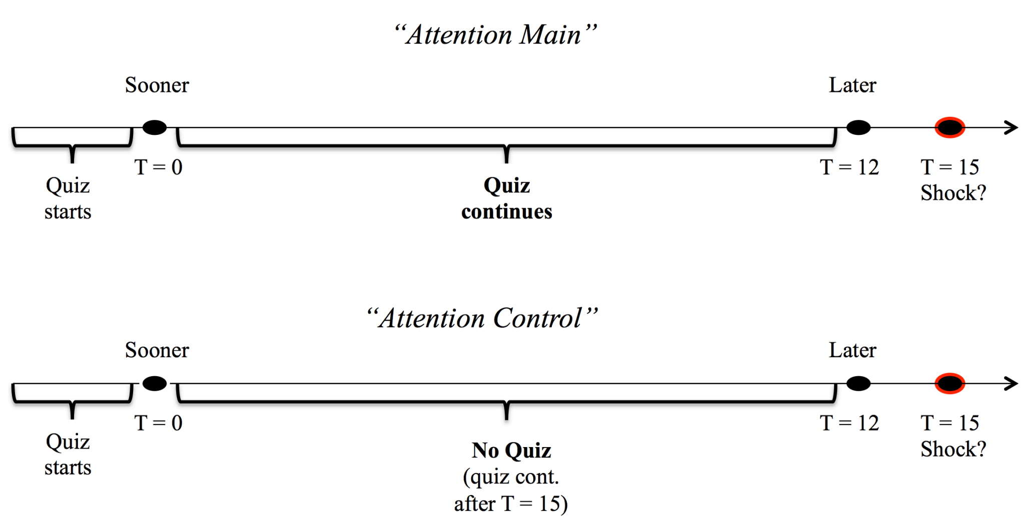


Figure 3: Timeline Attention treatments (in minutes). The Figure depicts both attention treatments. Subjects decided in $t = 0$ if they want to be informed sooner or later. The consequences of the information choice are shown in the Figure depicting the timeline of the SL-treatments (Figure 2). The upper panel shows treatment Attention Main. The lower panel depicts treatment Attention Control.

CP-Treatments

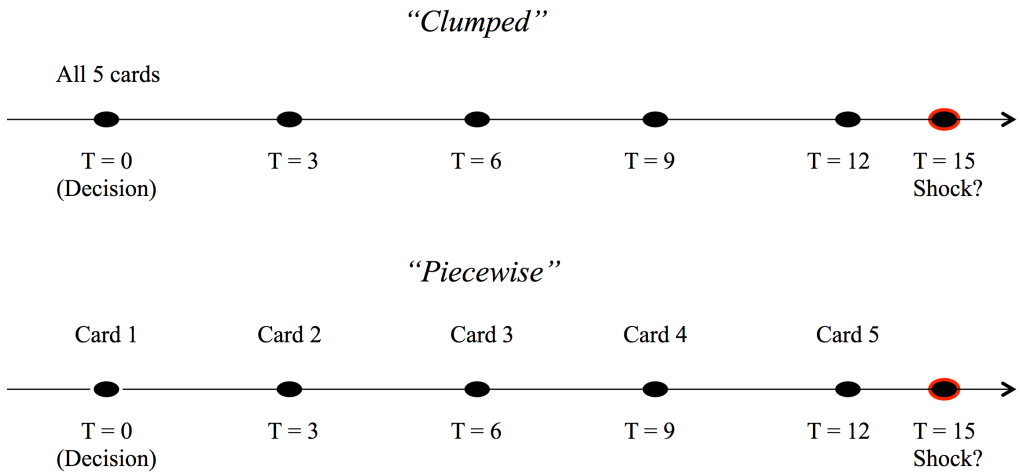


Figure 4: Timeline in the CP-treatments (in minutes). Subjects decide at $t = 0$. The upper panel shows the timeline if the option "Clumped" is chosen. The lower panel displays the timeline if "Piecewise" is chosen.

Appendix B

In the following we formally derive predictions for all models we are considering.

Kőszegi and Rabin (2009)

Applying Kőszegi and Rabin (2009) to our experimental set-up, instantaneous period-t utility for periods $t = 1$ through 5 depends on belief changes in t regarding future consumption:

$$u_t = \gamma_t N(F_t \,|F_{t-1})$$

In period $t = 6$, consumption is realized, and instantaneous utility in that period is given by:

$$u_t = m(c_t)$$

$m(c_t)$ denotes reference-independent consumption utility and we assume for simplicity that $m(c_t) = c_t$. The terms $N(F_t \,|F_{t-1})$ represent "gain-loss utility" from belief changes. $0 < \gamma_1 \leq \gamma_2 \leq ... \leq \gamma_5$ are the weights on gain-loss utilities. The weights γ 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 is realized.

Gain-loss utilities are specified such that subjects compare current and previous beliefs about consumption. Then we have that:

$$N(F_t \,|F_{t-1}) = \mu(\pi_t - \pi_{t-1})$$

$\mu()$ is a "standard" gain-loss utility function. We assume linearity such that $\mu(x) = \eta x$ if $x \geq 0$ and $\mu(x) = \eta\lambda x$ if $x < 0$.

The subject wants to maximize the expected sum of instantaneous utilities. Thus, when choosing between different information conditions, he maximizes

$$EU_0 = \sum_{\tau=1}^{6} u_\tau.$$

We now have all the ingredients necessary to derive predictions for the four different dimensions.

Sooner Versus Later Information

Notice that due to loss aversion in belief changes, information from an ex-ante perspective always decreases utility. Because by assumption, subjects care (weakly) less about belief-changes the further away they are from actual consumption (recall that $0 < \gamma_1 \leq \gamma_2 \leq ... \leq \gamma_5$), it is easy to see that a subject should (weakly) prefer σ_S over σ_L, as this maximizes the distance between information and consumption realization.

When we break up the weak preference and instead consider some subjects with $0 < \gamma_1 < \gamma_2 < ... < \gamma_5$ and some subjects with $0 < \gamma_1 = \gamma_2 = ... = \gamma_5$ (and assume that indifferent subjects randomize), we obtain that the faction of decision-makers choosing σ_S should lie in the interval $[0.5, 1]$.

PREDICTION 1 (Kőszegi and Rabin (2009)): *For choices in the SL-treatments, the fraction of subjects choosing σ_S should lie in the interval* $[0.5, 1]$

Attention Management

Kőszegi and Rabin (2009) do not capture effects of attention on information preferences. Accordingly, choices between σ_S and σ_L should not depend on the level of attention on the consumption event.

PREDICTION 2 (Kőszegi and Rabin (2009)): *Choices between σ_S and σ_L do not depend on the level of attention on the consumption event.*

Clumped Versus Piecemeal Information

As a first step, we compare σ_P with another information structure σ_P'. σ_P' is identical to σ_P, with the exception that $t(s_4|\sigma_P') = t(s_5|\sigma_P') = 4$, i.e., the last two signals are clumped together in period 4. When comparing this intermediate sequence with σ_P, we can focus on these last two signals. Denote by π_3 a subject's belief before receiving the last two signals and denote by $\pi_{4,5}$ the belief after receiving the last two signals. First note that (trivially) in cases where $\pi_3 = 0$ or $\pi_3 = 1$, or where the fourth signal necessarily leads to $\pi_4 = 0$ or $\pi_4 = 1$, the expected utility of the two sequences is identical. For all other cases we can write that expected utility at the beginning of $t = 4$ for the intermediate sequence is given by,[28]

$$\gamma_4\mu(\pi_{4,5} - \pi_3) = \gamma_4\mu(\pi_{4,5} - \pi_4 + \pi_4 - \pi_3) > \gamma_4\mu(\pi_{4,5} - \pi_4) + \gamma_4\mu(\pi_4 - \pi_3),$$

where the last inequality is driven by loss aversion. Because subjects prefer sooner to later information, it also holds that:

[28]Note that we abstract here from consumption utility which is identical in all information sequences.

$$\gamma_4\mu(\pi_{4,5} - \pi_4 + \pi_4 - \pi_3) > \gamma_5\mu(\pi_{4,5} - \pi_4) + \gamma_4\mu(\pi_4 - \pi_3).$$

Thus, we have that

$$EU_0(\sigma_P^{'}) > EU_0(\sigma_P).$$

Subjects prefer the intermediate sequence to the piecemeal sequence (this is stated in more general form in Proposition 1 in Kőszegi and Rabin (2009)). One can easily see that by the same logic,

$$EU_0(\sigma_C) > EU_0(\sigma_P).$$

Subjects strictly prefer the clumped structure to the piecemeal structure. Notice that this prediction is driven by two factors, an aversion to piecemeal information (caused by loss aversion in belief changes), and a (weak) preference for sooner information. Recall that in our experiment we isolate attitudes towards information piece by piece from preferences for sooner or later information by using choices between σ_S and σ_L as a benchmark. For that comparison, Kőszegi and Rabin (2009) predict that the faction of subjects choosing σ_S should be in the interval $[0.5, 1]$, while the fraction choosing σ_C should be 1, i.e., the fraction preferring σ_C over σ_P should be larger than the fraction choosing σ_S over σ_L.

PREDICTION 3 (Kőszegi and Rabin (2009)): *In the CP-treatments subjects strictly prefer σ_C over σ_P. Furthermore, the fraction of subjects choosing σ_C in the CP-treatments is larger than the fraction choosing σ_S in the SL-treatments.*

Variations in Priors

The effects of variations in F_0 on choices between σ_S and σ_L and on choices between σ_C and σ_P are straightforward. Neither the weak preference for σ_S over σ_L, nor the strict preference for σ_C over σ_P hinges on F_0.[29] Thus, the fraction of subjects choosing σ_S should not depend on F_0. Likewise, the fraction of subjects choosing σ_C should not depend on F_0.

PREDICTION 4 (Kőszegi and Rabin (2009)): *The fraction of subjects choosing σ_S (over σ_L) and the fraction choosing σ_C (over σ_P) does not depend on F_0.*

[29] Except of course for trivial cases where F_0 is degenerate, i.e., $\pi_0 = 1$ or $\pi_0 = 0$.

Golman and Loewenstein (2015)

Applying the model by Golman and Loewenstein (2015) to our set-up leads to the following utility function:

$$U(\pi_t, w_t) = \pi_t m(1) + (1 - \pi_t)m(0) + w_t\big(\pi_t v(1) + (1 - \pi_t)v(0) - H(\pi_t)\big)$$

The first part captures standard expected utility over consumption, where we again assume for simplicity that $m(c) = c$. The second part captures belief-based utility. Individuals are assumed to get utility from their beliefs about answers to "questions". In our set-up, the question subjects ask themselves is: "Does the consumption event realize, or not?". w_t captures the degree to which subjects focus attention on these questions, i.e., on future consumption. Attention can potentially be influenced by information. $v(c)$ reflects the degree to which subjects like or dislike thinking about the consumption event. Recall that in our case, the consumption event is an aversive event, an electric shock. Accordingly, it seems plausible to assume that subjects dislike thinking about the possibility of getting shocked. We assume that $v(0) < 0$ and $v(1) = 0$. Finally, individuals in general dislike uncertainty about answers to questions, implying curiosity. Uncertainty is captured by the entropy of the belief distribution $H(\pi_t) = -(\pi_t log(\pi_t) + (1 - \pi_t)log(1 - \pi_t))$.

Notice that, differently from Kőszegi and Rabin (2009), Golman and Loewenstein (2015) do not explicitly model the timing structure of future periods where utility is realized in each period. Instead, the individual utility components in their model should be thought of as aggregates over all future time periods, i.e., sums of (expected) future standard utilities from consumption as well as (expected) future anticipations.

Sooner Versus Later Information

Again, we start by analyzing the benchmark case of choices between σ_S and σ_L. An important factor in the model of Golman and Loewenstein (2015) is the role of attention. Preferences for information critically depend on the level of attention on the consumption event. The main channel is that receiving information about a question can potentially raise the attention weight w_t. Therefore, when analyzing predictions for information choices, one needs to specify the level of attention on future consumption. In the baseline conditions of our experiment where subjects choose between σ_S and σ_L, an effect of information on attention is very limited by design. Several exogenous factors that we already mentioned, e.g., the constant presence and visibility of the electronic device, the relatively short time interval and the lack of opportunities to distract attention, are likely to cause very high levels of attention on the consumption event, regardless of information. Therefore, in the following we analyze a situation where the predominant effect of information on utility from an ex-ante perspective is that it reduces uncertainty. Subjects that choose information sooner can reduce uncertainty from $H > 0$ to $H = 0$.

Thus, from an ex-ante perspective (i.e. before actually receiving the information), for subjects that (at the beginning of $t = 0$) choose σ_S, expected utility is given by:

$$EU(\sigma_S) = \pi_t m(1) + (1 - \pi_t)m(0) + w_t\big(\pi_t v(1) + (1 - \pi_t)v(0) - 0\big).$$

Instead, subjects that choose σ_L remain uncertain, such that expected utility is given by:

$$EU(\sigma_L) = \pi_t m(1) + (1 - \pi_t)m(0) + w_t\big(\pi_t v(1) + (1 - \pi_t)v(0) - H(\pi_t)\big)$$

Accordingly, due to curiosity, we have that:

$$EU(\sigma_S) > EU(\sigma_L).$$

Therefore, in the SL-treatments, subjects should strictly prefer σ_S over σ_L.

PREDICTION 1 (Golman and Lowenstein (2015)): *For choices in the SL-treatments, subjects prefer σ_S over σ_L.*

Attention Management

Recall that in this dimension we are interested in the effects of an exogenous reduction in attention (by offering a distraction activity) on choices between σ_S and σ_L. As benchmark, we again take a situation where attention is high on the consumption event, regardless of the timing of information. In such a situation, curiosity should dominate, leading to a preference of σ_S over σ_L (see above).

Now we move to a situation where attention is exogenously reduced by means of a distracting activity giving rise to a potential effect of information on attention. In other words, attention weight w is now at a lower baseline level, and likely to increase due to information. Denote by w_{info} the attention weight if subjects obtained information and say that $w_{info} > w_{noinfo}$.

Expected utility for subjects that at the beginning of $t = 0$ choose σ_S is given by:

$$U(\sigma_S) = \pi_t m(1) + (1 - \pi_t)m(0) + w_{info}\big(\pi_t v(1) + (1 - \pi_t)v(0) - 0\big).$$

Instead, subjects that choose later information remain uncertain but focus attention less on the aversive stimulus, and expected utility is given by:

$$U('\sigma_L) = \pi_t m(1) + (1-\pi_t)m(0) + w_{noinfo}\big(\pi_t v(1) + (1-\pi_t)v(0) - H(\pi_t)\big)$$

Thus, it can be seen that the curiosity motive remains present. However, now a countervailing motive exists. Sooner information causes attention to rise. Since subjects do not like thinking about the aversive stimulus (recall that $v(0) < 0$ and $v(1) = 0$), higher attention decreases utility. Which motive dominates is likely to be individual-specific. While for some subjects the curiosity motive might still dominate, others now might prefer later information. It could also be that that the two motives basically cancel each other leaving subjects more or less indifferent between sooner or later information. In any case, if the attention motive is strong enough, more subjects should choose later information in AttMain compared to AttControl.

PREDICTION 2 (Golman and Lowenstein (2015)): *The fraction of subjects choosing σ_L should be higher in AttMain compared to AttControl.*

Clumped Versus Piecemeal Information

Concerning choices between clumped and piecemeal information, there is no specific utility-consequence of obtaining information piecewise, except that piecewise information in the CP-treatments also implies a delay of information. Accordingly, Golman and Loewenstein (2015) predict that subjects should prefer clumped information. The model, however, does not predict a distinct aversion to piecemeal information. The choice fractions in the SL-treatments should not differ from the choice fractions in the CP-treatments.

PREDICTION 3 (Golman and Lowenstein (2015)): *Subjects should prefer σ_C over σ_P. There is no specific aversion against piecemeal information, such that the fraction preferring σ_C in the CP-treatments should be similar to the fraction preferring σ_S in the SL-treatments.*

Variations in Priors

One can easily see that variations in priors do affect expected utility in Golman and Loewenstein (2015) in a straightforward way. The less likely the negative outcome ex-ante, the lower is anticipatory disutility. However, neither in the SL- nor the CP-treatments is the utility ranking between the two choice options affected by variations in priors. Therefore, the fraction of subjects choosing σ_S (over σ_L) and the fraction choosing σ_C (over σ_P) should not depend on the prior.

PREDICTION 4 (Golman and Lowenstein (2015)): *The fraction of subjects choosing σ_S (over σ_L) and the fraction choosing σ_C (over σ_P) does not depend on F_0.*

Brunnermeier and Parker (2005)

In Brunnermeier and Parker (2005), individuals experience anticipatory utility, and can freely choose their beliefs in a self-serving way. Discipline on beliefs is generated from potential choice distortions that follow chosen beliefs. The role of information is important in this model framework, because information potentially puts restrictions on the possibility to chose beliefs. Specifically, if information leads to certainty, individuals in the model are no longer able to manipulate their own beliefs.

Formally applying Brunnermeier and Parker (2005) to our set-up where no actions can affect future consumption, expected utility is given by

$$EU(\hat{\pi}_t) = \hat{\pi}_t m(1) + (1 - \hat{\pi}_t) m(0),$$

where $\hat{\pi}$ denotes the chosen belief about future consumption, and $m(.)$ again denotes consumption utility. There are some restrictions on chosen beliefs, in particular $\hat{\pi} = 1$ if $\pi = 1$ and $\hat{\pi} = 0$ if $\pi = 0$. In other words, subjects can only manipulate their beliefs if there is objective uncertainty about future consumption.

Sooner Versus Later Information

When choosing between σ_S and σ_L, sooner information implies that subjects cannot manipulate their beliefs. In other words,

$$EU(\sigma_S) = \pi_t m(1) + (1 - \pi_t) m(0).$$

Instead, for later information, we have

$$EU(\sigma_L) = \hat{\pi}_t m(1) + (1 - \hat{\pi}_t) m(0).$$

Clearly, the optimal choice of beliefs in this case is $\hat{\pi} = 1$, assigning zero probability to receiving the aversive stimulus and we have that

$$EU(\sigma_L) > EU(\sigma_S).$$

PREDICTION 1 (Brunnermeier and Parker (2005)): *For choices in the SL-treatments, subjects prefer σ_L over σ_S.*

Attention Management

In Brunnermeier and Parker (2005), there is no specific effect of attention on information demand. Therefore, both for treatment AttMain and AttControl, the prediction remains that subjects should prefer later over sooner information.

PREDICTION 2 (Brunnermeier and Parker (2005)): *Choices between σ_S and σ_L do not depend on the level of attention on the consumption event.*

Clumped Versus Piecemeal Information

Looking at choices between clumped and piecemeal information, there is no specific utility-consequence of obtaining information piecewise, except that piecewise information in the CP-treatments also implies a delay of information and therefore allows belief manipulation (at least for some period of time). Thus, Brunnermeier and Parker (2005) predict that subjects should prefer piecewise information. The model, however, does not predict a distinct aversion to piecemeal information. Choice fractions between the CP-treatments and the SL-treatments should not differ.

PREDICTION 3 (Brunnermeier and Parker (2005)): *Subjects should prefer σ_P over σ_C. There is no specific attitude towards piecemeal information, such that the fraction preferring σ_P in the CP-treatments should be similar to the fraction preferring σ_L in the SL-treatments.*

Variations in Priors

It can easily be seen that variations in priors in our non-instrumental environment do not affect the capacity to manipulate beliefs (unless of course for the degenerate case $\pi = 0$ or $\pi = 1$). Therefore, subjects should always choose the information structure that allows them to manipulate beliefs, i.e., later information and piecemeal information.

PREDICTION 4 (Brunnermeier and Parker (2005)): *The fraction of subjects choosing σ_S (over σ_L) and the fraction choosing σ_C (over σ_P) does not depend on F_0.*

Ely et al. (2015)

We derive predictions under the assumption that subjects have a preference for suspense, as formalized in Ely et al. (2015). In Ely et al. (2015), information creates more suspense the higher the variance of the belief that is induced by the information. In other words, suspense in a given period t is given by

$$U(E_t(\tilde{\pi}_{t+1} - \pi_t)^2),$$

where $\tilde{\pi}_{t+1}$ is a random variable capturing possible beliefs in $t+1$ induced by the information received in t. U is increasing, reflecting a preference for suspense and assumed to be concave.

Note that $E_t(\tilde{\pi}_{t+1} - \pi_t)^2$ is simply the variance of the belief in $t+1$ given information t, thus we can write.

$$E_t(\tilde{\pi}_{t+1} - \pi_t)^2 = \sigma_t^2.$$

Sooner Versus Later Information

Utility from σ_S^2 is given by

$$E(U(\sigma_S^2)).$$

Likewise, utility from σ_L^2 is given by

$$E(U(\sigma_L^2)).$$

σ_S^2 and σ_L^2 respectively capture the variance of the final belief induced by receiving information. Notice that both for σ_S as well as σ_L subjects are fully informed (in one piece), and consequently $\sigma_S^2 = \sigma_L^2$. The point in time at which utility is generated is irrelevant in Ely et al. (2015), and therefore subjects should be indifferent between sooner and later information. Thus, assuming that indifferent subjects randomize, 50% of subjects should choose σ_L, 50% σ_S

PREDICTION 1 (Ely et al. (2015)): *Subjects are indifferent between σ_L and σ_S and therefore equal proportions of subjects should choose σ_L and σ_S respectively.*

Attention Management

There is no specific effect of attention on information demand.

PREDICTION 2 (Ely et al. (2015)): *Choices between σ_S and σ_L do not depend on the level of attention on the consumption event.*

Clumped Versus Piecemeal Information

Utility from suspense in the clumped information condition is given by

$$E(U(\sigma_C^2)).$$

Instead, in the piecemeal condition, utility from suspense is given by:

$$E\Big(\sum_{t=0}^{4} U(\sigma_t^2)\Big),$$

where σ_t^2 now reflects the belief variance induced by the piece of information in t respectively. By noting that the sum of variances in the piecewise condition equals the variance in the clumped condition, i..e,

$$E\Big(\sum_{t=0}^{4} \sigma_t^2\Big) = \sigma_C^2,$$

and by recalling that U is concave, one can easily see that suspense is higher in the piecemeal condition.

For the comparison between choices in the CP-treatments versus the benchmark SL-treatments, the fraction of subjects preferring piecemeal information should be larger than the fraction preferring lateen information.

PREDICTION 3 (Ely et al. (2015)): *In the CP-treatments subjects strictly prefer σ_P over σ_C. Furthermore, the fraction of subjects choosing σ_P in the CP-treatments is larger than the fraction choosing σ_L in the SL-treatments.*

Variations in Priors

Variations in priors do not affect the preference ranking for the SL- or the CP-treatments.

PREDICTION 4 (Ely et al. (2015)): *The fraction of subjects choosing σ_S (over σ_L) and the fraction choosing σ_C (over σ_P) does not depend on F_0.*

Epstein (2008)

Epstein (2008) differs from the above models in that he provides an axiomatic framework that captures anticipatory utility in order to show which types of patterns in information demand can be accommodated with such a framework. He shows that a dependency of preferences over σ_S versus σ_L on the prior F_0 can be generated. His model does not provide general predictions for choices between σ_S and σ_L, between σ_C and σ_P, and also does not capture a role of attention for information demand. In the following, we show that an example of Epstein (2008) where he uses rank-dependent utility (RDEU) can generate a prediction for the role of priors in information demand.

The key idea in Epstein (2008) is that preference relations might depend on the timing of the resolution of uncertainty. Thus, σ_S is evaluated using a different preference relation than σ_L. In the example we are using here, he employs a standard RDEU function.

Applied to our set-up, for late resolution of uncertainty, expected utility is given by:

$$U('\pi_0) = (1 - g(\pi_0))m(0) + g(\pi_0)m(1).$$

For early resolution of uncertainty, utility is captured by:

$$V('\pi_0) = (1 - h(\pi_0))m(0) + h(\pi_0)m(1).$$

g and h are usual RDEU probability distortion functions. Now assume that h lies above g for probabilities close to 1 and h lies below g for probabilities near 0, or as Epstein (2008) puts it, "h is s-shaped relative to g". This directly implies that subjects will prefer σ_S if π_0 is near 1, and will prefer σ_L if π_0 is near 0.

Appendix C

Perceived Priors

Here we analyze findings from the measure of perceived ex-ante likelihood of getting shocked we elicited for a subset of subjects from the SL- and CP-treatments (133 out of 185). We first demonstrate that our manipulation of prior probabilities was effective in the sense that it had a strong impact on perceived priors. Then we show that (similar to objective priors) subjective priors did not affect information choices.

Table 4: Linear Regression of Perceived Priors

	Perceived ex-ante likelihood	
	(1)	(2)
Prior high	33.101***	33.108***
	(2.084)	(2.060)
Prior low	-40.097***	-40.212***
	(1.583)	(1.491)
Additional Controls	No	Yes
Constant	49.688***	40.767***
	(0.311)	(12.394)
Observations	133	133
(R^2)	0.889	0.889

OLS estimates, robust standard errors in parentheses.
Perceived ex-ante likelihood for receiving a shock is regressed on a set of dummy variables capturing variations in objective priors.
Additional controls include age and gender.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

We find that in the two treatments with a low ex-ante likelihood of getting shocked (SLlow and CPlow) all subjecs stated perceived priors that reflected the fact that getting shocked was less likely than not getting shocked. More specifically, perceived priors of receiving the shocks were always less than (or equal) to 30%. 83% of subjects stated perceived priors of 10% (or lower). For treatments SLmedium and CPmedium 95% of subjects stated priors of exactly 50% (note that in these treatments we also directly told subjects in the instructions that getting shocked and not getting shocked was equally likely). For treatments with a high ex-ante probability of getting shocked (SLhigh and CPhigh) all subjecs stated perceived priors that reflected the fact that getting shocked was more likely than not getting shocked. Perceived priors of receiving the shocks for all subjects were more than (or equal) to 70%. 67% of subjects stated perceived priors of 90% (or higher). These findings are also reflected by regression analysis. In Table 4 we regress perceived likelihood of getting shocked on a set of dummy variables capturing variations in objective priors. The coefficients of the dummy variables are highly significant, indicating that the exogenous variations in priors were effective in manipulating the perceived likelihood of getting shocked.

Next we analyze if subjects' perceived priors affected choices of information conditions. In Table 5 we regress information choices on perceived priors and additional controls. Similar to results from Table 3 where objective probabilities are used, we find no effect of perceived priors on information choices.

Table 5: Probit Estimates of Information Choices

	Dependent variable:			
	Sooner vs. later		Clumped vs. piecemeal	
	(1)	(2)	(3)	(4)
Perceived Prior	-.001	-.002	0.004	0.110
	(0.005)	(0.005)	(0.007)	(0.008)
Additional Controls	No	Yes	No	Yes
Implementation left/right		.101		-.629
		(0.335)		(0.507)
Constant	0.676**	3.642**	1.041***	1.265
	(0.273)	(1.666)	(0.358)	(3.188)
Observations	70	70	63	63
(Pseudo R^2)	0.058	0.0659	0.010	0.278

Probit estimates, robust standard errors in parentheses. In regressions (1) and (2), choice between sooner or later information is regressed on the perceived ex-ante likelihood of getting shocked. In regressions (3) and (4), choice between clumped or piecemeal information is regressed on the perceived ex-ante likelihood of getting shocked. Additional controls include age and gender.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

AttMainMoney and AttControlMoney

Table 6: Probit Estimates of Information Choices

	Dependent variable: Sooner vs. later			
	AttMainMoney and AttControlMoney		All attention treatments	
	(1)	(2)	(3)	(4)
AttMain	.188	.234	-.925***	-.928***
	(0.343)	(0.080)	(0.349)	(0.348)
Money			-.534	-.528
			(0.354)	(0.354)
AttMain*Money			1.113**	1.112**
			(0.488)	(0.488)
Additional Controls	No	Yes	No	Yes
Constant	.307	.108	.842***	.422
	(0.239)	(1.805)	(0.262)	(1.175)
Observations	58	58	118	118
(R^2)	0.004	0.013	0.050	0.051

Probit estimates, robust standard errors in parentheses.

Additional controls include age and gender.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix D

We provide instructions for treatments SLhigh, AttMain and CPmedium, translated into English. We also provide the consent form subjects had to sign at the beginning of the experiment if they wanted to participate, as well the instructions for the calibration phase.

Instructions - SLhigh

Instructions were provided on the computer screen.

Screen 1

Before the experiment begins, in the following you will receive instructions about the experiment. All instructions will be provided on your computer screen. Once you have read and understood all the explanations and information provided on a screen, please press the red button on your keyboard to get to the next screen.

At the very end of the experiment we will distribute a short questionnaire. Afterwards, the experiment ends.

Please note: in this experiment, there are no correct or incorrect answers. You should simply decide based on your own preferences.

For your participation in this study you will receive 20 euros, which will be paid to you at the end of the experiment.

Please put on your headphones now to avoid distractions from other participants. In case you have any questions, feel free to ask the experimenter at any time.

Screen 2

In this experiment, a lottery will determine,

- whether about 15 minutes after the beginning of the experiment you will receive a series of 30 painful electric shocks,

- or whether you will not receive any electric shocks.

In the lottery, receiving the electric shocks is very likely.

If the outcome of the lottery is such that you do not receive the electric shocks, you will definitely not receive any electric shocks throughout the experiment.

If the outcome of the lottery is such that you will receive the electric shocks, a series of 30 shocks will be delivered in random time intervals within a time span of a couple of minutes.

During the 15 minutes, the experimenter will inform you in 3 minute intervals about the time elapsed so far.

Screen 3

In front of you you see 10 sealed envelopes. Each envelope contains a card. This card is either red or blue. In total there is an equal number of red and blue cards. In other words, 5 envelopes contain a red card and five envelopes contain a blue card.

You will soon be asked to select 5 of the 10 envelopes and hand these 5 envelopes over to the experimenter.

The lottery then works as follows: The experimenter will open the 5 envelopes you handed over to him. If **at least** 1 out of the 5 selected envelopes contains a red card, you will receive the series of 30 electric shocks. Otherwise (i.e., if none of the 5 envelopes contains a red card), you will receive no electric shocks. Since the total number of red cards is 5, it is very likely that you will receive the electric shocks.

Screen 4

Please select 5 out of the 10 envelopes and hand them over to the experimenter.

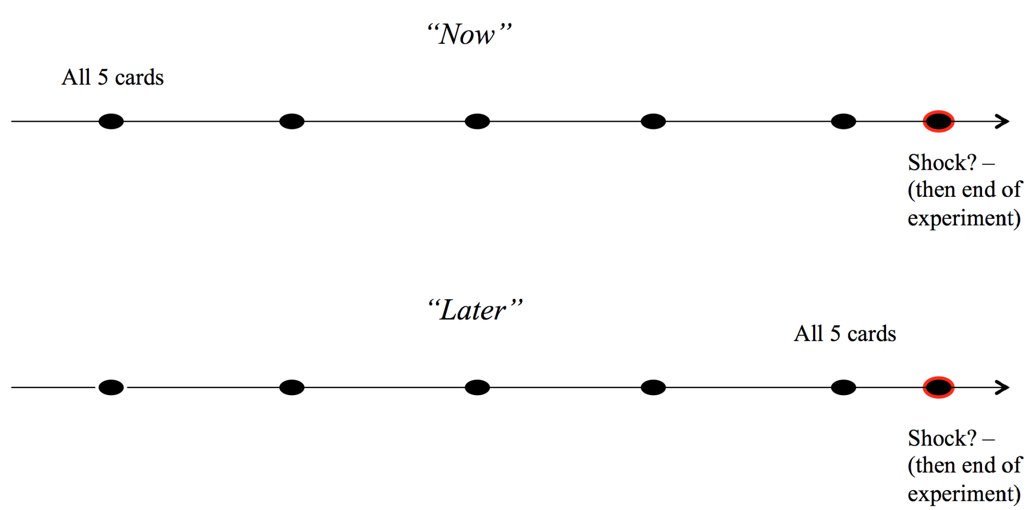
If you want to, you will be given the opportunity to open the remaining 5 envelopes at the end of the experiment to verify that in total there were indeed 5 red and 5 blue cards in the 10 envelopes.

Screen 5

There are two options how you can be informed about whether 15 minutes after the beginning of the experiment you will receive the series of electric shocks or not. You can decide which of the two options you prefer (in terms of timing, the experiment begins with your choice).

- "Now": the experimenter, right at the beginning of the experiment (i.e. right after you made your decision), will open all 5 envelopes, such that you will learn immediately whether you will receive the series of 30 electric shocks or not.
- "Later": the experimenter will open all 5 envelopes later, 12 minutes after the beginning of the experiment (i.e. 12 minutes after you made your decision), such that you will learn after 12 minutes whether you will receive the series of 30 electric shocks or not.

Screen 6



This graph illustrates both options. You can also see from the graph that neither the total duration of the experiment, nor the time when you potentially receive the electric shocks depends on your decision.

Screen 7

Example 1

Imagine that 2 of the 5 cards you selected contain a red card.

"Now": if you decided for the option "now", directly at the beginning of the experiment all envelopes would be opened and you would learn in this example that 2 of the 5 cards are red and that therefore you will receive the series of electric shocks.

"Later": if you decided for the option "later", 12 minutes after the beginning of the experiment all envelopes would be opened and you would learn in this example that 2 of the 5 cards are red and that therefore you will receive the series of electric shocks.

Screen 8

Example 2

Imagine that 4 of the 5 cards you selected contain a red card.

"Now": if you decided for the option "now", directly at the beginning of the experiment all envelopes would be opened and you would learn in this example that 4 of the 5 cards are red and that therefore you will receive the series of electric shocks.

"Later": if you decided for the option "later", 12 minutes after the beginning of the experiment all envelopes would be opened and you would learn in this example that 4 of the 5 cards are red and that therefore you will receive the series of electric shocks.

Screen 9

As already mentioned, your choice in this experiment is whether you want to be informed “now” or “later” about whether you will receive the electric shocks or not.

You can make your choice by simply selecting your preferred option on the decision screen.

The next screen was a waiting screen which was displayed for 10 seconds. Afterwards the next screen appeared.

Screen 11

Remember: Depending on the content of the 5 envelopes you selected, 15 minutes after the beginning of the experiment, you will receive a series of 30 painful electric shocks.

If at least 1 of the 5 envelopes contain a red card, you will receive the series of electric shocks.

After this, subjects could make their choice, i.e., the experiment began.

Instructions - AttMain

Instructions were provided on the computer screen.

Screen 1

Before the experiment begins, in the following you will receive instructions about the experiment. All instructions will be provided on your computer screen. Once you have read and understood all the explanations and information provided on a screen, please press the red button on your keyboard to get to the next screen.

At the very end of the experiment we will distribute a short questionnaire. Afterwards, the experiment ends.

Please note: in this experiment, there are no correct or incorrect answers. You should simply decide based on your own preferences.

For your participation in this study you will receive 15 euros, which will be paid to you at the end of the experiment.

Please put on your headphones now to avoid distractions from other participants. In case you have any questions, feel free to ask the experimenter at any time.

Screen 2

In this experiment you will be participating in a quiz. The quiz will take place at the computer on the desk next to you. The quiz questions cover different topics (for instance sports, geography, history, arts, music etc.). For each question you will be provided with 4 possible answers, of which exactly one will be correct.

You earnings from this experiment increase, the more quiz questions you answer correctly. More specifically, your earnings increase in the level that you are reaching. Once you have answered 10 questions correctly (you do not need to answer 10 questions in a row correctly, what counts is the total number of correctly answered questions) you reach level 2. Afterwards, you always need to answer 20 questions correctly to reach the next level. Your earnings from the quiz are determined as follows:

- Level 1 = 0 euros

- Level 2 = 1 euros
- Level 3 = 2 euros
- Level 4 = 4 euros
- Level 5 = 8 euros
- Level 6 = 16 euros

You can see that your earnings increase substantially, the higher the level that you reach. Notice that the total number of quiz questions is limited. Therefore, you should try to answer each question as best as you can.

Screen 3

The quiz will shortly be interrupted after 4 minutes.

During this interruption you will be asked to make a decision, which we will in the following explain in more detail.

After the interruption, the quiz continues.

Screen 4

In this experiment, a lottery will determine,

- whether about 20 minutes after the beginning of the experiment you will receive a series of 30 painful electric shocks,
- or whether you will not receive any electric shocks.

In the lottery, receiving the electric shocks and not receiving the electric shocks is equally likely.

If the outcome of the lottery is such that you do not receive the electric shocks, you will definitely not receive any electric shocks throughout the experiment.

If the outcome of the lottery is such that you will receive the electric shocks, a series of 30 shocks will be delivered in random time intervals within a time span of a couple of minutes.

Screen 5

In front of you you see 10 sealed envelopes. Each envelope contains a card. This card is either red or blue. In total there is an equal number of red and blue cards. In other words, 5 envelopes contain a red card and five envelopes contain a blue card.

You will soon be asked to select 5 of the 10 envelopes and hand these 5 envelopes over to the experimenter.

The lottery then works as follows: The experimenter will open the 5 envelopes you handed over to him. If **at least** 3 out of the 5 selected envelopes contain a red card, you will receive the series of 30 electric shocks. Otherwise (i.e., if less than 3 out of the 5 envelopes contain a red card), you will receive no electric shocks. Since the total number of red and blue cards is exactly the same, both events are equally likely.

Screen 6

Please select 5 out of the 10 envelopes and hand them over to the experimenter.

If you want to, you will be given the opportunity to open the remaining 5 envelopes at the end of the experiment to verify that in total there were indeed 5 red and 5 blue cards in the 10 envelopes.

Screen 7

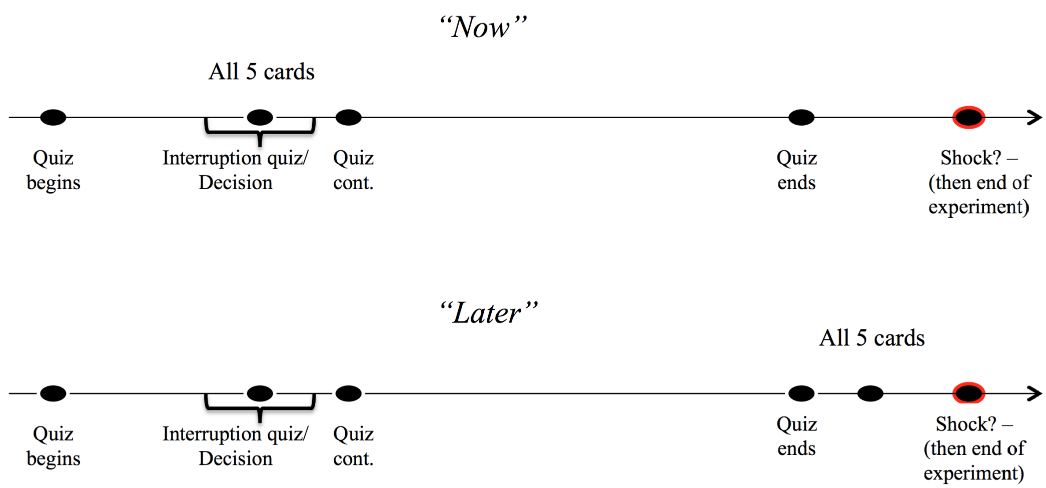
There are two options how you can be informed about whether 20 minutes after the beginning of the experiment you will receive the series of electric shocks or not. During the interruption of the quiz you can decide which of the two options you prefer.

- “Now”: the experimenter will open all 5 envelopes right away (i.e. during the interruption of the quiz), such that you will learn immediately whether you will receive the series of 30 electric shocks or not.

- "Later": the experimenter will open all 5 envelopes later, after the end of the quiz (i.e. about 12 minutes after you decision), such that you will learn after 12 minutes whether you will receive the series of 30 electric shocks or not.

The following two screens illustrate the two options in more detail.

Screen 8



This graph illustrates both options. You can also see from the graph that neither the total duration of the experiment, the sequence of the quiz, the amount of time you can spend on the quiz, or the time when you potentially receive the electric shocks depends on your decision.

Screen 9

Thus, the timing of the experiment is as follows:

- Right after the instructions, the quiz begins.
- The quiz will be interrupted after 4 minutes.

- During this interruption you can decide when you want to be informed about whether you will receive the electric shocks or not.
- If you choose "now", you will be informed immediately, during the interruption of the quiz.
- If you choose "later", you will be informed later, after the quiz ended (i.e. after 12 minutes).
- After the interruption, the quiz will presume. Note again that the length of the interruption is fixed and does not depend on your choice.
- After the quiz, depending on the outcome of the lottery, you will either receive the series of electric shocks, or not.

Screen 10

Example 1

Imagine that 4 of the 5 cards you selected contain a red card.

"Now": if you decided for the option "now", directly after your decision, during the interruption of the quiz, all envelopes would be opened and you would learn in this example that 4 of the 5 cards are red and that therefore you will receive the series of electric shocks. After that the quiz would presume.

"Later": if you decided for the option "later", 12 minutes after your decision, after the quiz ended, all envelopes would be opened and you would learn in this example that 4 of the 5 cards are red and that therefore you will receive the series of electric shocks.

Screen 11

Example 2

Imagine that 2 of the 5 cards you selected contain a red card.

"Now": if you decided for the option "now", directly after your decision, during the interruption of the quiz, all envelopes would be opened and you would learn in this example that 2 of the 5 cards are red and that therefore you will not receive the series of electric shocks. After that the quiz would presume.

"Later": if you decided for the option "later", 12 minutes after your decision, after the quiz ended, all envelopes would be opened and you would learn in this example that 2 of the 5 cards are red and that therefore you will not receive the series of electric shocks.

Screen 12

As already mentioned, your choice in this experiment is whether you want to be informed "now" or "later" about whether you will receive the electric shocks or not.

You can make your choice during the interruption of the quiz by simply selecting your preferred option on the decision screen.

The next screen was a waiting screen which was displayed for 10 seconds. Afterwards the next screen appeared.

Screen 14

Remember: Depending on the content of the 5 envelopes you selected, about 20 minutes after the beginning of the experiment, you will receive a series of 30 painful electric shocks.

If at least 1 of the 5 envelopes contain a red card, you will receive the series of electric shocks.

Screen 15

On the computer on the desk next to you you can now start the quiz.

Instructions - CPmedium

Instructions were provided on the computer screen.

Screen 1

Before the experiment begins, in the following you will receive instructions about the experiment. All instructions will be provided on your computer screen. Once you have read and understood all the explanations and information provided on a screen, please press the red button on your keyboard to get to the next screen.

At the very end of the experiment we will distribute a short questionnaire. Afterwards, the experiment ends.

Please note: in this experiment, there are no correct or incorrect answers. You should simply decide based on your own preferences.

For your participation in this study you will receive 20 euros, which will be paid to you at the end of the experiment.

Please put on your headphones now to avoid distractions from other participants. In case you have any questions, feel free to ask the experimenter at any time.

Screen 2

In this experiment, a lottery will determine,

- whether about 15 minutes after the beginning of the experiment you will receive a series of 30 painful electric shocks,
- or whether you will not receive any electric shocks.

In the lottery, receiving the electric shocks and not receiving the electric shocks is equally likely.

If the outcome of the lottery is such that you do not receive the electric shocks, you will definitely not receive any electric shocks throughout the experiment.

If the outcome of the lottery is such that you will receive the electric shocks, a series of 30 shocks will be delivered in random time intervals within a time span of a couple of minutes.

During the 15 minutes, the experimenter will inform you in 3 minute intervals about the time elapsed so far.

Screen 3

In front of you you see 10 sealed envelopes. Each envelope contains a card. This card is either red or blue. In total there is an equal number of red and blue cards. In other words, 5 envelopes contain a red card and five envelopes contain a blue card.

You will soon be asked to select 5 of the 10 envelopes and hand these 5 envelopes over to the experimenter.

The lottery then works as follows: The experimenter will open the 5 envelopes you handed over to him. If **at least** 3 out of the 5 selected envelopes contain a red card, you will receive the series of 30 electric shocks. Otherwise (i.e., if less than 3 out of the 5 envelopes contain a red card), you will receive no electric shocks. Since the total number of red and blue cards is exactly the same, both events are equally likely.

Screen 4

Please select 5 out of the 10 envelopes and hand them over to the experimenter.

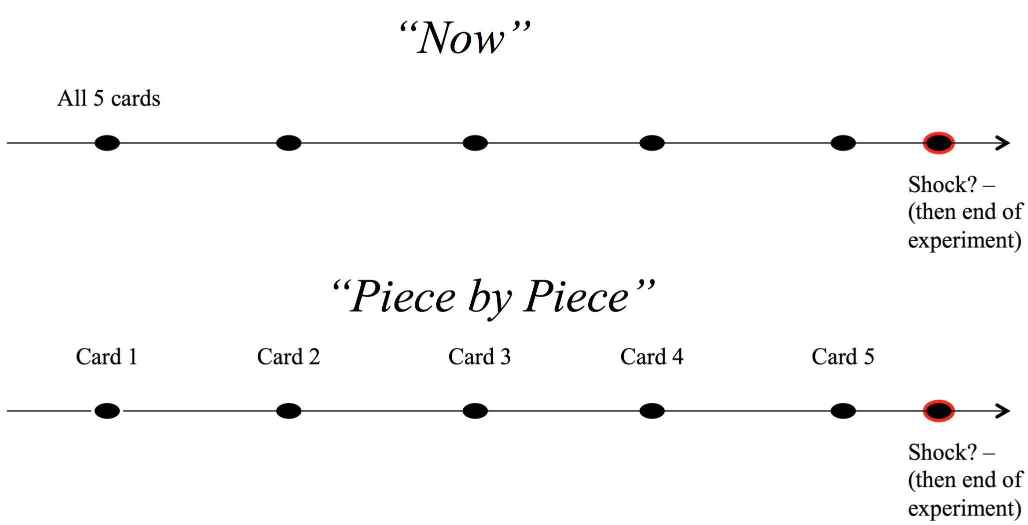
If you want to, you will be given the opportunity to open the remaining 5 envelopes at the end of the experiment to verify that in total there were indeed 5 red and 5 blue cards in the 10 envelopes.

Screen 5

There are two options how you can be informed about whether 15 minutes after the beginning of the experiment you will receive the series of electric shocks or not. You can decide which of the two options you prefer (in terms of timing, the experiment begins with your choice).

- "Now": the experimenter, right at the beginning of the experiment (i.e. right after you made your decision), will open all 5 envelopes, such that you will learn immediately whether you will receive the series of 30 electric shocks or not.
- "Piece by piece": the experimenter will open one envelope after the other, in intervals of several minutes - more precisely the experimenter always opens one envelope when he informs you about the time elapsed so far. Thus, right at the beginning of the experiment (i.e. right after you made your decision), you will learn the color of the card of the first envelope. Three minutes later, the second envelope will be opened and you will learn the color of the card from the second envelope. Three minutes later the next envelope is opened, and so on, until all 5 envelopes are open and you will know whether you will receive the series of 30 electric shocks or not.

Screen 6



This graph illustrates both options. You can also see from the graph that neither the total duration of the experiment, nor the time when you potentially receive the electric shocks depends on your decision.

Screen 7

Example 1

Imagine that 4 of the 5 cards you selected contain a red card.

“Now”: if you decided for the option “now”, directly at the beginning of the experiment all envelopes would be opened and you would learn in this example that 4 of the 5 cards are red and that therefore you will receive the series of electric shocks.

“Piece by piece”: if you decided for the option “Piece by piece”, directly at the beginning of the experiment one envelope would be opened. This envelope then for example contained a red card. 3 minutes later the next envelope would be opened, for example containing a blue card. Again 3 minutes later the next envelope would be opened, containing a red card. After the opening of the next envelope you would, in this example, know that you will receive the series of electric shocks.

Screen 8

Example 2

Imagine that 2 of the 5 cards you selected contain a red card.

“Now”: if you decided for the option “now”, directly at the beginning of the experiment all envelopes would be opened and you would learn in this example that 2 of the 5 cards are red and that therefore you will not receive the series of electric shocks.

“Piece by piece”: if you decided for the option “piece by piece”, directly at the beginning of the experiment one envelope would be opened. This envelope then for example contained a blue card. 3 minutes later the next envelope would be opened, for example containing a red card. Again 3 minutes later the next envelope would be opened, containing a blue card. The next envelope then for example contained a red card. After the opening of the last envelope you would, in this example, know that you will not receive the series of electric shocks.

Screen 9

As already mentioned, your choice in this experiment is whether you want to be informed "now" or "piece by piece" about whether you will receive the electric shocks or not.

You can make your choice by simply selecting your preferred option on the decision screen.

The next screen was a waiting screen which was displayed for 10 seconds. Afterwards the next screen appeared.

Screen 11

Remember: Depending on the content of the 5 envelopes you selected, 15 minutes after the beginning of the experiment, you will receive a series of 30 painful electric shocks.

If at least 3 of the 5 envelopes contain a red card, you will receive the series of electric shocks.

After this, subjects could make their choice, i.e., the experiment began.

Consent Form

Upon arrival in the lab, subjects were welcomed and asked to carefully read all the information provided on the consent form. In case a subject was willing to participate, the subject was asked to sign the consent form.

Information for participating in this experiment of the BonnEconLab

Dear participant,

welcome to this study. For participating in this study, you will receive 20 euros.

As part of this study, it can happen that you will receive a somewhat painful electric stimulus via two electrodes attached to your wrist. In the following we will provide you with more information about the electric shocks. Should you decide to participate in this study, we will ask you to sign a consent form. After this, you will receive detailed information and instructions about your tasks and all the details of the experiment. Please read the following information carefully and feel free to ask questions at any time.

Information

As part of this study, you might receive a somewhat painful electric stimulus via two electrodes, that will be attached to your wrist. The electric stimulus will be administered with devices that are specifically tailored for scientific purposes. This method has been used in many studies without any complications.

The level of electric shocks will be adapted to your individual pain perception. For this, your individual pain perception will be calibrated on a simple scale.

The scale goes from 1 to 10 and looks as follows:

On the scale, a “2” should reflect a shock intensity that you were just able to detect. A “8” should reflect an intensity that you are maximally able to tolerate.

Example: the first time you are able to perceive the stimulus, you rate it with a “2”. The subsequent stimuli will have a higher intensity, so, depending on how you perceived them, you maybe rate them with a “3” or a “4”. Once you have reached “8”, the calibration phase is over.

You cannot participate in this study if one of the following applies to you:

- Pregnancy
- Programmable devices in your body (e.g., insulin pump, heart pacemaker)
- Currently under pain medication
- Chronic pain syndrom
- Heart diseases
- Age below 18

The electric shocks are medically harmless. However, we would like to mention the following: The shocks can lead to a small increase in body temperature. Also stimulation of nerves can occur. Finally, we need to inform you that for this study there exists no special insurance for participants. Insurance coverage therefore only exists via the liability insurance of the University of Bonn.

Consent form

Name of participant:

I have read the information provided above and the experimenter *name of experimenter* answered the questions I had.

Please check all that apply:

- I have read and understood the consent form as well as the information for participants. Questions have been discussed and answered. I had a sufficient amount of time to decide whether I want to participate in this study or not.
- I was informed my participation in this study is entirely voluntary. I can withdraw my consent to participate in this study any time. Also the experimenter can stop the study any time he wants based on his experiences.
- I agree to participate in this study.

Finally, participants were asked to state if any of the above mentioned exclusion criteria applied to them.

Instructions - Calibration

We will now measure your individual pain perception using a simple scale. This is done to ensure that the intensity of the electric stimulus you will receive is still tolerable for you.

The scale goes from 1 to 10 and looks as follows:

We will begin with a very low shock intensity. The intensity is then gradually increased. After every shock, you can rate how you perceived this shock using this scale.

On the scale, a “2” should reflect a shock intensity that you were just able to detect. A “8” should reflect an intensity that you are maximally able to tolerate.

Example: the first time you are able to perceive the stimulus, you rate it with a “2”. The subsequent stimuli will have a higher intensity, so, depending on how you perceived them, you maybe rate them with a “3” or a “4”. Once you have reached “8”, the calibration phase is over.