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Framing Effects in Intertemporal Choices: 3 Two-Step Experiments

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ABSTRACT

Framings may affect individuals' choices. In particular, the perception of (implicit) risks and their costs may influence intertemporal choices. In a between-subjects experimental design, participants are presented choices either in a standard (i.e., current vs. future payoffs), penalty (i.e., the same as before, presenting the differences between present and future amounts as losses), future-improved (i.e., increasing by 35% the future payoff with respect to the standard frame) or penalty present-improved way (i.e., with small differences between present and future amounts). Undergraduate students participated in 3 two-step experiments. The results show that the negative and the present-improved frames render the participants more patient and subjects who are trained to be more farsighted using a penalty decision problem continue to be patient in subsequent classical formulations where that specific attribute is no longer present.

1 | Introduction

Discounting has been extensively studied in the economics literature through both theoretical and empirical approaches for decades (Grüne-Yanoff 2015; Heal 2007). Intertemporal choices are particularly interesting, as they play a relevant role in many policies and individual decisions (Ericson and Laibson 2019), including savings, precautionary and financial choices, consumption and inequality (Deaton and Paxson 1994; Meloso and Penalva 2016).

Wahlund and Gunnarsson (1996) and Thaler (1999) showed that mental discounting is sensitive to the framework in which the agent takes the decisions, highlighting that different options in finance and consumption may engender differences in mental discounts. Tversky and Kahneman (1981) and Starmer (2000) show that different frames may be artificially created, simply by presenting the same situation using different phrasing and wording. This approach allows enhancing participants' accessibility—the ease with which thoughts come to our minds (Higgins 1996)—to the idea that preferring immediate to delayed payoffs results in smaller earnings. Closely related to the present paper is Faralla, Novarese, and Ardizzone (2017), which shows that mental discount rates may be manipulated in an intertemporal decision problem by presenting the same payoffs with different words. In particular, the difference between the future (larger) and the present (smaller) amount is presented either with neutral wording (i.e., simply declaring the two amounts) or as a loss (highlighting that choosing the present amount entails losing the difference between the future and the present sum), so rendering experimental subjects more patient.

Starting from these premises, the present paper proposes three experiments in which participants choose between present and delayed sums. The treatments involve a first phase, in which either the wording presenting the different payoffs or the delayed

amounts are manipulated. Some choice games, played after the previous phase, are, instead, common to all the experiments and treatments and aim to test the persistence of the effects of the treatments.

2 | Hypotheses

The purpose of our study is to test the following hypotheses:

1. Framing differences between future and larger and present and smaller payoffs as losses renders people more patient.
2. Framing effects engender persistent effects after being removed, at least in the short term.
3. Persistence effects are not driven by the convenience of making future-oriented choices with high incentives. While increasing payoffs will prompt subjects to choose delayed options when the larger and later amounts are particularly appealing; however, this effect will fade when the larger, later options are no longer as attractive.

The second hypothesis is the central focus of this study. The results show that presenting the difference between delayed and present payoffs as a penalty makes individuals more patient than a neutral description of the same payoffs. This effect appears to persist in subsequent choice tasks where the idea of penalisation no longer appears. From a policy perspective, these results suggest that presenting lost earnings as penalties may induce individuals to be more patient (i.e., save and invest more). Cao and Werning (2018) theoretically show that dissaving depends crucially on individual impatience, particularly on the comparison between it and the interest rate on savings. The same authors suggest that this result may apply to models of public spending, thus broadening the scope of studies on patience and delayed payoffs.

3 | Literature Review

Different theoretical models analysing discounting exist, proposing hyperbolic, exponential, hybrid forms or no discount at all (Adamou et al. 2021). As there is no agreement on which functional form best represents how people mentally discount the future (Rubinstein 2003), empirical research has flourished to test existing models. Given the difficulty of observing preferences in the real world, most of the empirical research relies on experiments. Rachlin and Jones (2008) propose three experiments manipulating delays and payoffs, providing support for hyperbolic discount. Focussing on the role of delays and the magnitude of payoffs, Olsen, Macaskill, and Hunt (2018) show that experimental subjects tend to discount small more than large sums. How choices and decision problems are presented may play a relevant role.

The idea that preferences can be influenced by the representation of decision problems (i.e., different wordings) was originally explored and empirically investigated as a cognitive bias (i.e., a failure of standard rationality; see Kahneman and Tversky 1979; Tversky and Kahneman 1981, 1992). Later, this exploration evolved to describe real agents' behaviour and contributed to the development of bounded rationality models (Kahneman 2011; Tversky and Kahneman 1981, 1986). Nowadays, researchers study framing effects in terms of choice architecture as nudging tools to attain desirable outcomes (Hansen 2016; Thaler and Sunstein 2008). More specifically, a frame can be built so that behavioural constructs, such as *status quo* or loss aversion, can be elicited and applied to influence the decision-making process (Faralla, Novarese, and Ardizzone 2017; Levin 1987; Li, Sun, and Wang 2007; Loewenstein and Prelec 1992; Marzilli Ericson et al. 2015; Read, Frederick, and Scholten 2013; Weber et al. 2007; Zhao et al. 2015). In this view, frames create accessibility to these constructs, lowering the cost of processing information. During his Nobel Prize lecture, Kahneman (2003) referred to the concept of accessibility to underlie how it can endorse one view over another. Imagining that decision problems are designed by multiple features, he underlined that alternative frames can be managed to highlight one or more of these attributes and make them more accessible to influence individual choices: the more the feature is accessible, the more it influences the decision-making process. In other words, individuals do not necessarily desire the opportunity or the time to evaluate all the attributes of a situation; rather, they respond to some of its specific features, characterised by higher accessibility (such as, as mentioned, loss aversion—Kahneman and Tversky 1979; Tversky and Kahneman 1992), which becomes the main element considered when making a decision or revealing a preference. In this regard, Kahneman argued that accessibility is mainly associated with intuitive judgment and that 'to understand intuition, we must understand why some thoughts are accessible and others are not' (Kahneman 2003, p. 1452).

Different areas of behavioural economics research have investigated the framing effect, especially for the decision-making under risk and for gains and losses. Brooks, Peters, and Zank (2014) show that people behave differently in front of gains or losses. In particular, the effect of delayed losses on current decisions may be stronger than that of delayed gains: Ostaszewski and Karzel (2002) ran an experiment with undergraduate students, showing that the subjects discounted delayed losses less than delayed gains; this effect is stronger for large than for small amounts. Estle et al. (2007) confirmed the previous results for both monetary and in-kind (food) payoffs. Consistently, Green et al. (2014) investigated the effects of amounts and delays, framing the differences between future and immediate payoffs as losses. They found that the size of the loss and the delay play separated roles—that is, their experimental subjects mentally evaluated them separately, so that the two characteristics had different and independent effects on the individuals' decisions. Tanaka et al. (2014) conducted a neuroeconomics experiment and find that participants' brains respond more to losses than gains and to delayed losses than delayed gains, suggesting that losses are perceived as more relevant than gains.

Framing payoffs as gains or losses has proved to be relevant in several games. For instance, Buchan et al. (2005) found that people playing an ultimatum game offer and demand more money in a loss than in a gain frame. Boun My et al. (2018) showed that, in an experiment on inequality, people are less averse to it when redistribution is framed as losses for persons with higher payoffs than

gains for individuals with lower payoffs. In dictator games, participants are more selfish when what they give to their counterparts is framed as a loss than when it is presented as a gain (Fiedler and Hillenbrand 2020). Another frame effect relates to the difference between voluntary contributions and prices that may end in payoffs presentable as gains or losses: There is evidence that the asymmetry between gains and losses is larger when experimental subjects choose the amount to contribute to a public good than the price of a private good (Basu and Srinivasan 2021).

Standard intertemporal tasks generally present the choice between receiving some small amount of money soon or a larger later (e.g., '$34 tonight or $35 in 43 days'; Kirby and Maraković 1996). Keeping the same logic and substance behind the intertemporal choice, researchers tested other formulations, inquiring into several individual characteristics that may lead to different results. In particular, the literature has studied impulsivity in association with manipulations of interest rates, calendar dates and other choice attributes (see Cohen et al. [2020] for a review of the literature). Faralla, Novarese, and Ardizzone (2017) present intertemporal choice in a penalty fashion, explicitly indicating the amount of money subjects have to give up in case of preference for a smaller and immediate option versus a larger and later one. In terms of accessibility, this frame seems to enhance the difference between the two outcomes so that the choice of the short-term outcome appears as a loss to the decision-maker. The results show that activation of loss-related scenarios occurred, producing a decreasing pattern of choice of the sooner option. More specifically, the study demonstrated that even very simple information about the amount of money one must surrender for choosing the earlier option resulted in a choice to delay payoffs with both real and hypothetical monetary rewards: Faralla et al. (2017, p. 22) argue that 'Despite the arithmetic computation of the explicit penalty in each decision problem was relatively easy [...] the explicit reference to that amount triggered a shift of preference towards larger but later options, at least compared to controls'. In their experiment, the effect of framing increased individual rationality and reduced self-control problems.

In the present paper, accessibility is enhanced through different wordings, which correspond to different treatments. The main point of the present study is that framing choices in a manner that includes salient penalty information can affect subsequent decision-making, particularly generalising the choice of less impulsive outcomes in future decisions. The same situation—an intertemporal choice—is presented with different words to the participants, rendering some aspects more accessible under one treatment than another. Hence, accessibility may relate to selective attention, which helps to focus on particular inputs and select information for further processing (Colby and Goldberg 1999; Martinez et al. 2001; O'Connor et al. 2002). Kahneman (2003) underlines that accessibility can create a reference point able to influence individual judgment and provide a biased assessment.

4 | Overview of the Experiments

Three 2-phase experiments are used to respond to the research questions. In the first phase (A), the subjects faced pairs of intertemporal choices, differentiated by the type of framing—either a standard or a penalty mode, as presented in the introduction. Standardised and pre-tested monetary-choice questionnaires (MCQs) with repeated choices were used. The first experiment also employed a modified version of the questionnaire, which was identical to the standard one, except that larger and later options (LL henceforth) were increased by 35%; this represents the *future-improved* frame. In addition, in the third experiment, we used a *penalty present-improved* mode, identical to the penalty one but with a minimal difference between the immediate and delayed options. Following the literature review, the expectation is that participants should be more patient in the penalty modes, where the decision problem is framed in terms of losses (Hypothesis 1).

In the second phase (B), all the participants faced at least an intertemporal choice task in a standard format and one or two matching questions with no reference to losses. Frederick et al. (2002, p. 308): 'matching tasks are another popular method for eliciting discount rates. In matching tasks, respondents "fill in the blank" to equate two intertemporal options (e.g., $100 now = in one year)'. The matching questions used here are very similar and used as an alternative to standard frames as robustness checks. The hypothesis to test is whether subjects' preferences in the second part of the experiment (phase B) are different depending on the frame presented in phase A (Hypothesis 2). More specifically, individuals should be more patient under the penalty, rather than neutral (classical) or future-improved treatment: Focussing on losses may render them more likely to prefer future over smaller, immediate gains also in subsequent choice, where the penalty frame is no longer present. In the future-improved treatment, instead, the subjects are supposed to choose the larger, later payoff more frequently in phase A (where payoffs were increased by 35%, making it much more profitable to wait) but also no longer prefer larger over smaller options in phase B as it happened after the penalty mode. The future-improved treatment is designed to show that the preference for delayed options in phase B strictly relates to the use of the penalty frame in phase A, rather than just being the result of a recurring choice of future options. Similarly, the penalty present-improved treatment allows us to investigate (1) whether the penalty decision problem stimulates more farsighted preferences when LL options are less favourable and especially (2) if the penalty frame still prompts delay in the post-questionnaire phase while subjects are exposed to the penalty feature but do not necessarily prefer the delayed option, considering there is a minimal difference between the immediate and the delated options.

The MCQ in phase A of experiment 1 is the well-known 27-item MCQ (Kirby, Petry, and Bickel 1999), while experiments 2 and 3 employ an 8-item questionnaire, tested in hypothetical and real choices (Faralla, Novarese, and Ardizzone 2017). The extant literature has already used both questionnaires to elicit individual intertemporal preferences in experimental studies (Faralla, Novarese, and Ardizzone 2017). In particular, despite being introduced almost 20 years ago, the MCQ is still cited and utilised in recent studies (e.g., Wan, Myerson, and Green 2023; Yang, Li, and Hu 2022). The two questionnaires present a series of intertemporal choices between two different monetary options, which can strengthen the persistence of

the treatment effects (Hypothesis 3). To improve robustness, different tools for different experiments in phase B were similarly applied. Experiment 1 employs a standard intertemporal choice and two matching questions, without any reference to losses and eliciting individual intertemporal preference. Experiments 2 and 3 present one matching question and three standard intertemporal choices. Table 1 and the following sections provide more details about the three experiments. The standard questionnaire works as control treatment: as experimental results based on it are consolidated, its outcomes will serve as a benchmark to compare the results from the other treatments. Differently from our study, Faralla, Novarese, and Ardizzone (2017) only tested the different intertemporal choice treatments in one phase (i.e., phase A), with phase B absent. Furthermore, they used penalty and standard frames but did not include future-improved and penalty present-improved modes. Their primary focus was comparing classical versus penalty treatments, aiming to evaluate the penalty frame as a nudge tool to increase future-oriented choices and improve long-term planning. In our paper, the primary objective is to investigate the persistence of the effects of the different treatments. Hence, we adopted a two-step design (i.e., phase A and phase B) and introduced additional frames beyond the two examined by Faralla, Novarese, and Ardizzone (2017). Our future-improved treatment explores the relationship between recurring choice of future options and subsequent preference for delayed payoffs. Moreover, the penalty present-improved mode assesses whether the penalty frame continue to prompt future-oriented choices when larger, later options are less favourable in phase A. Furthermore, while Faralla, Novarese, and Ardizzone (2017) included standard intertemporal choices, they did not present matching questions, which we used as alternatives to standard frames for robustness checks in phase B. Both studies used the 27- and 8-item questionnaires.

All experiments used LimeSurvey (Limesurvey GmbH. 2019) and ran online using the LimeService platform, between May 2020 and March 2021. Appendices S1–S4 report the instructions for Experiment 1 (standard and penalty treatment), which include both Italian and English versions. These instructions are comparable across the different treatments and experiments. Appendix S5 reports screenshots of the different frames used in this study. In addition to the experimental instructions, we provided subjects examples and hypothetical outcomes. Prior to the experiments detailed in this paper, we carried out a pilot study to check the experimental instructions and the overall procedure. All participants were students from the University of Piemonte Orientale and provided consent prior to participation. The study was approved by the local ethics committee. All analyses were performed with STATA 17.

5 | Experiment 1

The first experiment investigates accessibility in the framing of intertemporal choice by considering two hypotheses. The first is that repeated exposure to specific representations may be self-reinforcing and people who are trained to be farsighted throughout certain types of decision problems (phase A) continue to be patient also in classical formulations of intertemporal choice (phase B). To test this assumption, phase A used three different

TABLE 1 | Summary of treatments and sample sizes in the three experiments.

Experiment	Number of subjects	Share of subjects by frame in phase A[a]	Questionnaire in phase A	Decision problems in phase B
Experiment 1	230	37% standard 32% penalty 31% future-improved	27-item Monetary-Choice Questionnaire	One standard decision problem, two matching questions
Experiment 2	258	52% standard 48% penalty	8-item questionnaire	Three standard decision problems, one matching question
Experiment 3	143	51% penalty 49% penalty present-improved	8-item questionnaire	Three standard decision problems, one matching question

[a]In phase B, all subjects were tested with the same decision problems.

frames: standard, penalty and future-improved. The choice between two outcomes—different in size and time for delivery—was represented in standard choices, whereas the decision problem was framed in terms of losses in the penalty treatment. Instead, the third version of the questionnaire was identical to the standard type, except that LL options were 35% larger. As noted earlier, this was our future-improved frame, which aimed to nudge subjects' preference towards the delayed choice. All subjects then faced the same decision problems in phase B.

The second hypothesis is that the future-improved frame is not as able as that based on penalty to render the concept of loss accessible, that is, to make the participants focus their attention on the difference between the future and the immediate payoff in such a way they perceive the immediate option as a loss with respect to the alternative choice. This may mainly depend on people's loss aversion, which is larger than gain propensity (Kahneman and Tversky 1979). In line with this view, the future-improved mode will prompt people to choose delayed options in phase A, as LL amounts are more appealing; however (differently from the penalty framing), its effects will fade when later options are no longer particularly high (phase B). Farsighted decisions in phase B would then place participants in a context of loss rather than the exposure to a situation, where delayed alternatives are frequently selected.

5.1 | Methods

5.1.1 | Participants

Phase A uses a between-subject design with each group including 74, 85 and 71 subjects, respectively, for a total of 230 individuals (age range: 19 to 30 years; 63% females). They were randomly assigned to the standard, penalty or future-improved treatment. In phase B, all the subjects indicated their intertemporal preferences in a standard decision problem and two matching questions.

5.1.2 | Experimental Materials

Phase A employed a structured intertemporal choice task, the MCQ proposed by Kirby, Petry, and Bickel (1999) that identifies subjects' preferences for monetary outcomes, with three conditions. Each condition consisted of 27 choices. In the standard treatment, participants had to choose between a smaller and a sooner option (SS), available at time t, and a LL, at time t + 1 (e.g., 'Would you prefer €55 today or €75 in 61 days?'). The delay for LL options (t + 1) was set between a minimum of 7 and a maximum of 186 days. The amounts for the SS options ranged between €11 and €80, while the alternative LL options varied between €25 and €85. The penalty treatment presented the same series of intertemporal choices; however, the amount of money that the subject had to give up for choosing the SS option was explicitly indicated (e.g., 'Would you prefer €75 in 61 days or €55 today with a penalty of €20?'). Finally, in the future-improved treatment, LL options were increased by 35% with respect to the standard MCQ (e.g., 'Would you prefer €55 today or €101 in 61 days?'). In all the treatments, for each choice of the intertemporal task, participants had to state their preference using the PC mouse to click on the preferred alternative (i.e., either SS or LL). The two alternatives appeared together on the PC screen in random order, that is, LL on the left (right) and SS on the right (left). The order of presentation of the 27 intertemporal choices followed Kirby, Petry, and Bickel (1999), who designed it to avoid any correlation between SS and LL options.

In the post-questionnaire phase, all the participants completed the same three decision problems. The first was an intertemporal choice in the (classical) standard frame (i.e., 'Would you prefer €10 today or €13 in 30 days?'). Then, they responded two matching questions, which also elicited individual intertemporal preferences without any reference to losses: 'Imagine that you had won €75 available today. What (additional) amount of money do you want to wait for 30 days and collect the prize?' and 'Imagine that you had won €20 in 30 days. How much are you willing to give up to get the prize today?'. Participants expressed their preferences in the classical frame by clicking on one of the two alternatives, while, in the matching choices, they had to write a number in the space provided. These three items were designed so to test the hypothesis that subjects keep being more patient after previously facing the penalty treatment than the classical formulations of intertemporal choice.

In sum, participants stated a total of 30 preferences in the two phases. Participants knew since the beginning that a choice would have been randomly selected for payment at the end of the experiment. At the end of the session, all the subjects received the payoff associated with the standard intertemporal choice in phase B (i.e., 'Would you prefer €10 today or €11 in 30 days?'). For delayed payments, subjects received it in their classroom with the chosen delay. In addition, all of them received a participation fee of €5. The experiment lasted about 50 min (from arrival to departure of the subjects). These amounts, consistent with Faralla, Novarese, and Ardizzone (2017), represent a reasonable compensation for the participants, students residing in Piedmont, given the time spent in the experiment. For context, the French and the Spanish minimum wages are €11.65 and €7.82 per hour, respectively. As for 2022, their per capita GDPs were 43,023 and 29,835 current USD.[1] In comparison, the per capita GDP for Piedmont in the same year was 38,180 current USD.[2]

To analyse data, given their different nature, diverse techniques are used. The main variables of interest are those allowing to understand whether the treatments increased the number of delayed choices and/or decreased the amount required to postpone the receipt of a sum won at a lottery. In both cases, the outcomes under the different treatments are analysed first by comparing average choices between each couple of treatments. In such a case, analyses used t-tests or Poisson regressions (as the dependent variable is a count variable). Dummy variables represent the responses to the other choices providing similar information about the participants' willingness to postpone the receipt of some money against the option of getting less, but immediately. Indeed, the choice between receiving €10 today or a higher amount in a month is a binary variable, taking value 1 if the participant chose to delay the receipt of the sum, and 0 otherwise. In such a case, the experimental outcomes are analysed through Mann–Whitney tests and Fisher exact tests. Finally, some interesting information may come from the response times, which allow us to evaluate the instinctiveness of the choices (Kahneman 2011; Lotito, Migheli, and Ortona 2013; Rubinstein 2007, 2016). Response times are helpful in the

analysis of experimental data, as they provide information about the degree of instinctiveness of decisions: Kahneman (2011) extensively discusses the dual decisional mechanism of the human mind, emphasising the difference between fast (and intuitive) and slow (and reflexive) decisions. Much of the existing literature aims to differentiate between these two categories by employing response (decision-making) times. This variable enters the Poisson regression. The standard mode appears in the specification as a control treatment, i.e. as the benchmark to compare the results from the other treatments.

5.2 | Results

Figure 1 shows that, in phase A, the participants chose the LL option more often in the future-improved and in the penalty treatment. More specifically, the percentage of preferences for the delayed outcome was 59% in the standard MCQ, 67% in the future-improved MCQ and 77% in the penalty MCQ. The differences between the treatments are all statistically significant (Fisher exact test, p-value < 0.001—significances were adjusted using the Bonferroni method).

To compare the experimental results across conditions and time periods, Figure 1 includes the percentage of LL choices selected in the standard decision problem in phase B (all participants faced the same choice, i.e., 'Would you prefer €10 today or €13 in 30 days?'). As is evident from the figure, the percentage of LL options dropped in all treatments. However, the figure was much higher in the penalty frame (36%) than in the classic and future-improved MCQs (14% and 13%, respectively), although the payoffs in the future-improved treatment were higher by 35%.

Table 2 presents the probability (i.e., percentage of respondents) of preferring €10 today instead of €13 in a month. Once again, the penalty treatment is the most effective; however, in this case, it enhances the probability of preferring €13 in 30 days rather than 10 today. Table 3 presents the same information as Figure 1, providing tests to assess whether the detected differences are significant at some conventional statistical level.

The figures in Table 3 represent the average number of delayed options (out of 27) chosen by subjects under the different treatments. All the differences are highly statistically significant, suggesting that the treatments were effective in rendering the participants more patient. Indeed, values under the future-improved and the penalty treatments are higher than those under the standard setting. In addition, highlighting the value of the penalty has a stronger effect on patience than offering participants a higher future stake.

Table 4 presents a multivariate analysis (i.e., the incidence ratios after Poisson regression), which considers the future-improved and the penalty treatments together and shows their effects on the number of delayed options chosen by the participants with respect to their number under the standard framework treatment. The figures in the table confirm the previous results. They show also that choosing delayed options required some more time, while the opposite holds under the penalty treatment. In

TABLE 2 | Probability of preferring €13 in a month than €10 today.

Treatment	Probability	Significance[a]
Standard	14.12	°
Future-improved	12.67	
Standard	14.12	***
Penalty	36.49	
Future-improved	12.67	***
Penalty	36.49	

Note: Percentage values.
[a]Mann–Whitney tests.
°p-value > 0.1.
***p-value < 0.01.

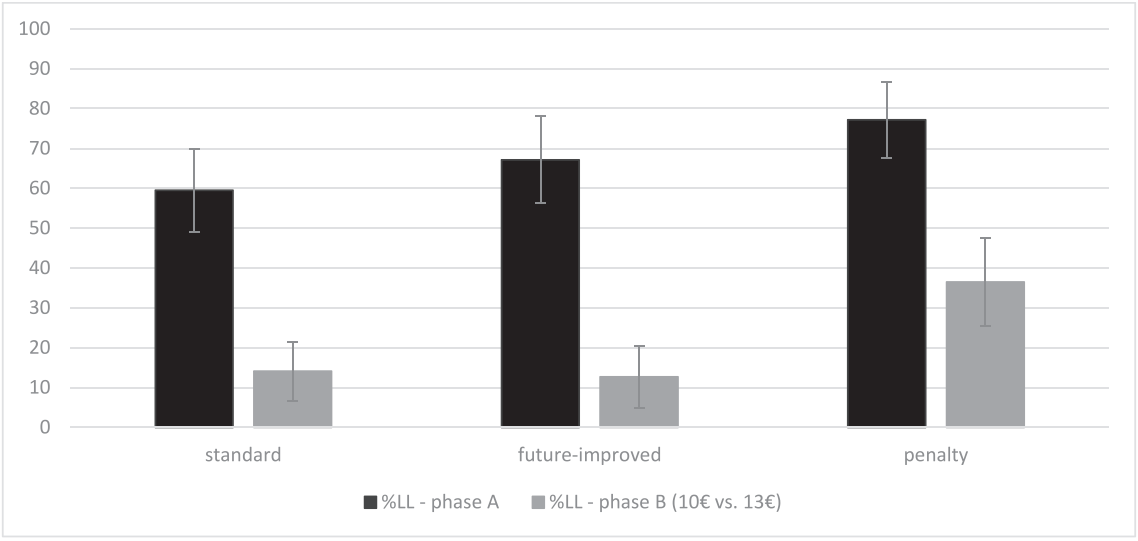

FIGURE 1 | Percentage of larger, later options chosen by type of questionnaire in phases A and B (standard versus future-improved versus penalty frame).

TABLE 3 | Average number of delayed choices by treatment (pair comparisons).

Treatment	Number of choices	Standard deviation	Significance[a]
Standard	16.06	6.02	**
Future-improved	18.13	6.94	
Standard	16.06	6.02	***
Penalty	20.84	5.41	
Future-improved	18.13	6.94	***
Penalty	20.84	5.4	

[a]*t*-tests.
**0.01 > *p*-value > 0.05, and ***p-value < 0.01.

TABLE 4 | Effects of penalty and top-up on the number of delayed choices.

	(1)	(2)	(3)	(4)
Future-improved	1.129	1.114	1.113	1.115
	(0.068)**	(0.071)*	(0.071)*	(0.070)*
Penalty	1.298	1.299	1.304	1.716
	(0.065)***	(0.065)***	(0.063)***	(0.191)***
Female		1.067	1.068	1.061
		(0.051)	(0.051)	(0.049)
Total response time			0.999	1.001
			(0.0002)	(0.0004)**
Total response time × penalty				0.998
				(0.0004)***
Constant	16.059	15.463	15.675	13.558
	(0.650)***	(0.678)***	(1.028)***	(1.222)***
R^2	0.029	0.031	0.031	0.041
Observations	230	230	230	230

Note: Incidence ratios after Poisson estimation. Robust standard errors in brackets. Reference treatment: standard.
*0.05 > *p*-value > 0.1, **0.01 > *p*-value > 0.05, and ***p-value < 0.01.

this last case, delayed options appear to be slightly more instinctive, while in the classic framework the opposite holds. In other words, the penalty treatment seems to affect not only the participants' time preferences but also their instinctiveness. The effect of gender was not statistically significant.

As for the matching questions, the amount of money required in the first ('Imagine that you had won €75 available today. What (additional) amount of money do you want to wait for 30 days and collect the prize?') was lower under penalty MCQ than classical MCQ. Again, for the future-improved MCQ, the results are similar to those under to the classical setting. Finally, the second matching question ('Imagine that you had won €20 in 30 days. How much are you willing to give up to get the prize today?') elicited an amount, which, although very similar, was lower following the penalty than the standard and future-improved MCQs (see the following tables).

More specifically, Tables 5 and 6 report the same comparisons, where the variable of interest is the amount required to wait 30 days before obtaining €75 won at a lottery or the amount that participants are willing to give up receiving €20 won at a lottery today instead of in 30 days. Due to some participants requesting very high amounts compared with the offered sum, the analysis presents responses divided into two sub-samples (e.g., in Table 5, participants who requested €1000 are distinguished from those asking for €100 or less, while requests above €1000 are excluded; the same approach is applied in Table 6).

The figures reported in the tables partially confirm the conclusions suggested in Table 3: The penalty frame renders people more patient; namely, they require (are willing to give) less (more) to obtain the prize of the lottery sooner. Interestingly, people who are willing to give up more than €10 to anticipate the collection of the won amount offer more in the penalty than in the classic

TABLE 5 | Amount required to wait 30 days to get €75 won at a lottery (pair comparisons).

	Required €1000 or less		Required €100 or less	
Treatment	**Amount**	**Significance[a]**	**Amount**	**Significance[a]**
Standard	111.58	°	55.13	°
	(165.88)		(35.15)	
Future-improved	100.34		60.09	
	(75.41)		(29.76)	
Standard	111.58	***	55.13	***
	(165.88)		(35.15)	
Penalty	51.41		35.75	
	(51.61)		(30.03)	
Future-improved	100.34	***	60.09	***
	(75.41)		(29.76)	
Penalty	51.41		35.75	
	(51.61)		(30.03)	

[a]*t*-tests.
°*p*-value > 0.1.
***p-value < 0.01.

TABLE 6 | Amount offered to get €20 won at a lottery now versus in 30 days (pair comparisons).

	Offered €10 or more		Offered less than €10	
Treatment	**Amount**	**Significance[a]**	**Amount**	**Significance[a]**
Standard	12.75	°	3.04	°
	(3.65)		(2.01)	
Future-improved	13.50		3.09	
	(4.40)		(2.17)	
Standard	12.75	***	3.04	***
	(3.65)		(2.01)	
Penalty	19.40		2.24	
	(0.55)		(1.69)	
Future-improved	13.50	***	3.09	***
	(4.40)		(2.17)	
Penalty	19.40		2.24	
	(0.55)		(1.69)	

[a]*t*-tests.
°*p*-value > 0.1.
***p-value < 0.01.

framework, while the opposite happens for those offering €10 or less. It is worth stressing that, as 14 participants required (offered) amounts that were larger than the won amount, the tables present results limited to participants below a certain threshold.

In sum, evidence emerges showing that even very simple information about the amount of money participants must give up for choosing the SS option triggered the choice for delayed outcomes by making future gratification more attractive. More specifically, in line with the second hypothesis of Experiment 1, focussing on losses (penalty frame) made subjects more likely to prefer future gains also compared with increasing LL options by 35% (future-improved frame). Furthermore, individuals appeared to be more patient in subsequent choices when they were subjected to the penalty formulation. In line with the first hypothesis, although in phase B references to penalty were no longer present, the subjects continued being more long-term focussed on the penalty rather than the classical and the future-improved frames. In particular, the preference for delayed options in phase B seems closely linked to the use of the penalty frame in phase A, rather

than resulting from an increased choice of future options, as compared to the standard mode. This confirms that people, who are trained to be farsighted throughout certain types of decision problems (i.e., penalty frames), continue being patient also in more classical formulations of intertemporal choice. Since the future-improved frames did not significantly differ from the standard one in phase B in terms of results, we did not retain this treatment in the following experiments.

After the experimental session, participants were asked to comment on the experiment and reveal the adopted strategies. Most of the subjects did not seem conscious of the treatment effects while choosing their preferred options. However, 17% of the participants subjected to the penalty treatment referred to embracing a particular strategy during the experiment and/or consciously thinking of words such as 'loss' or 'penalty'. This percentage was reduced to 1% for the other two treatments.

6 | Experiment 2

Experiment 2 dismissed the future-improved mode while retaining the classical and the penalty frames. However, to test for robustness, instead of the MCQ, the subjects responded the 8-item questionnaire. This experiment inquires whether the observed effect of long-term orientation in the penalty mode holds also under a different set of choices. It is worthwhile to note that in the current experiment, the value of the outcomes in 27- and 8-item questionnaires is different (i.e., the value of both SS and LL options is lower in the 8-items).

6.1 | Methods

6.1.1 | Participants

Two hundred fifty-eight subjects participated in the study (age range: 19 to 21 years; gender was not recorded). In phase A, half of them were randomly assigned to either the standard or the penalty mode. In phase B, they dealt with three standard decision problems and a matching question.

6.1.2 | Experimental Materials

As in Experiment 1, after reading the introductory information, participants responded an 8-item self-report MCQ in two different versions, randomly assigned to them: standard or penalty. Faralla, Novarese, and Ardizzone (2017) had already used this questionnaire. In line with the MCQ used in Experiment 1, participants had to choose between a smaller and sooner option (SS), at time t, and a larger and later option (LL), at time t + 1. In this case, the SS option was the same for all the couples (€8) and the payment followed immediately. The amounts for the LL options were €8.5, €9, €9.5, €10, €10.5, €11, €11.5 and €12. Finally, the delay for LL options (t + 1) was 4 weeks for every choice. Examples of the two frames are: (1) 'Would you prefer €8 today or €11 in four weeks?' and (2) 'Would you prefer €11 in four weeks or €8 today with a penalty of €3?'. The order of presentation of the 8 intertemporal choices was random. Finally, three standard decision problems and a matching question were administered as post-questionnaire items ('Would you prefer €10 today or €11 in 30 days?'; 'Would you prefer €10 today or €12 in 30 days?'; 'Would you prefer €10 today or €13 in 30 days?'; 'Imagine that you had won €75 available today. What (additional) amount of money do you want to wait for 30 days and collect the prize?') in phase B. The experiment lasted about 40 min (from arrival to departure of the subjects) and participants expressed a total of 12 preferences. The presentation of options, selection of preferences and temporal sequence of events is analogous to Experiment 1. Regarding the payment to the experimental subjects, participants knew that a choice would be randomly selected for payment at the end of the experiment. At the end of the session, all the subjects received the payoff associated with one of the three standard decision problems presented in phase B. As in Experiment 1, for delayed payments, subjects received the payment individually in their classroom after the chosen number of days. All of them also received a participation fee of €5. As indicated in Experiment 1, these amounts represent a reasonable remuneration for Piedmont's residents.

The statistical methodology is the same as that used in the previous section. However, as the choices in phase A are only eight, the analysis employs also pairwise comparison for each of these eight choices. Such comparisons allow us to show that the overall result, on the average number of delayed choices, does not depend on specific couples of options but is, instead, consistent within all of them.

6.2 | Results

As in Experiment 1, we first analysed intertemporal choice in phase A. Although we used the 8-item questionnaire, the results confirm the finding that subjects' preference for delayed options was higher in the penalty treatment. Accordingly, the percentage of LL options was 74%, in the penalty treatment, and 47%, in the standard one (Fisher exact test, p-value < 0.001) (Figure 2). In line with the presentation of the results of Experiment 1, Figure 2 includes the percentage of LL options selected in the standard decision problems in phase B (all participants faced the same choices; i.e., 'Would you prefer €10 today or €11 in 30 days?', 'Would you prefer €10 today or €12 in 30 days?', 'Would you prefer €10 today or €13 in 30 days?'). Statistical analyses confirm that the penalty treatment increases the share of participants who choose the delayed options: In all three standard decision problems, the differences are highly statistically significant (these results are presented in Appendix S5, Table S6.1, which shows the same comparisons for the outcomes of both Experiments 2 and 3, to provide a more comprehensive picture of the effects of large penalty frameworks on the participants' choices). Table 7 shows the differences between the share of participants who chose the delayed to the immediate option for each of the eight choices of the 8-item in the MCQ in phase A. The figures highlight that the participants' behaviour was strongly consistent across all the options.

In addition, Table 7 shows that the share of people preferring the delayed to the immediate payment grows with the difference between the two amounts.

Finally, as for the matching question ('Imagine that you had won €75 available today. What (additional) amount of money

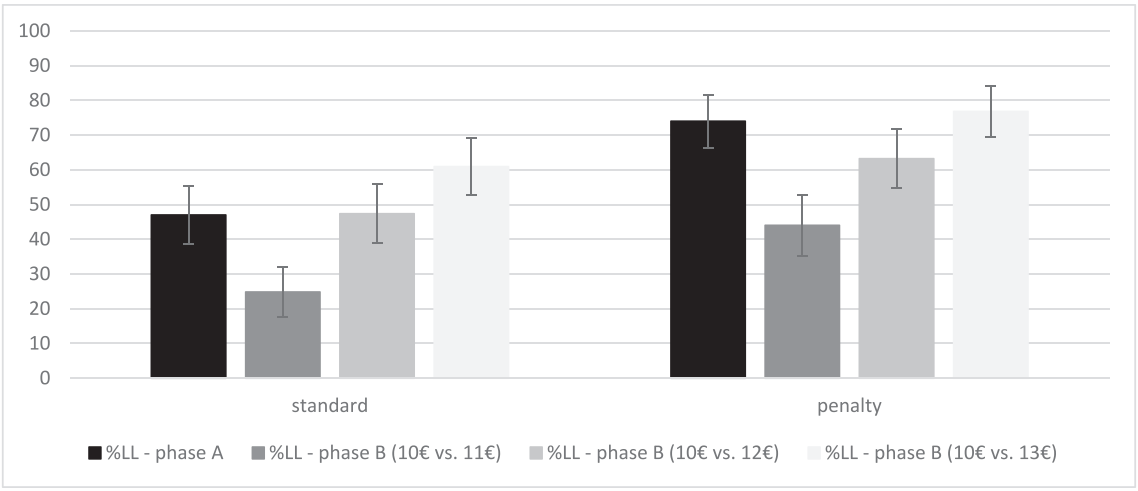

FIGURE 2 | Percentage of larger, later options chosen by type of questionnaire in phases A and B (standard versus penalty frame).

TABLE 7 | Preferences for the delayed payment in Experiment 2.

Treatment	Standard	Penalty	Significance[a]
The average number of choices	3.76	5.92	***
Standard deviation	3.02	2.53	
Percentages of choices for the delayed payment for each option			
€8.5 in a month vs. 8 today	18.8	45.6	***
€11.5 in a month vs. 8 today	59.4	85.6	***
€9.5 in a month vs. 8 today	36.8	69.6	***
€10.5 in a month vs. 8 today	53.4	80.0	***
€11 in a month vs. 8 today	60.9	84.0	***
€12 in a month vs. 8 today	69.9	90.4	***
€9 in a month vs. 8 today	27.8	58.4	***
€10 in a month vs. 8 today	48.9	78.4	***

[a]Mann–Whitney test, except for the average number of choices (*t*-test in this case).
***p-value < 0.01.

TABLE 8 | Amount required to wait 30 days to get €75 won at a lottery.

	Required €1000 or less		Required €100 or less	
Treatment	Amount	Significance[a]	Amount	Significance[a]
Standard	94.95	***	54.02	***
	(142.65)		(34.77)	
Penalty	53.03		39.62	
	(66.19)		(34.25)	

Note: Standard deviations in brackets.
[a]*t*-tests.
***p-value < 0.01.

do you want to wait for 30 days and collect the prize?'), the amount of money required by subjects that made the penalty frame in phase A was again particularly lower than that elicited following the standard setting, as the figures in Table 8 show, suggesting a more patient behaviour. In line with Experiment 1, as some participants requested very high amounts, those (10) who asked for more than €1000 do not enter the analysis, while the others (248) do. However, the subsample of participants requesting €100 or less (214 individuals) is considered separately.

The figures in the table suggest that the participants' response to the treatment is qualitatively the same in both sub-samples.

Despite using a different set of choices in phase A, these results confirm the main findings of Experiment 1: Subjects were less impulsive when exposed to the penalty treatment (phase A) and this result affected individual behaviour in successive decision-making (phase B).

7 | Experiment 3

In Experiment 3, only the penalty frame was tested, using two different versions of it: that applied in the first two experiments and another version, in which the differences between immediate and delayed options were particularly small (we called this treatment *penalty present-improved*). Using this additional framing, it is possible to investigate whether the penalty decision problem stimulates more farsighted preferences when LL options are less favourable. Moreover, this supplementary treatment allows testing whether the penalty frame still prompts delay in the post-questionnaire phase, while subjects are exposed to the penalty feature and do not necessarily prefer the delayed option.

7.1 | Methods

7.1.1 | Participants

One hundred forty-three subjects participated in Experiment 3 (age: 19 to 21 years; gender was not recorded). During phase A, they were randomly assigned to the penalty or the penalty present-improved mode. Both used the 8-item questionnaire. In phase B, the subjects faced the same decision problems as those in Experiment 2 (i.e., three standard decision problems and one matching question).

7.1.2 | Experimental Materials

The penalty questionnaire was identical to that used in Experiment 2. For the penalty present-improved questionnaire, the outcomes for the SS option were €8.3, €8.4, €9.0, €9.9, €10.2, €10.8, €11.4 and €11.9. The respective amounts for the LL options were €8.5, €9, €9.5, €10, €10.5, €11, €11.5 and €12. This reduced the difference between the delayed and the present amounts for all the couples. The delay for LL options was fixed in 4 weeks for each choice. The two frames presented a series of choices between two options, one characterised by a large and the other a small difference between the delayed and the immediate option, for example: (1) 'Would you prefer €11 in four weeks or €8 today with a penalty of €3?' and (2) 'Would you prefer €8.5 in four weeks or €8.3 today with a penalty of €0.2?'. The order of presentation of the eight intertemporal choices was random.

Phase B, as in Experiment 2, presented the following decision problems to the participants: 'Would you prefer €10 today or €11 in 30 days?'; 'Would you prefer €10 today or €12 in 30 days?'; 'Would you prefer €10 today or €13 in 30 days?'; 'Imagine that you had won €75 available today. What (additional) amount of money do you want to wait for 30 days and collect the prize?'. They expressed a total of 12 preferences. The experiment lasted about 40 min (since the subjects entered in the lab to when they left it). Additional materials, temporal sequence of events, and payments to experimental subjects conformed to those of Experiment 2.

Again, the data are analysed using the same techniques as for the previous experiment.

7.2 | Results

During phase A, as expected, the percentage of LL choices was higher in the penalty treatment (77% versus 51%; Fisher exact test, p-value < 0.001) since options are more favourable. Results are in line with those obtained for the penalty treatment in Experiment 2, which also tested the 8-item questionnaire (Figure 3).

As in Experiment 2, all the subjects in phase B dealt with three standard decision problems and one matching question. The choices were identical to Experiment 2. In the three standard choices ('Would you prefer €10 today or €11 in 30 days?'; 'Would you prefer €10 today or €12 in 30 days?'; 'Would you prefer €10 today or €13 in 30 days?'), the percentage of preferences for the delayed option was mostly lower following the penalty

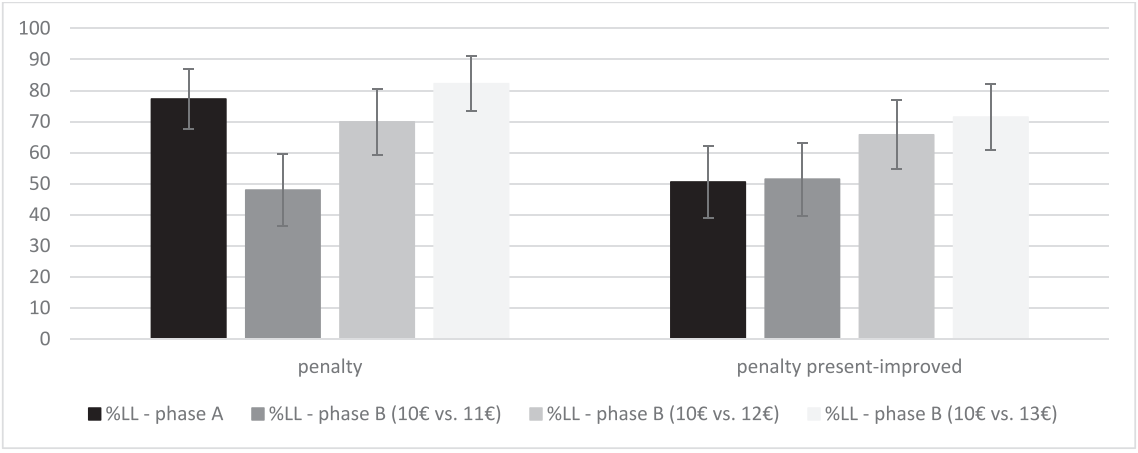

FIGURE 3 | Percentage of larger, later options chosen by type of questionnaire in phases A and B (penalty versus penalty present-improved frame).

present-improved treatment (Figure 3). No statistically significant difference emerges between the choices under the two treatments. Appendix S6 presents the figures relative to this phase and provides a comparison between the results of experiments 2 and 3. Table 9 reports the shares of participants who chose either option for each of the eight couples. The penalty treatment increases the probability that the delayed option is chosen more than the penalty present-improved frame. However, the picture is less neat than in the previous experiment, where the standard frame was compared to those underlying the penalty. Indeed, in this third experiment, the differences are not statistically significant when the amounts paid today are very close to each other. In the second column, which features the smallest penalties, participants seem to be indifferent between receiving the payment today or in a month in the present-improved treatment. Indeed, they tend to divide roughly equally between the two options (as indicated by the following percentages: 50%, 51% and 56%; Table 9), as if they had chosen randomly. This is generally associated with indifference between the options.

Finally, the amount of money required by subjects in the matching question ('Imagine that you had won €75 available today. What (additional) amount of money do you want to wait for 30 days and collect the prize?') was similar following the two treatments and the difference was not statistically significant.

Overall, this experiment confirms that penalty decision problems prompt farsighted preferences; however, this is not the case when LL options were less favourable and indeed when the difference between immediate and delayed options was particularly small, the choice of LL option decreased. Nevertheless, the penalty present-improved treatment seemed to affect post-questionnaire decisions similarly, as being connected with substantially analogous results for preferences stated in the standard as well as in matching choices during phase B. In other words, the penalty frame still has some persistent effect while subjects do not necessarily prefer the delayed option, particularly when they face standard intertemporal choice where penalty features are no more present.

In Appendix S6, we provide the comparison between the outcomes of experiments 2 and 3, which share one of the two frames. A major reason for such a comparison is to test whether different individuals behaved equally in both experiments. If this were the case, the results would provide some support for the external validity of the results, at least when undergraduate students are concerned.

8 | Discussion and Conclusions

The main aim of this paper was to investigate experimentally the framing effects in intertemporal choice using different elicitation modes. We enhanced accessibility by exposing each participant to the same frame multiple times. The results of the paper indicate that the persistence of treatment effects may depend on frames. In the case of the present paper, for instance, the penalty questionnaire—which entails accessibility to loss aversion—trains subjects to consider the difference between the LL outcome and its corresponding SS option as a loss inducing more patience (Hypothesis 1), compared with both classical and future-improved treatments where payoffs were increased by 35% and was much more profitable to select the future option. In phase B, they retained the effect of penalty even when the context of choice was more neutral and reference to loss was absent (Hypothesis 2). Different tools and payoffs (Hypothesis 3) in both phases of each experiment allowed us to test the robustness of this result. The results emerge also when LL options were less favourable, and subjects did not necessarily choose the delayed option, indicating that this type of training can result in long-term planning since subjects were found to be more patient and have increased preference for the delayed outcome.

TABLE 9 | Preferences for the delayed payment in Experiment 3.

Treatment	Penalty	Penalty present-improved	Significance[a]
The average number of choices	6.18	4.04	***
Standard deviation	2.10	3.23	
Percentages of choices for the delayed payment for each option			
€8.5 in a month vs. 8 (8.3) today	34.2	50.0	*
€11.5 in a month vs. 8 (11.4) today	90.4	34.3	***
€9.5 in a month vs. 8 (9) today	76.7	67.1	°
€10.5 in a month vs. 8 (10.2) today	86.3	55.7	***
€11 in a month vs. 8 (10.8) today	89.0	51.4	***
€12 in a month vs. 8 (11.9) today	95.9	38.6	***
€9 in a month vs. 8 (8.4) today	60.3	71.4	°
€10 in a month vs. 8 (9.9) today	84.9	35.7	***

[a]Mann–Whitney test, except for the average number of choices (*t*-test in this case).
°p-value > 0.1.
*0.05 > p-value > 0.1, and ***p-value < 0.01.

The experiments proposed show that loss accessibility engenders some persistence in the mind of the subjects: losses may be easily accessed in the penalty frame, so supporting the evidence that the choice of the immediate and smaller payoff is less compelling. The influence of the penalty frame seems to be strong since its effect persists, at least in the immediate period. Alternative explanations could hold for this result. Losses may be unconsciously primed during phase A. However, the effect of priming might render a frame highly, but also temporarily and/or situationally, accessible (Merema and Speelman 2015); therefore, the preference for LL gains could be transitory to different extents. Alternatively, LL preferences in phase B could be the result of a more conscious reflection process, as some participants' responses about the adopted strategies suggest. As noted earlier, they used words such as 'loss' or 'penalty'. Further research should investigate this hypothesis to disentangle differences and similarities (if any) between accessibility and other mechanisms, which may intervene in making judgments and decisions.

As usually happens with experiments, concerns about external validity may arise. However, the fact that the results are consistent in all three experiments helps to support their external validity. Moreover, the experiments involved different participants; therefore, consistency between their outcomes suggests that these are likely externally valid, at least for the population from which the samples are drawn (i.e., undergraduate students). Also, the participants enter the second stage of each experiment with the payoff of the first phase, thus some wealth effect may affect the results in these second phases. On the one hand, there is some degree of uncertainty about the precise payoff (which depends on a random draw) and this should decrease the wealth effect, if any. On the other hand, the participants know that the minimum amount of their payoff is equal to the lowest option chosen, therefore possibly inducing some wealth effect, which is, however, present in all the experiments and under all the treatments. Therefore, it should not affect the comparison between the experiments. In addition, for the sake of comparability, we selected questionnaires that similar experimental settings had already used (Cohen et al. 2020; Faralla, Novarese, and Ardizzone 2017). More specifically, in this study, we used the MCQ as a tool for eliciting intertemporal choice. Although this type of questionnaire has been extensively used in experimental studies on time preference; nevertheless, alternative procedures (such as adjusting procedures; see da Matta, Gonçalves, and Bizarro 2012) are applicable (and possibly combinable). Moreover, as underlined by Paglieri (2016), the choice of LL options is typically but not necessarily tied to a delay tolerance, at least for some individuals.

The results of the experiments proposed in this paper may have applications outside academic research, where our analysis can find a broader application. For instance, when information about pension plans is concerned. Informing people with low or no contribution to pension funds may result in losing benefits, instead of receiving smaller ones, once retired may incentivise workers to join pension funds or to contribute more than they are currently doing. This might be particularly useful in countries (e.g., Scandinavian and Mediterranean countries), where this type of financial instrument is not much diffused, because public pensions are generous. Indeed, in these areas workers rely on the current legislation, without considering that the governments of many European countries have enacted several reforms, reducing future generations' benefits to preserve the sustainability of the pension systems. Increasing the participation to pension funds in these countries may help the pensioners of tomorrow to avoid large decreases in their incomes. More broadly, our results can also hold implications for financial literacy programs and education in general. Considering that in 2023 only 18% of European citizens display a high level of financial literacy[3] and that individuals are typically impatient over time (Frederick, Loewenstein, and O'Donoghue 2002), they should acquire the reasoning ability about the importance of postponing consumption in early life (Faralla, Novarese, and Di Giovinazzo 2021) and other stages of life. To this aim, starting from behavioural results, particularly financial literacy programs should target people who are outside standard educational programs for age reasons and struggle to take important financial decisions that are required in everyday life (loans, saving, investment) and can have a major impact on individual and social wealth. In this context, educators could emphasise the potential downsides of choosing immediate gratification, such as reduced financial security or missed investment opportunities. By consistently reinforcing this message, individuals may embody the benefits of long-term financial planning, even in the absence of specific reminders, and make a habit of prioritising delayed gratification. This could in turn lead to a lasting mindset shift promoting more farsighted preferences. Even in the absence of a constant reminder of the penalty, the framing effect could persist over time and become salient when people face situations analogous to those experienced in the past. Therefore, the use of penalties with educational purposes may be effective to protect individuals from myopic choices. Another field of application of the present results is the subject area of environment and sustainability. For instance, the use of framing in energy demand and consumption may nudge people to more sustainable means of transport, by underlying the negative long-term consequences of their consumption habits for the environment. In these frameworks, the penalty attribute may help designing suitable policy interventions. Loss aversion is a strong determinant of decision-making and can prevent individuals from taking bad decisions as well as promote healthier behaviours. As in this study, losses should be accessible and appropriately presented to create a habit in which individuals would not indulge in instant gratification. The penalty frame made the idea that choosing the sooner option would imply a loss more accessible fostering the preference for the larger and later option, even when the idea of penalty is no longer reminded. Finally, long-term financial decisions require not only patience but also involve increasing uncertainty over time. As a result, individuals' risk preferences may influence willingness to choose a delayed, larger reward over a sooner, smaller one. This is particularly relevant when designing the financial education programs and reforms aimed at encouraging long-term savings behaviour, as discussed earlier. Acknowledging the presence of risk in these decisions is crucial, as increased awareness of risk might lead some individuals to avoid long-term investments.

Several future research lines can be drawn. First, long delays for later-stage choices (phase B) should be further investigated to test the persistence of the effects we have found in this study. At a more general level, the findings of this paper may have

important implications in the malleability of intertemporal choice behaviour and, as noted earlier, in long-term financial decision-making and planning, such as consumption-saving intertemporal decisions. As a result, real-life decision contexts should be considered for further research, particularly using field experiments. These future studies should continue testing how wording may affect not only individual choice but also how information is given for developing better communication in the financial sector and related fields (taxation, management, etc.). The role of personal characteristics (for instance, gender and age but also personality traits) can also be crucial, especially for tailored feedback and advice. Intertemporal decisions can be indeed characterised by some degree of heterogeneity. In line with this view, the role of genetics in time preference formation could be another interesting and original line of research for future work (e.g., Hübler 2018). Insight on the role of both environment and genetic dynamics shaping intertemporal choice is also important to understand how these kinds of preferences are formed and thus can be of great help in shaping effective interventions for future perspective.

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Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Endnotes

[1]Source: Osservatorio Economico del Governo Italiano (Economic Observatory of the Italian Government: https://www.infomercatiesteri.it, last accessed on 6 January 2024).

[2]Source: ISTAT (https://www.istat.it/, last accessed on 6 January 2024).

[3]Source: Eurobarometer (https://europa.eu/eurobarometer/screen/home, last accessed on 6 January 2024).

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.