

# The Effect of Grammatical Variation on Economic Behavior

Varying Future Time References within the German Language

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**Abstract:** We test the proposed impact of *future-tense reference* on economic decision-making. To this end, we implement a within language framing experiment, varying exclusively the grammatical reference of future events. We do so by leveraging the grammatical structure of the German language, thereby avoiding the introduction of potential confounds, present in cross-lingual studies. In our results, we find no supporting evidence for a causal link between a language’s grammatical structure and the speaker’s economic decision-making in the time discounting and risk domain. We find weak support for impacts on individuals’ believe formation. Our results hint at the fact that a language or grammar dummy absorbs facets of culture not captured by a culture dummy.

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# 1 Introduction

Known as the ‘Sapir-Whorf Hypothesis’ among linguists (e.g., Regier and Kay, 2009), research has long since conjectured that language-specific idiosyncrasies, like differences in grammatical structures (e.g., Cook et al., 2006; Daniel L. Everett, 2005; Daniel L. Everett, 2012), distinct means to describe physical properties (e.g., colors Winawer et al., 2007; Franklin et al., 2008), or non-physical occurrences like emotions (e.g., Lindquist et al., 2006), can affect human behavior and perception.

Cook et al. (2006) show for bilingual English-speaking subjects from Japan scoring highly on English tests, that they exhibit significant tendencies to classify material objects more in line with US than with Japanese monolinguals. Winawer et al. (2007), testing Russian and English native speakers for their color discrimination capabilities, find Russian native speakers to be faster in differentiating colors close in spectrum compared to English native speakers. They attribute the advantage of Russian native speakers to the more diverse color nomenclature available in the Russian language compared to English. Majid et al. (2004) find that frames of references in spatial tasks varied cognitively with the linguistic differences of the respective native languages of children.

Investigating grammatical peculiarities of different languages, the seminal contribution by K. Chen (2013) studies the impact of *future-time reference* (henceforth FTR) on saving and health-oriented behavior. FTR classifies how strongly descriptions of future and current events are grammatically segregated. *Strong-FTR* languages mandate the use of specific grammatical indicators when talking about the future, contrary to *weak-FTR* languages, where future events can be referenced using the present tense.<sup>1</sup> Studying World Bank savings data, K. Chen (2013) finds a strong relationship between weak-FTR languages and higher rates of savings or lower rates of types of behavior detrimental to health. He postulates that two channels may influence his results. Either *weak-FTR* languages let future events appear more immediate (Linguistic-Savings Hypothesis) or weak-FTR languages cause an imprecision of beliefs about the timing of a future event, also making saving more attractive. However, given potential confounds in the underlying non-experimental real world-data, K. Chen (2013) cautions from interpreting his results as causal. He states that the direction of

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<sup>1</sup>Examples for *strong-FTR* languages are: English, Arabic, Italian, and Korean. Exemplary for *weak-FTR* languages are German, Japanese, and Brazilian Portuguese.

the linkage of language and behavior is unclear and that language might be a reflection of “deeper differences” transported with the language itself.

To test K. Chen’s 2013 language behavior relationship, Sutter et al. (2015) implement a set of delayed gratification task experiments with German (weak-FTR) and Italian (strong-FTR) native tongue school children in southern Switzerland. Sutter et al. (2015) find that German native-tongue schoolchildren show a significant inclination to delay gratification longer, concluding that strong-FTR languages indeed induce higher impatience in their native speakers.

Li (2017) uses bilingual (English-Chinese) Hong Kong citizens to test the impact of Chinese and English framing on risk and prosocial behavior. Li (2017) finds suggestive evidence that subjects change their beliefs about the behavior of others if tasks are presented in language frames differing in FTR. Additionally, Li (2017) finds a preference for “Chinese lucky numbers” when the experiment is framed in Chinese, indicating differing cultural mindsets caused by a change in lingual frame. In our opinion, both results relate to “deeper differences” cautioned by K. Chen (2013).<sup>2</sup>

Literal translations in different languages have been shown to evoke diverging concepts and transmit particular supplementary information in the respective language (Houser, McCabe, Smith, et al., 2004; Majid et al., 2004; Briley, Morris, and Simonson, 2005; Luna, Ringberg, and Peracchio, 2008; Van Nes et al., 2010).<sup>3</sup> A recent study by Thompson, Roberts, and Lupyan (2020), investigating word meanings using semantic alignment across different languages, shows low correlations in all investigated domains, supporting the idea of deviating concepts contained in literal translations.

Consequently, a clean identification strategy, aiming at testing whether addressing a future event in the future or present tense impacts economic decision-making, needs to avoid the confounds described above. Ideally the language is kept constant across treatments to avoid the transmission of deviating concepts and or varying cultural mindset. The German

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<sup>2</sup>While the discipline of linguistics does not know the term *belief*, it employs the term *perception* in a similar fashion. Under that terminological umbrella, linguists cluster together those lingual effects affecting *visual* perception (e.g., Athanasopoulos et al., 2010) as well as such effects affecting the *abstract* perceptions of concepts, such as duration (e.g., Bylund and Athanasopoulos, 2017) or professional ideas (e.g., Monti-Belkaoui and Belkaoui, 1983). For this reason, it is not unreasonable to draw the connection between the latter and what economists define under the term *beliefs*.

<sup>3</sup>An example is the concept of “police”. While in nations with low corruption and high trust in state authorities, “police” is often connoted with the concept of “helper”, this certainly is not the case for people living in states where corruption is rife and the populace is violently suppressed by state authorities. While this is a very salient example, the issue is still valid for smaller and less obvious conceptual differences.

Table 1: Comparison of Future Time Reference Options in English and German

	English	German
Future	I am <i>going to</i> buy groceries <u>soon</u> .	Ich werde <u>bald</u> Lebensmittel einkaufen gehen.
Present	<b>Incorrect:</b> I buy groceries <u>soon</u> .	Ich gehe <u>bald</u> Lebensmittel einkaufen.

<sup>\*</sup> Grammatical future time reference marker is shown in *italic*

<sup>\*</sup> Unspecified temporal marker is underlined

language allows identical future events to be referenced in the present and the future tense equally without becoming grammatically false (Dahl, 2000; Dahl and Velupillai, 2005; K. Chen, 2013).

According to K. Chen (2013), German is classified as a weak-FTR language as it does not necessitate a grammatical marker when referencing the future. However, the German language still incorporates specific grammatical markers for the future tense. German offers different options to a speaker for referencing future events while staying grammatically correct (Dahl, 2000; Dahl and Velupillai, 2005). One option is to reference future events in the future tense, which necessitates the use of a *specific* grammatical marker. The second option is to reference future events in the present-tense in conjunction with at least one *unspecific* temporal marker.<sup>4</sup> The *unspecific* temporal marker, though not necessary, can equally be integrated in the future reference by future tense. To illustrate Table 1 provides an example, comparing English and German language FTR properties. The sample sentence shows that there is only one correct way to refer to a future event within the English language. English necessitates a grammatical marker for future event referencing, in the example "going to", and is classified as strong-FTR by K. Chen (2013). The German language, like English, can express future events using a grammatical marker which shifts the verb to a future tense form. In the following, we refer to this grammatical construct as the *future-tense future reference* (henceforth FF). However, it is also possible the use the verb in a present tense form if an unspecific temporal marker exists. In the example, this temporal marker is "soon" (German: "bald"). We will refer to this grammatical construct as the *present-tense future reference* (henceforth PF).<sup>5</sup>

<sup>4</sup>Unspecific temporal markers in this sense are words such as *soon* or *afterwards*.

<sup>5</sup>Note that the unspecific temporal marker is used in both sentences. While it is not required in an FF grammatical structure, as the specific temporal marker indicates a future setting, it is required in a PF structure. As it is required in a PF structure and allowed in an FF structure, we always included the unspecific temporal

This feature of the German language allows us to vary *solely* how future events are grammatically referenced and permits us to investigate the impact of FTR on subjects' economic decision-making, while avoiding the introduction of confounds contained in multilingual experiments. Making use of this particularity of the German language, our study tries to provide a clean identification strategy for the effect of *future tense reference* on economic decision-making within a single language.

In order to investigate the effect of differing FTR on economic decision-making, we implement a delayed-gratification and a risk-aversion task, varying German FF and PF between subjects. To account for potential shifts in beliefs, we further implement a number of vignettes to disentangle whether varying the grammatical frame for future events influences subjects' judgement of the likelihood and immediacy of future events.<sup>6</sup> To our knowledge, we are the first to investigate the causal link between grammatical variations in framing of future events and people's risk and time preferences within a single language.

Comparing subjects' behavior in PF vs. FF framing in the German language, we find little evidence for an impact on people's risk aversion and time preferences. We find weak support for an impact on people's beliefs about the immediacy and probability of events occurring in the future. The impact on beliefs, however, appears to be easily overpowered by preconceived notions held by the subjects. Personal preferences for one or the other grammatical structure do not seem to play a role in subjects' choices.

The paper proceeds as follows. In the following Section 2 we outline our approach as well as the experimental design of the study. The subsequent Section 3 presents our findings. Section 4 summarizes the findings.

## 2 Experimental Design

We implement a between-subjects experimental design to elicit the effect of varying the way future events are grammatically referenced in the German language on the *time* and *risk preferences* of German native speakers. We also implement a number of vignettes to investigate potential impact on the subjects' beliefs about immediacy and likelihood of an

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marker in both framings during the experiment in order to vary only the grammatical tense of the verb.

<sup>6</sup>Framing something in the present tense might convey the event as being more likely and/or more immediate to occur than a framing in grammatical future tense (K. Chen, 2013).

event occurring. To this end, we specifically designed the experimental texts to include clean and unobtrusive grammatical variations allowing for a strong framing.

Additionally, we designed a task to elicit subjects' preferences for a specific grammatical tense, which might mitigate the efficacy of the respective framing. Concluding the experiment, subjects answered a socioeconomic survey. With the exception of the task investigating subjects' preferences for a grammatical tense and the socioeconomic survey, every bit of text referencing future occurrences is framed in either PF or FF. This includes task descriptions, vignettes, as well as introductory explanations about the experimental session, behavioral rules, and matters of payment.

## 2.1 Time-Preferences – Choice List

The time-preferences elicitation task, henceforth called TimeGame, is a choice between 10 different payment schemes.<sup>7</sup> The implementation is mathematically equivalent to the traditional choice list approach (e.g., Andersen et al., 2008). Each payment scheme corresponds to a small interval of discount rates. Each scheme could be inspected by subjects before selecting the preferred one. A selection could easily be changed until final submission. Before submitting their choice, at which point no change would be possible anymore, a popup window would ask subjects to confirm their choice. Payment schemes beginning at a later date paid more money overall. The payment schemes are constructed in such a way that they all pay a fixed amount of money once a week over six consecutive weeks. The money is transferred to subjects' bank accounts on the dates corresponding to the chosen payment schemes. All payment schemes start at least one week after the experiment ended to avoid any biases (Burks et al., 2012; Benhabib, Bisin, and Schotter, 2010) or confounds introduced by participating at a date later than a payoff scheme's start. We opted for a simple task because an online experiment only offers limited means to explain an assignment (Dave et al., 2010).<sup>8,9</sup>

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<sup>7</sup>See supplementary online materials for screenshots of the experiment

<sup>8</sup>Other tasks for eliciting time preferences were considered, e.g., a nested choice list based on Attema et al. (2015), but deemed unsuitable for an online experiment during a trial runs due to complexity.

<sup>9</sup>Appendix A2 provides detailed calculations.

## 2.2 Risk-Preferences – The BombGame

We elicited the risk aversion of individuals using a variation of the BombGame introduced in Crosetto and Filippin (2013). During the selection stage of the BombGame, subjects are presented with 100 numbered fields. 99 fields hold cash prices, each valued at 0.20€. The remaining field contains a destructive option, represented by a bomb, which is placed in the  $10 \times 10$  matrix at random. If selected, the bomb field nullifies all gains from the other fields, leaving the subjects with a zero payoff from this task.<sup>10</sup> Subjects select as many fields as they like, but are not informed of the selected fields' content. The result from this task is revealed on a later page in order to not affect the decision for the other tasks. During the BombGame subjects construct their own preferred lottery. Therefore, as the risk of selecting the bomb field increases with the absolute number of selected fields, this task provides us with a good measure of a subject's risk preferences.

The order of the risk-preference and time-preference elicitation tasks is randomized on the subject level to control for possible order effects.

## 2.3 Belief Elicitation Vignettes

The belief elicitation vignettes consist of small paragraphs in the range of three to five sentences. In total, eight vignettes are shown to subjects, consisting of four vignettes concerning *likelihood* and four concerning *immediacy* of events.<sup>11</sup> To the authors' knowledge, no vignettes existed prior to this study to investigate this relationship. Consequently, the vignettes are specifically designed for our experiment. They, too, were tested in a small pilot study with non-incentivised subjects prior to implementation.

### 2.3.1 Immediacy

The first set of vignettes investigates whether varying FTR influences the perceived *immediacy* of an event when no explicit information of a future date is provided. Subjects choose the point in time they think reflects the average of what the other subjects estimated to be the most likely time frame when the described event would occur. The time frame could be chosen from ten predefined intervals, ranging from “within a week” to “later than 6 months”.

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<sup>10</sup>See screenshot in the supplementary online material.

<sup>11</sup>See section A3 of the appendix for a complete overview of the vignettes in FF and PF framing.

Payments depend on a subject's answer either being adjacent to the average prediction of all answers (0.50€) or guessing the exact average prediction (1.00€).

### 2.3.2 Likelihood

To investigate the domain of risk, we elicit whether varying FTR influences to the perceived likelihood of events. During a vignette, subjects are asked to guess the average likelihood of an event occurring in the future as indicated by the other participants. Input is possible either via a slider ranging between [0 : 100] or via direct numerical input. Manually moving the slider sets the numerical value. The slider button is initially hidden until the slider bar is clicked at to prevent setting an anchor. The slider is also color-coded (red for less likely and green for more likely) to improve usability during the online experiment.<sup>12</sup> Subjects would receive a payment of 0.50€ if their answer lies within five percent of the average of all subjects' answers for this vignette, given the same treatment. If subjects managed to guess the correct average, they would receive a payment of 1.00€.

Fischbacher et al. (2010) show that such incentive schemes are a reliable method for the elicitation of beliefs, while at the same time reducing the possibilities for hedging. The likelihood and immediacy vignettes are presented to subjects in blocks of the same type to avoid confusion about what needs to be assessed. The order of the blocks and the order of the vignettes within each block are randomized on the subject level.

As the experiment was conducted as an online study, we designed vignettes in such a way that the content, while easy to understand and believable, had to be completely fictional. This means no factual information about dates in regard to the content could be found. However, while no factual content can be found online, depending on the topic of the vignette, it may be possible either to find related information or come into the experiment with a strong preconception about the topic. The latter could interfere with an induced framing effect. At the same time, we can exploit such an effect to serve as a boundary on the stability of a grammatical framing effect. Consequently, while we had four vignettes in both categories, we opted to include one topic in each category which would offer the possibility to invite additional information, outside preconceptions, or predispositions. The immediacy vignettes contain a scenario incorporating the topic of Bitcoin.<sup>13</sup> The likelihood vignettes

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<sup>12</sup>See the supplementary online material section for screenshots of the experiment

<sup>13</sup>The topic was widely discussed at the time of the experiment, exhibiting a high prevalence in newspaper



include a topic concerning the German city of Buxtehude, which offers itself to preconceived notions.<sup>14</sup> These are the vignettes labelled (d) and (h), respectively.

Concerning the content and topic of the other vignettes, we could not deduce any systematic outside influence, which means that only such information as provided in the respective vignette is available to subjects. The likelihood vignettes covered topics ranging from announcements of a German Federal authority and a multinational consulting firm to a business forecast of a European airport. For the immediacy vignettes, topics touched upon the Bonn EconLab, announcements concerning roadworks, and the scheduling of a city council meeting regarding broadband internet. We chose the design of the vignettes to include specific scenarios as the vignettes needed to be easily understood, believable, and feature plausible occurrences as the plausibility of the content necessitates a well-considered answer. In a small pilot, no evidence was found that subjects found the content unbelievable or hard to grasp.

## 2.4 Paragraph Construction and Questionnaire

The paragraph construction task elicits subjects' preferences for a tense used to express future events in the German language. Preferences for a specific tense might impact the efficacy of the respective treatment. To this end, subjects have to construct a paragraph consisting of 5 sentences. For each sentence, two versions are provided to each subject; one is in the present tense, while the other is in the future tense. A subject then has to decide which combination of sentences she considers to feel most natural. Since this task potentially draws the subjects' attention to the linguistic aspect of the experiment, the paragraph construction task is placed after all other tasks. As subjects select their preferred tense for a specific sentence, a complete paragraph is generated and shown to subjects, who can make changes to their choices before submission. The paragraph contains a short news report about an urban redevelopment project and future plans for the area. Just as in the vignettes, we

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articles and online blog posts.

<sup>14</sup>Buxtehude is a city in northern Germany which many southern Germans consider a proverbial place (Förste, 1995) 'where nobody wants to go or nothing ever happens, i.e., a faraway, place of no concern to anybody'. Many are surprised when they learn of its real existence. The real city is located near Hamburg. A potential origin of this peculiar association is that the city prominently featured in a children's tale by Ottfried Preußler in the early 1960s. The city would be a faraway place where a warlock would go using his broomstick (Preußler, 1962). The story has been continuously retold in popular media and the city features prominently in modern day German children's tales. (e.g., Watson, Holm, and Heike, 1992; Bartos-Höppner, 2010; Michael, 2018).

chose a topic that was easy to grasp and could not be related to any factual occurrences in a systematic way.

Finally, subjects filled in a survey. The survey includes self-reported measures for risk aversion (Dohmen et al., 2011) and elements from the German SOEP (Wagner, Frick, and Schupp, 2007), as well as questions on socioeconomic characteristics.<sup>15</sup>

## 2.5 Implementation

The experiments were programmed and conducted as online experiments using the experimental software *oTree* (D. L. Chen, Schonger, and Wickens, 2016). This was done to allow for a larger number of participants to pick up on potential null-effects. In order to assess the criteria under which our design is able to pick up on potential null-effects, we primarily considered the paper by K. Chen (2013), as it is the most widely-cited in this domain. The author finds that the odds of an individual saving within the year is twice as high for wFTR speakers compared to sFTR speakers. That effect level remains, regardless of the controls added. While such an effect may conventionally be seen as a strong effect, we used the data available from K. Chen (2013)<sup>16</sup> to estimate the required number of individuals. Consequently, in order to test for an effect size of the magnitude found in K. Chen (2013) with a power in the 95% confidence interval, we require a minimum of 1,083 observations under our experimental design. We therefore opted for the implementation as an online experiment, using subjects from the Bonn EconLab's subject pool.<sup>17</sup> Usage of the experimental software *oTree* (D. L. Chen, Schonger, and Wickens, 2016) allowed us to design the experiment to be accessible from a large variety of devices, especially mobile devices.

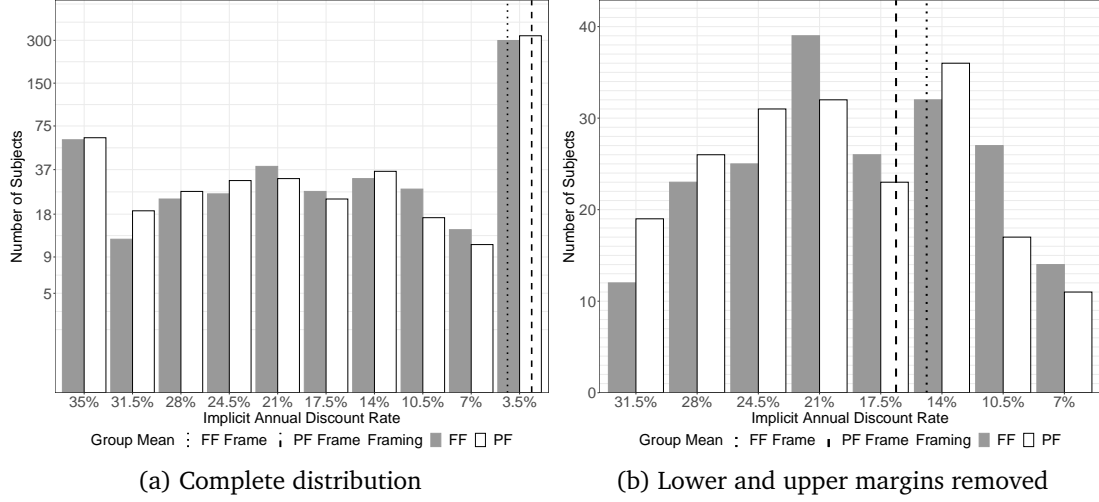
1,389 subjects participated during the online session and were assigned to one of two treatments – *Present Tense Future Reference (PF)* or *future tense Future Reference (FF)* framing – at random. 234 individuals were excluded from the analysis because they either had not completed the experiment in full or had participated twice, in which case only the observations from their first participation are included. Observations of the remaining 1137 subjects are considered in our analyses. Of these subjects, 557 were treated with the *future* and 580

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<sup>15</sup>For a comprehensive list, see the supplementary online material.

<sup>16</sup>The data as well as the code may be downloaded from [www.openicpsr.org](http://www.openicpsr.org). We adapted the code and used the R packages *pwr* and *effsize* for the calculations.

<sup>17</sup>Online experiments were shown to yield reliable results when compared to traditional lab studies, despite lower stakes (Paolacci, Chandler, and Ipeirotis, 2010; Amir, Rand, et al., 2012).



Note: Distribution of choices by treatment for the time-preference task. Panel (a) shows the distribution for 1,137 (557 FF; 580 PF) observations; panel (b) shows the distribution for 393 (198 FF; 195 PF) observations, given that the lower and upper margins are removed. The dashed lines show the median of choices for the respective treatment. Presentation in absolute values.

Figure 1: Distribution of TimeGame Choices

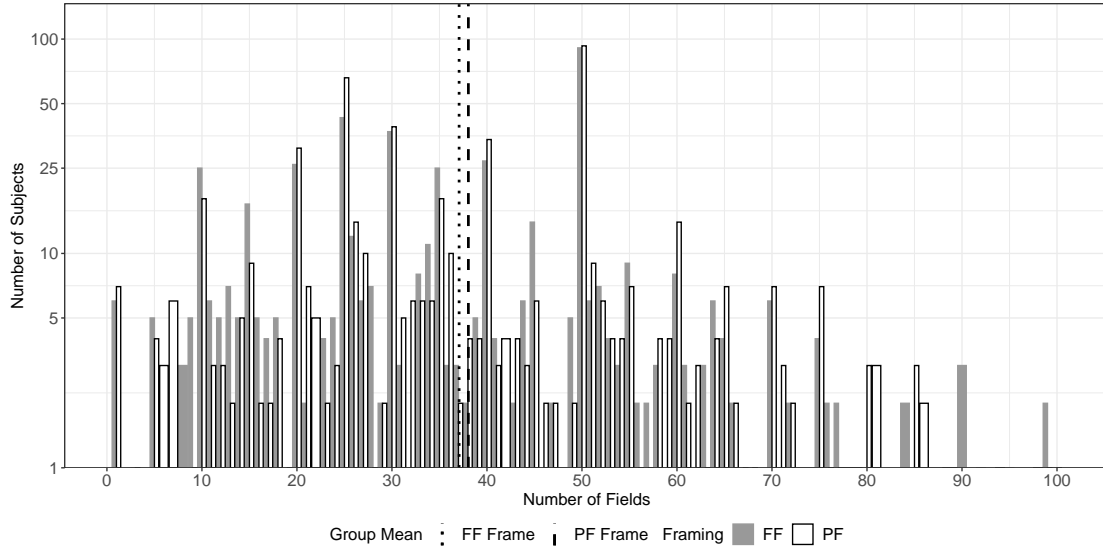
with the *present* tense framing.

### 3 Results

#### 3.1 Time Preference Elicitation Task and Risk-Aversion Task

Figure 1a presents the distribution of decisions in the time-preference elicitation task. A  $\tilde{\chi}^2$ -test yields a  $p\text{-value}^{\text{Time}} = 0.674$ , leading us not to reject the null-hypothesis of no significant difference in chosen payoff schemes between the two treatments. As the large number of responses at the lower and upper limit could mask existing distributional differences, we remove the observations in the lower and upper margins for a secondary test. The distribution of the reduced data set is shown in figure 1b. A  $\tilde{\chi}^2$ -test on the reduced set yields a  $p\text{-value}^{\text{TimeNC}} = 0.525$ , showing no significant differences in payoff scheme selection between the two treatments. Results from Tobit regressions, presented in section A2.1 of the Appendix, support these results.

In the next step, we analyze the results of the risk-aversion elicitation task. Figure 2 displays the distributions of individually selected number of lottery fields in each treatment.



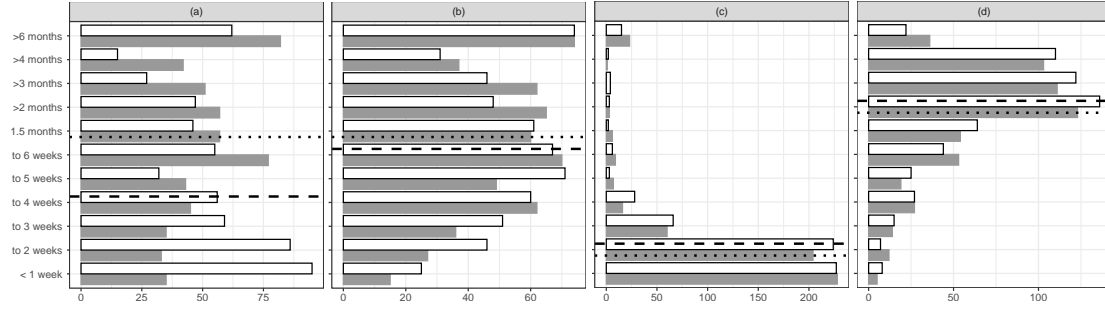
*Note:* Distribution of the number of individually selected lottery fields during the risk-aversion elicitation task for 1,137 (557 FF; 580 PF) subjects. The dashed lines indicate the respective median. Presentation in absolute values.

Figure 2: Number of Selected Fields in the BombGame

The visual representation suggests that choices in the risk-aversion task match closely across treatments. This result is supported by a Mann-Whitney-Wilcoxon test (U-test) which yields a  $p\text{-value}^{\text{Bomb}} = 0.364$ . Given the observations in our sample, we cannot reject the null-hypotheses for equality of distributions for the time preference and risk preference elicitation task. The implemented future and present tense framing does not appear to impact the economic choices to statistically significant degrees in our chosen settings. Results from OLS and logit regressions, presented in Table A.4 and Table A.5, support these results.

### 3.2 Belief Vignettes

In the following, we analyze the data obtained from the vignettes. We first focus on the vignettes concerning the immediacy of events. To recap, we implement two types of vignettes. ‘Immediacy vignettes’ elicit whether different grammatical framings influence subjects’ beliefs about the immediacy of future events whose exact occurrence is undetermined. ‘Likelihood vignettes’ investigate whether the grammatical framing alters subjects’ beliefs on the likelihood of events occurring in the future. Vignette (d) and (h) contain the aforementioned



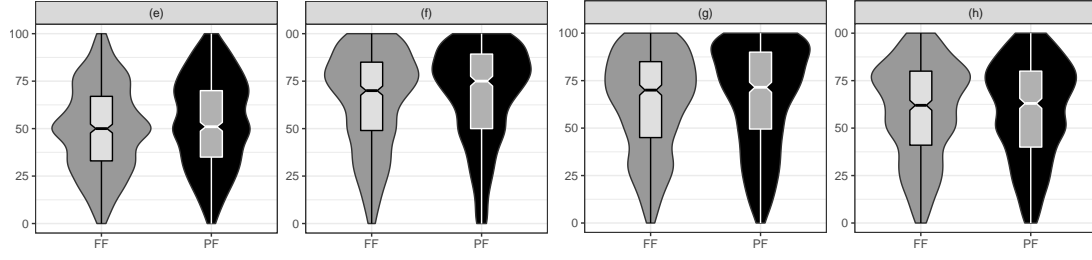
Note: Distribution of subjects' choices for immediacy vignettes. Light color represents FF, dark color represents PF framing. Median of FF is depicted by the dashed, PF by the dotted lines. x-axis presents choices in absolute terms for 557 (FF) and 580(PF) subjects.

Figure 3: Distribution of Choices in Immediacy Vignette

checks for the influence of preconceptions.

### 3.2.1 Immediacy

Figure 3 depicts the observed distributions of choices made in the four immediacy vignettes. The immediacy vignettes (a) and (b) show significant differences ((a)  $p$ -value  $< 0.01$ ; (b)  $p$ -value = 0.038;  $\chi^2$ -test) in subjects' choices about the perceived immediacy of the described events. These results are in line with the idea that future events framed in the present-tense are perceived as more immediate than future events framed in the future tense. The third vignette (c) shows no significant differences in choices ( $p$ -value  $< 0.161$ ;  $\chi^2$ -test) but suffers from lower-bound truncation. Vignette (d), which we included in the test for the influence of preconceptions, is not significant on any conventional level ( $p$ -value = 0.545;  $\chi^2$ -test). Vignette (d) shows median choices for FF which are more immediate than PF choices. That, however, goes against the idea of present tense framed events being perceived as more immediate than future tense framed events. Results for vignette (d) hint at the fact that the PF framing induced believe changes are not robust when introducing additional preconceptions. To check the robustness of these results we estimated ordered logit models, including order effects, the measured preference for a specific tense and socioeconomic data collected during the survey, which support these findings. See Table A.7 in the Appendix.



Notes: Violin plots depict the distributions of likelihoods of the described events to occur in the future as assigned by the subjects. Boxplots show the median and 25%, 75% quantiles, respectively. Median: e: FF=50, PF=51; f: FF=70, PF=75; g: FF=70, PF=71; h: FF=62, PF=63. Likelihoods could only be chosen using integer values.

Figure 4: Violin Boxplots for Likelihood Vignettes

### 3.2.2 Likelihood Vignettes

The following section takes a look at the vignettes related to the domain of risk. While the grammatical framing is not directly related to this domain, it may be influenced by an indirect link (Andersen et al., 2008).

Figure 4 plots the observed likelihoods for the described events to occur in the future. The plots for vignettes (e), (f), and (g) show a shift in the distributions towards higher likelihoods in the PF framing, i. e., future events framed in the present-tense are assigned a higher likelihood of occurring in the future. These visual findings are accompanied by shifts in the respective median value (Median: e: FF=50<PF=51; f: FF=70<PF=75; g: FF=70<PF=71.5; h: FF=62<PF=63) and are significant on at least the 5 percent level ( $p\text{-value}^{(e)} = 0.022$ ,  $p\text{-value}^{(f)} = 0.002$ ,  $p\text{-value}^{(g)} = 0.033$ ; U-test). For vignette (h), we observe no such clear shift, a finding that is supported by the results of a U-test ( $p\text{-value}^{(h)} = 0.886$ ). Results for vignette (h) similarly to the results for vignette (d), indicate that, although grammatical tense framing impacts beliefs in intuitive ways, the effect is not necessarily robust against additional preconceptions and might be overruled by such. To check the robustness of these results, we estimated ordered logit models for vignettes (e-h), including order effects, the measured preference for a specific tense and socio-economic data collected during the survey. These estimates, although still showing the expected direction of effects, turn out to be significantly weaker than the U-test results. See Table A.9 in the Appendix. For the vignettes, except for (e), the inclusion of additional variables renders the observed effects insignificant.

## 4 Summary

The seminal study by K. Chen (2013) shows that a person's future-oriented savings rates is lower, and future-oriented health behavior is less prevalent if a person's native tongue is classified as a strong-FTR language, i. e., it demands the use of a grammatical future tense when describing future events. As word meanings and connotations are not perfectly aligned across languages (Thompson, Roberts, and Lupyan, 2020), studying FTR across languages can introduce confounds, making a clean identification of an FTR effect spurious. To avoid such potential confounds, we implemented a within-language experiment with German native speakers. The German language allows for referencing future events in the grammatical present as well as the future tense, facilitating a within-language investigation. We tested the impact of present-tense and future-tense framing in the German language on behavior related to *time* and *risk preferences* in a medium-scale online framing study. We included two sets of vignettes to investigate the influence of the present and future tense on subjects' beliefs about the *immediacy* and *likelihood* of future events. We further designed an exercise to elicit subjects' preferences for a specific tense to reference future events and supplemented the study with a socioeconomic survey. Our within-language variation of future-time referencing (FTR) and experimental setting allows for a clean identification of the impact of only varying the grammatical tense in the German language on economic behavior and beliefs.

Our results show no significant effect on people's behavior in the risk and time preference elicitation tasks. However, we find evidence for influences of future and present tense reference to future events on subjects' beliefs. Nonetheless, the effects are weak and can be counteracted when additional preconceptions are introduced.

Our experiment finds no evidence in support of the idea that altering the grammatical future tense reference impacts economic decision-making in a meaningful way. Consequently, when viewed in conjunction with the results of K. Chen (2013), our results hint at a deeper but imperfect link between language and culture (and maybe even subcultures). That difference is not necessarily captured in a simple culture dummy. We therefore argue that future, cross-border research should take this into account by relying on additional language and language-use information, as well as between language alignment, in order to more cleanly control for culture effects when testing behavioural channels.

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## Appendix

### A1 Extensive Analysis

Table A.1: Wilcoxon rank sum test with continuity correction - Likelihood Vignette with the Categories Present - Future

	Data Likelihood Vignettes on Tense Framing			
	Federal Audit Office	McKinsey	Buxtehude	Chopin
	(1)	(2)	(3)	(4)
W	148940	145120	160740	149800
p-value	0.023	0.003	0.89	0.034
Note:	alternative hypothesis: true location shift is not equal to 0			

Table A.2:  $\tilde{\chi}^2$ -test Immediacy Vignettes with the Categories Present - Future

	Data Immediacy Vignettes on Tense Framing			
	BonnEconLab	Halle/Saale	Mansfeld	Bitcoin
$\tilde{\chi}^2$ -test	14.25	88.56	19.17	8.86
df	10	10	10	10
p-value	0.16	$1.032 * 10^{-16}$	0.038	0.54
Note:	Alternative hypothesis: "Estimated point in time and 'framing language' are not independent."			

### A2 Design of the Experimental Tasks

#### A2.1 Time Preference Elicitation Task

Table A.3: Illustration of the Payment Schemes

Schedule	Payment in week after experiment in €														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	27.95	27.95	27.95	27.95	27.95	27.95									
2		28.64	28.64	28.64	28.64	28.64	28.64								
3			29.26	29.26	29.26	29.26	29.26	29.26							
4				29.8	29.8	29.8	29.8	29.8	29.8						
5					30.26	30.26	30.26	30.26	30.26	30.26					
6						30.64	30.64	30.64	30.64	30.64	30.64				
7							30.95	30.95	30.95	30.95	30.95	30.95			
8								31.18	31.18	31.18	31.18	31.18	31.18		
9									31.33	31.33	31.33	31.33	31.33	31.33	
10										31.4	31.4	31.4	31.4	31.4	31.4

The purpose of the time elicitation task in experiment 1 is to classify subjects by their personal discount rate. In this task, the effect of linguistic framing (tense) on time preferences was analyzed. Hence, it was sought to design a task in such a way that subjects could choose payment schedules. This choice should then automatically imply different personal discount rates.

*Assumptions and Constraints:*

1. The range of relevant personal discount rates was thought to lie between 2.25% and 36.25%. Personal discount rates within this band seem to be the most common in laboratory experiments for subject groups similar to the one participating in experiment 1 and frequently-cited studies regarding time preferences supported this assumption (Harrison et al., 2005). The range was then divided up into 10 intervals as a compromise between attempted fine-graininess and not wanting to overwhelm participants of the experiment with a multitude of choices.
2. The discounting function of subjects can be modelled by a utility function that is both increasing and concave. For this reason, the log-utility specification, i.e.,  $u(x) = \ln(x)$ , was chosen. This utility specification is often used in applications which require a specification.
3. For the final schedules, the midpoint of each interval was chosen to calculate the weekly amounts.
4. The weekly amounts were calculated transforming the yearly discount rate into a weekly one.

*Payment Schedule:*

Each schedule ran for six weeks and consisted of a weekly payment, the amount of which was fixed.<sup>18</sup> Each schedule had a different starting date for the first payment. This simulates different multiple-choice lists for which we only showed an optimal switching point for one particular discounting factor. The payment schedules were designed as follows:

1. Schedule 1: This is the schedule targeting the most impatient group of subjects, i.e., subjects with a personal discount rate in the interval of (0.3625; 0.3175).

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<sup>18</sup>If we amended the amounts on a weekly basis to factor in the additional change induced by a weekly discount rate, the amounts would only change at the second, third, or even fourth decimal.

2. Schedule 1 pays an amount  $S_1$  every week, starting 1 week after the experiment and lasting six weeks in total.
3. The schedule targeting the second-most impatient group of subjects, i.e., those with a personal discount rate in the interval of  $(0.3175; 0.2825)$ , is called schedule 2 and so forth.
4. Schedule 2 pays an amount  $S_2$  every week, starting 2 weeks after the experiment for six weeks in total.
5. Schedule 3 pays an amount  $S_3$  every week, starting 3 weeks after the experiment and for six weeks in total and so forth.

For a graphical illustration of the payment schedules, please see the Table A.3.

*Calculation of the Optimal Schedules for Subject Groups:*

Each bracket of time preferences corresponds to a certain group of subjects. Thus, they are identified by revealing their preferences through their choice of a payment schedule. It is important that the payment schedules calculated are optimal for the different subject groups, i.e., schedule 1 should be optimal for the most impatient subject group and so forth. Schedule 10 is the optimal schedule for the most patient subjects and therefore must yield the most money on a weekly basis, i.e.,  $S_{10} = 31.4$  Euro.

From the optimality conditions of payment schedules, it follows that:

$$u(schedule10|r \in (0.025; 0.0475)) \geq u(allotherschedules|r \in (0.025; 0.0475)) \quad (A.1)$$

,in particular

$$u(schedule10|r = 0.0475) \geq u(schedule9|r = 0.0475) \quad (A.2)$$

The same optimality conditions also need to hold for subjects who are targeted by schedule 9. Hence, the following needs to hold.

$$u(schedule9|r \in (0.0475; 0.0825)) \geq u(allotherschedules|r \in (0.0475; 0.0825)) \quad (A.3)$$

,in particular

$$u(schedule9|r = 0.0475) \geq u(schedule10|r = 0.0475) \quad (A.4)$$

and

$$u(schedule9|r = 0.0825) \geq u(schedule8|r = 0.0825) \quad (A.5)$$

From the optimality of both schedule 10 and schedule 9 at  $r = 0.0475$ , it is possible to deduce the following equality :

$$u(schedule10|r = 0.0475) = u(schedule9|r = 0.0475) \quad (A.6)$$

Equation A.6 uniquely determines the payment for  $S_9$  as a function of the initial payment of  $S_{10}$ . The remaining values  $S_8$  as well as the others can be calculated recursively, i.e.:

$$u(schedule8|r \in (0.0825; 0.1175)) \geq u(allotherschedules|r \in (0.0825; 0.1175)) \quad (A.7)$$

,in particular

$$u(schedule8|r = 0.0825) \geq u(schedule9|r = 0.0825) \quad (A.8)$$

and

$$u(schedule8|r = 0.1175) \geq u(schedule7|r = 0.1175) \quad (A.9)$$

This determines  $S_8$  uniquely as a function of  $S_9$  (and therefore of  $S_{10}$ ). By iteration, this procedure allows for the identification of all  $S_x \forall x \in (1, 2, \dots, 9)$  from the externally given starting point  $S_{10}$ .

	(1)	(2)	(3)	(4)	(5)	(6)
PF	−0.023 (0.112)	0.065 (0.162)	−0.226 (0.225)	−0.214 (0.228)	−0.181 (0.232)	−0.065 (0.234)
TR		0.261 (0.160)	0.265 (0.160)	0.294 (0.162)	0.281 (0.164)	0.348* (0.166)
Present-Pref			−0.068 (0.073)	−0.073 (0.073)	−0.067 (0.075)	−0.045 (0.075)
PF TR		−0.180 (0.225)	−0.172 (0.226)	−0.181 (0.229)	−0.193 (0.231)	−0.303 (0.235)
PF Present-Pref			0.188 (0.103)	0.198 (0.105)	0.178 (0.107)	0.158 (0.108)
Add. Controls <sup>c</sup> :	No	No	No	Yes	Yes	Yes
	Obs.: 1,137					

Note: Ordered Logit estimation results. Standard errors in parenthesis. \*p<0.05; \*\*p<0.01; \*\*\*p<0.001

- a Interaction effect between the blockwise order of time-preference and risk-preference task and PF framing. Order Time → Risk = Likelihood = 1.
- b Number of sentences in the present tense ({0...5}) selected during paragraph construction task.
- c Additional controls include: gender, alcohol consumption (beer/wine/spirits, smoking, sports per week, marital status, available monthly income, language-related studies, pet owner). The full set of estimates is available from the authors upon request.

Table A.4: Ordered Logit Estimations for Time Preference Task (shortened)



	(1)	(2)	(3)	(4)	(5)	(6)
PF	0.973 (1.123)	−0.337 (1.627)	−0.261 (2.167)	−0.666 (2.158)	−0.530 (2.198)	−0.454 (2.173)
TR		−2.458 (1.608)	−2.438 (1.613)	−2.755 (1.600)	−2.929 (1.584)	−2.974 (1.552)
Present-Pref			−0.283 (0.724)	−0.188 (0.719)	−0.157 (0.721)	−0.259 (0.719)
PF TR		2.646 (2.243)	2.611 (2.248)	3.282 (2.222)	3.472 (2.231)	3.335 (2.204)
PF Present-Pref			0.016 (0.996)	−0.057 (0.988)	−0.106 (1.001)	0.091 (0.990)
Add. Controls <sup>c</sup> :	No	No	No	Yes	Yes	Yes
				Obs.: 1,137		

Note: Ordered Logit estimation results. Standard errors in parenthesis. \*p<0.05; \*\*p<0.01; \*\*\*p<0.001

a Interaction effect between the block-wise order of time-preference and risk-preference task and PF framing. Order Time → Risk = Likelihood = 1.

b Number sentences in the present tense ({0...5}) selected during paragraph construction task.

c Additional controls include: gender, alcohol consumption (beer/wine/spirits, smoking, sports per week, marital status, available monthly income, language-related studies, pet owner). The full set of estimates are available from the authors upon request.

Table A.5: OLS Estimations for Risk Preference Task (shortened)

## A3 Belief Vignettes

### A3.1 Immediacy Vignettes

Table A.6: Vignette Wording – Immediacy

PF	FF
(a)	
Nachdem dort die Arbeiten bald <b>fertiggestellt sind</b> , <b>gibt</b> die Stadtverwaltung in Halle an der Saale die Straße am Steintor wieder frei und <b>hebt</b> dann auch die Sperrung der Dessauer Straße wieder <b>auf</b> . Wann endet die Sperrung der Dessauer Straße?	Nachdem dort die Arbeiten bald fertiggestellt sein werden, <b>wird die Stadtverwaltung</b> in Halle an der Saale die Straße am Steintor wieder <b>freigeben</b> und <b>wird</b> dann auch die Sperrung der Dessauer Straße wieder <b>aufheben</b> . Wann <b>wird</b> die Sperrung der Dessauer Straße <b>enden</b> ?
(b)	
Im Landkreis Mansfeld-Südharz <b>beginnt</b> bald der Ausbau von schnellem Internet. Der Kreistag <b>berät</b> dazu in der nächsten außerordentlichen Sitzung, der Startschuss für die Anschlussarbeiten <b>erfolgt</b> dann umgehend. Wann <b>folgt</b> der Startschuss für die Anschlussarbeiten in Mansfeld-Südharz?	Im Landkreis Mansfeld-Südharz <b>wird</b> bald der Ausbau von schnellem Internet <b>beginnen</b> . Der Kreistag <b>wird</b> dazu in der nächsten außerordentlichen Sitzung <b>beraten</b> , der Startschuss für die Anschlussarbeiten <b>wird</b> dann umgehend <b>folgen</b> . Wann <b>wird</b> der Startschuss für die Anschlussarbeiten in Mansfeld-Südharz <b>folgen</b> ?
(c)	
Laborleiter Dr. Holger G. des BonnEconLabs erwartet, dass bald alle Teilnehmer des Labors die Stifte <b>zurückbringen</b> , die sie bei Experimenten versehentlich mitgenommen haben. Er <b>macht</b> demnächst einen Aushang am schwarzen Brett des Labors. Wann <b>macht</b> Laborleiter Dr. Holger G. einen Aushang?	Laborleiter Dr. Holger G. des BonnEconLabs erwartet, dass bald alle Teilnehmer die Stifte <b>zurückbringen werden</b> , die sie bei Experimenten versehentlich mitgenommen haben. Er <b>wird</b> demnächst einen Aushang am schwarzen Brett des Labors <b>machen</b> . Wann <b>wird</b> Laborleiter Dr. Holger G. einen Aushang <b>machen</b> ?
(d)	
Aufgrund des extremen Kurswachstums berichtete das Handelsblatt kürzlich über Bitcoin. Experten prognostizieren, dass ein Bitcoin innerhalb des nächsten halben Jahres einen Wert von 1100 Euro <b>übersteigt</b> . Wann <b>übersteigt</b> ein Bitcoin den Wert von 1047 Euro?	Aufgrund des extremen Kurswachstums berichtete das Handelsblatt kürzlich über Bitcoin. Experten prognostizieren, dass ein Bitcoin innerhalb des nächsten halben Jahres einen Wert von 1100 Euro <b>übersteigen wird</b> . Wann <b>wird</b> ein Bitcoin den Wert von 1047 Euro <b>übersteigen</b> ?

Notes: Wording of Immediacy Vignettes for the present-tense future reference (PF) and future-tense future reference (FF) framing. Differences between frames in **bold** font.

Robustness checks support these findings. We estimate a set of ordered logit models (OLM), adding a number of controls. The effect of the framing is captured by the variable *PF Framing*, which is 1 if the subject observed the PF Framing, and zero otherwise. For an overview, see Table A.7, which shows a reduced set of control variables. We depict the controls for the order in which time and Likelihood Vignettes were shown to the subjects. The elicited individual preferences for present tense, as measured by the paragraph-construction task, are also shown. Both variables are included as interactions with the respective fram-

	(a)	(b)	(c)	(d)
PF	0.713*** (0.208)	0.415* (0.205)	−0.254 (0.220)	−0.113 (0.209)
IL	0.022 (0.148)	0.332* (0.150)	0.308 (0.163)	−0.323* (0.155)
Present-Pref	0.056 (0.068)	−0.006 (0.068)	−0.003 (0.074)	0.010 (0.071)
PF IL	0.342 (0.211)	0.021 (0.212)	0.362 (0.226)	0.084 (0.213)
PF Present-Pref	0.003 (0.097)	−0.046 (0.096)	0.033 (0.104)	0.059 (0.098)
Add. Controls <sup>c</sup> :	Yes	Yes	Yes	Yes
		Obs.: 1,137		

Note: Ordered Logit estimation results. Standard errors in parenthesis. \*p<0.05; \*\*p<0.01; \*\*\*p<0.001

- a Interaction effect between the block-wise order of Immediacy and Likelihood Vignettes and PF framing. Order Immediacy → Risk = Likelihood = 1.
- b Number of sentences in the present tense ({0...5}) selected during paragraph construction task.
- c Additional controls include: gender, alcohol consumption (beer/wine/spirits, smoking, sports per week, marital status, available monthly income, language-related studies, pet owner). The full set of estimates are available from the authors upon request.

Table A.7: Ordered Logit Estimations for Immediacy Vignettes (shortened)

ing as observed by each subject. Additionally, we include the responses to survey questions eliciting risk aversion, taken from the SOEP (Wagner, Frick, and Schupp, 2007). These are included to capture linkages between time and risk (Anderhub et al., 2001; Andersen et al., 2008). Finally, a standard set of socio-economic and sociodemographic controls is included. Table A.7 presents the estimation results. When including additional controls, the results remain in line with the results of the non-parametric tests. While we find some evidence for an effect of grammatical framing on time, this effect seems to be spurious, highly context-dependent, and easily disrupted.

### A3.2 Likelihood Vignettes

In order to test these findings on their robustness, we estimated six OLS models for each vignette, increasing the number of controls in each model subsequently, as had been done for the OLM models. The truncated results can be seen in Table A.9. In the baseline model, the results from the boxplots as well as the U-tests are validated. Similar to the vignette "Bitcoin" in the prior section, the vignette "Buxtehude", which again brings with it a relatively strong outside predisposition, shows no significant framing effect for all estimated models. This is seen as support for the assumption that any grammatical framing effect, irrespectively of the domain targeted, is susceptible to preconceived opinions or outside predispositions and additional information.

As before, the framing effects prove unstable when including additional control variables. This can especially be seen for the case of the "BonnEconLab" vignette, for which the framing effect loses any significance when including the additional controls.

Consequently, we do not find a stable effect on risk due to grammatical framing either.

Table A.8: Vignette Wording – Likelihood

PF	FF
(e)	
Laut McKinsey <b>geht</b> in der westeuropäischen Versicherungsbranche in den nächsten zehn Jahren jeder vierte Arbeitsplatz <b>verloren</b> . Besonders davon betroffen <b>ist</b> der Bereich der Schadensabwicklung, wo jeder dritte Arbeitsplatz <b>verloren geht</b> . <b>Bestätigt</b> sich die Prognose für den Bereich der Schadensabwicklung in den nächsten zehn Jahren?	Laut McKinsey <b>wird</b> in der westeuropäischen Versicherungsbranche in den nächsten zehn Jahren jeder vierte Arbeitsplatz <b>verloren</b> gehen. Besonders davon betroffen wird der Bereich der Schadensabwicklung sein, wo jeder dritte Arbeitsplatz verloren gehen wird. <b>Wird</b> sich die Prognose für den Bereich der Schadensabwicklung in den nächsten zehn Jahren <b>bestätigen</b> ?
(f)	
Der Chopin-Flughafen in Warschau verzeichnete ein Wachstum des Passagieraufkommens um 15% und beförderte im Kalenderjahr 2016 12,8 Millionen Passagiere. Laut Betreibergesellschaft <b>sind</b> die Zuwächse für 2017 stabil. Auch der Frachtverkehr <b>nimmt</b> dann in vergleichbarem Umfang zu. <b>Fertigt</b> der Flughafen 2017 bis zum Jahresende mindestens 14,3 Millionen Passagiere <b>ab</b> ?	Der Chopin-Flughafen in Warschau verzeichnete ein Wachstum des Passagieraufkommens um 15% und beförderte im Kalenderjahr 2016 12,8 Millionen Passagiere. Laut Betreibergesellschaft <b>werden</b> die Zuwächse für 2017 stabil <b>sein</b> . Auch der Frachtverkehr <b>wird</b> dann in vergleichbarem Umfang zunehmen. <b>Wird</b> der Flughafen 2017 bis zum Jahresende mindestens 14,3 Millionen Passagiere <b>abfertigen</b> ?
(g)	
Der Bundesrechnungshof <b>veröffentlicht</b> kommende Woche einen Bericht darüber, dass alle öffentlichen Körperschaften im nächsten Jahr 5.500 neue Stellen <b>benötigen</b> . Der Bericht <b>stellt</b> dar, dass sich dennoch die Arbeit pro Kopf im öffentlichen Dienst <b>erhöht</b> und die Zahl der Krankmeldungen dadurch <b>ansteigt</b> . <b>Erhöht</b> sich die Arbeitslast pro Kopf im öffentlichen Dienst im kommenden Jahr?	Der Bundesrechnungshof <b>wird</b> kommende Woche einen Bericht darüber <b>veröffentlichen</b> , dass alle öffentlichen Körperschaften im nächsten Jahr 5.500 neue Stellen <b>benötigen werden</b> . Der Bericht <b>wird darstellen</b> , dass sich dennoch die Arbeit pro Kopf im öffentlichen Dienst <b>erhöhen wird</b> und die Zahl der Krankmeldungen dadurch <b>ansteigen wird</b> . <b>Wird</b> sich die Arbeitslast pro Kopf im öffentlichen Dienst im kommenden Jahr <b>erhöhen</b> ?
(h)	
In Buxtehude <b>beginnt</b> der Bau eines neuen Fahrradweges im Stadtpark. Der Förderverein Stadtpark Buxtehude e.V. <b>berät</b> bei seiner nächsten Vollversammlung über die zusätzliche Beschilderung. Sie <b>beraten</b> dabei dann ebenfalls über das Aufstellen zusätzlicher Hundekot-Beutelspendern. <b>Finanziert</b> der Förderverein das Aufstellen zusätzlicher Hundekot-Beutelspender im Buxtehuder Stadtpark?	In Buxtehude <b>wird</b> der Bau eines neuen Fahrradweges im Stadtpark <b>beginnen</b> . Der Förderverein Stadtpark Buxtehude e.V. <b>wird</b> bei seiner nächsten Vollversammlung über die zusätzliche Beschilderung <b>beraten</b> . Sie <b>werden</b> dann ebenfalls über das Aufstellen zusätzlicher Hundekot-Beutelspendern <b>beraten</b> . <b>Wird</b> der Förderverein das Aufstellen zusätzlicher Hundekot-Beutelspender im Buxtehuder Stadtpark <b>finanzieren</b> ?

Notes: Wording of Likelihood Vignettes for the present-tense future reference (PF) and future tense future reference (FF) framing. Differences between frames in **bold** font.

	(e)	(f)	(g)	(h)
PF	8.044** (2.704)	2.531 (3.033)	1.100 (2.990)	−1.043 (2.952)
IL	4.847* (1.908)	4.844* (2.164)	−3.133 (2.183)	−1.327 (2.217)
Present-Pref	0.717 (0.868)	0.401 (1.034)	0.629 (1.034)	−0.129 (0.964)
PF IL	−3.123 (2.766)	−3.387 (3.167)	3.653 (3.054)	2.963 (3.098)
PF Present-Pref	−1.809 (1.311)	1.389 (1.503)	−0.160 (1.406)	−0.626 (1.365)
Add. Controls <sup>c</sup> :	Yes	Yes	Yes	Yes
		Obs.: 1,137		

Note: Ordered Logit estimation results. Standard errors in parenthesis. \*p<0.05; \*\*p<0.01; \*\*\*p<0.001

- a Interaction effect between the block-wise order of Immediacy and Likelihood Vignettes and PF framing. Order Immediacy → Risk = Likelihood = 1.
- b Number of sentences in the present tense ({0...5}) selected during paragraph construction task.
- c Additional controls include: gender, alcohol consumption (beer/wine/spirits, smoking, sports per week, marital status, available monthly income, language-related studies, pet owner). The full set of estimates are available from the authors upon request.

Table A.9: Ordered Logit Estimations for Immediacy Vignettes (shortened)