

# Introducing money at any time can reduce discounting in intertemporal choices with rewards: An extension of the upfront money effect

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## Abstract

To study intertemporal choices, researchers typically instruct subjects to choose between smaller and sooner (SS) and larger and later (LL) rewards (e.g., gaining CNY 210 in a week vs. gaining CNY 250 in five weeks). People generally tend to discount steeply and prefer SS to LL rewards in such situations. Jiang, Hu and Zhu (2014) recently showed that adding upfront losses or gains to both SS and LL rewards can reduce people's discounting, and they provided several possible accounts for this effect, including the salience account and the time scale hypothesis. In the current paper, based on the upfront money effect found in Jiang et al. (2014), we further showed that the effect of discounting decreasing could be extended to adding dated-money between SS and LL rewards and after LL rewards. The results helped us exclude both the time scale hypothesis and another possible explanation: preference for improvement. We hypothesized that all the current findings (recorded in this paper and in Jiang et al.) could be accommodated well using the salience account.

Keywords: salience account, intertemporal choice, discounting, extra dated-money.

## 1 Introduction

An apple or tiramisu, investment in a pension plan or buying a brand new mobile phone – choices such as these require one to tradeoff between consequences occurring at different points in time. These intertemporal choices are common in daily decisions. To study intertemporal choices, researchers typically instruct subjects to choose between smaller and sooner (SS) and larger and later (LL) rewards (e.g., gaining CNY 210 in a week vs. gaining CNY 250 in five weeks). People usually show steep discounting and prefer sooner-smaller rewards to later-larger rewards when making these choices (Estle, Green, Myerson & Holt, 2007; Jiang, Hu & Zhu, 2014; Takahashi, 2005). Researchers have identified several ways to reduce people's discounting (Urminsky & Kivetz, 2011; Magen, Dweck & Gross, 2008; Read, Frederick, Orsel & Rahman, 2005), for example, framing delays (e.g., CNY 1500 in two month) as dates (e.g., CNY 1500 on August 18, 2015) (Read et al., 2005).

Jiang et al. (2014) recently reported a new way to reduce the degree of discounting: adding upfront losses or gains to both SS and LL rewards. For example, if an immediate loss or gain of CNY 11 was added to a pairwise choice of “gain CNY 210 in a week (SS) vs. gain CNY 250 in 5 weeks (LL)”, the preference for the LL option (i.e., lose/gain CNY 11 immediately and gain CNY 250 in 5 weeks) over the SS option (i.e., lose/gain CNY 11 immediately and gain CNY 210 in a week) was significantly increased. Their findings are incompatible with both the normative exponential and descriptive hyperbolic discounting models, which agree on the additive assumption and the independence assumption. Jiang et al. also excluded the integration explanation, which assumes that the subjects integrate upfront money with final rewards and make a decision with a bottom line at the end. They then proposed two possible accounts for this upfront money effect (including upfront losses and gains). One explanation is the time scale hypothesis, which assumes that the presentation of the 0-delay amount anchors the time dimension at 0 rather than the delivered time of the SS outcome, which may make the delay between the LL and SS outcomes appear shorter than when the upfront money is not introduced and thus increase the attractiveness of the LL rewards. The other explanation is the salience hypothesis. Cognitive limitations make people focus their attention on some but not all aspects of the environment, and salience detection is considered to be a key attentional mechanism that leads people to focus on the relevant aspects of the environment (Bordalo, Gennaioli & Shleifer, 2012). Salience refers to the phenomenon that, once one portion of the environment is more focused, the information in that portion

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will receive increased weighting in subsequent decision-making events (Bordalo, Gennaioli & Shleifer, 2012; Taylor & Thompson, 1982). Jiang et al.'s salience account assumed that introducing upfront money could make the money dimension more salient, which would lead people to assign a greater decision weight to the money dimension and thus make the money dimension affect the choice more. As a result, the LL reward would become more attractive.

Based on the upfront money effect found in Jiang et al. (2014) and their proposed salience account, in this paper, we aimed to examine whether discounting could also be reduced by adding dated money between the SS and LL rewards and after the LL rewards. If this were confirmed, the results would be compatible with the salience account. This is because introducing dated money between the SS and LL rewards or after the LL rewards may also make the money dimension more salient and, thus, affect the choice more. At the same time, we continued to examine other possible accounts for the added money effect, e.g., the time scale hypothesis.

By adapting the stimuli from Jiang et al. (2014), in Experiments 1 and 2, we asked whether introducing losses between the dates of the SS and LL rewards and after the date of the LL rewards could reduce discounting in intertemporal choices with rewards. In Experiment 3, we examined whether introducing gains between the dates of the SS and LL rewards and after the date of the LL rewards could reduce discounting.

## 2 Experiment 1

### 2.1 Method

In Experiment 1, 73 undergraduates (40 males,  $M_{\text{age}} = 18.84$ ,  $SD = 0.94$ ) from Zhengjiang University of Technology were approached and participated in the experiment in their dormitories. Each subject was randomly assigned to one of two conditions. Subjects in the pure gain condition responded to typical choice pairs (e.g., gaining CNY 210 in a week vs. gaining CNY 250 in five weeks), whereas subjects in the mixed condition had the same choices except that both options had the same loss inserted between the SS and LL rewards (e.g., gaining CNY 210 in a week and losing CNY 11 in three weeks vs. losing CNY 11 in three weeks and gaining CNY 250 in five weeks).

To assess whether the results were maintained for different rewards, we constructed two pairwise choices between which the rewards were varied (CNY 210 and CNY 3500 for the SS rewards; these two pairwise choices were both adapted from Experiment 1A in Jiang et al. (2014)). Each subject indicated his or her preferences for two pairwise choices in the questionnaire (Table 1), which was presented with other unrelated questions on paper. After completion, each subject received a small gift.

## 2.2 Results and discussion

As shown in Table 1, the introduction of intervening losses to both intertemporal rewards reduced people's discounting, and the effect remained unchanged regardless of whether the rewards were small or large. These results are directly inconsistent with the time scale hypothesis (Jiang et al., 2014). This hypothesis assumes that the presentation of the 0-delay amount (i.e., upfront money) anchors the time dimension at 0 and thus makes the delay comparison between the SS and LL options appear smaller compared with the pure condition, in which the time dimension anchors at the delay at which the SS rewards are delivered. Therefore, people are more likely to choose the LL options in the mixed conditions than in the pure conditions. However, in the current experiment, because introducing intervening losses did not change the anchoring of the time dimension, the time scale hypothesis could not account for the present results.

Combined with the findings in Jiang et al. (2014), it appears that, whether the losses are added before or in the middle of the pairwise temporal rewards, discount rate was reduced. The effect of intervening losses is consistent with the salience account, which implies that the introduction of losses makes people place a greater decision weight on the money dimension and thus increases the attractiveness of the LL rewards.

At the same time, we must consider another possible explanation for the effect of introducing intervening losses: preference for improvement. When choices are framed as being between sequences of outcomes, people show a preference for improvement, which means they like things to improve rather than worsen over time (Loewenstein & Prelec, 1993). In the current experiment, when pairwise intertemporal rewards were both added with the same intervening loss, the SS option could be framed as a declining sequence, and the LL option could be framed as an improving sequence. Therefore, the increase in the attractiveness of the LL option may reflect a preference for improvement. To test this explanation and to further explore whether the reduction in the discounting effect was maintained when a loss occurring after the date of the LL reward was added to both intertemporal options, we conducted Experiment 2.

## 3 Experiment 2

In Experiment 2, we introduced losses after instead of between both intertemporal rewards.

### 3.1 Method

A total of 199 undergraduates (85 males, 4 did not report their gender,  $M_{\text{age}} = 20.65$ ,  $SD = 1.58$ ) from Zhengjiang University of Technology participated in this experiment.

Table 1: Questionnaire items and summary of the results for Experiment 1 ( $\varphi$  is effect size).

Choice	Item (proportion of responses, 95% confidence interval) (%)		Difference between proportions of LL choices (95% c.i.) (%)	$p$ ( $\varphi$ )
	Pure gain	Mixed condition		
1	Gaining CNY 210 in a week (81.8, 65.6–91.4) vs.	Gaining CNY 210 in a week and losing CNY 11 in three weeks (59.0, 43.4–72.9) vs.	22.8 (1.5–41.1)	0.043 (0.25)
	Gaining CNY 250 in five weeks (18.2, 8.61–34.4)	Losing CNY 11 in three weeks and gaining CNY 250 in five weeks (41.0, 27.1–56.6)		
2	Gaining CNY 3500 in a year (66.7, 49.6–80.3) vs.	Gaining CNY 3500 in a year and losing CNY 160 in two years (37.5, 24.2–53.0) vs.	29.2 (6.1–48.2)	0.019 (0.29)
	Gaining CNY 5800 in three years (33.3, 19.8–50.4)	Losing CNY 160 in two years and gaining CNY 5800 in three years (62.5, 47.0–75.8)		

Note: One subject in the mixed condition did not finish Choice 1 and was therefore excluded from the analysis of Choice 1.

Data were collected in the library's study room. Each subject was randomly assigned to one of two conditions. In the pure gain condition, subjects responded to typical choice pairs as in Experiment 1 (e.g., gaining CNY 220 in three weeks vs. gaining CNY 270 in five weeks), whereas subjects in the mixed condition had the same choices except that both the SS rewards and the LL rewards had additional losses occurring after the date of the LL rewards. As in Experiments 1B, 2B and 2C of Jiang et al. (2014), the losses added favored the SS options, that is, the losses added to the LL rewards were slightly greater than the losses added to the SS rewards (e.g., gaining CNY 220 in three weeks and losing CNY 21 in six weeks vs. gaining CNY 270 in five weeks and losing CNY 27 in six weeks). The added losses should thus make the SS option in the mixed condition more popular than the SS option in the pure condition.

To assess whether the results were consistent for different rewards, we varied the rewards in two pairwise choices (CNY 220 and CNY 3800 for the SS reward). Each subject indicated his or her preferences for two pairwise choices in the questionnaire (Table 2), which was presented with other unrelated questions on paper. The order of the two pairwise choices was counterbalanced. After completion, each subject received a small gift.

### 3.2 Results and discussion

Compared with Experiment 1, although the timing of the added losses changed, the results were consistent. As Table 2 illustrates, the introduction of later losses to both intertem-

poral options reduced people's discounting even though the prospect of the SS options became objectively better than the LL options in the mixed condition. The effect was maintained across different reward sizes. The explanation of the preference for improvement cannot account for the effect reported here, because both options in the mixed conditions were framed as decreasing sequences, and the precipitation speed is even greater in the LL options (e.g., from CNY 270 to -27) than in the SS options (e.g., from CNY 220 to -21). However, the salience account can explain these observations: the effect of these later losses, together with the upfront loss effect found by Jiang et al. (2014) and the intervening loss effect in Experiment 1, suggests that, whenever the losses were inserted, their introduction makes the money dimension more salient and thus lead people to place more decision weight on the money dimension.

## 4 Experiment 3

Because Jiang et al. (2014) reported that adding upfront rewards to both the SS and LL options reduced people's discounting,<sup>1</sup> we examined whether introducing rewards between the dates of the SS and LL rewards and after the date of the LL rewards (in Experiment 3A and 3B, respectively) would reduce discounting.

<sup>1</sup>This upfront gain effect was first reported by Urminsky and Kivetz (2011).

Table 2: Questionnaire items and summary of the results for Experiment 2 ( $\varphi$  is effect size).

Choice	Item (proportion of responses, 95% confidence interval) (%)		Difference between proportions of LL choices (95% c.i.) (%)	$p$ ( $\varphi$ )
	Pure gain	Mixed condition		
1	Gaining CNY 220 in three weeks (67.7, 58.0–76.1) vs.	Gaining CNY 220 in three weeks and losing CNY 21 in six weeks (53.0, 43.3–62.5) vs.	14.7 (1.1–27.5)	0.043 (0.15)
	Gaining CNY 270 in five weeks (32.3, 23.9–42.0)	Gaining CNY 270 in five weeks and losing CNY 27 in six weeks (47.0, 37.5–56.7)		
2	Gaining CNY 3800 in three years (50.5, 40.8–60.2) vs.	Gaining CNY 3800 in three years and losing CNY 65 in four years and a week (31.0, 22.8–40.6) vs.	19.5 (5.9–32.2)	0.006 (0.20)
	Gaining CNY 5000 in four years (49.5, 39.9–59.2)	Gaining CNY 5000 in four years and losing CNY 86 in four years and a week (69.0, 59.4–77.2)		

### 4.1 Method

In Experiment 3A, 119 students (24 males, 2 subjects did not report their gender;  $M_{age} = 20.54$ ,  $SD = 1.02$ ) from Zhejiang University of Technology and Tianjin Normal University participated in exchange for course credit and were randomly assigned to either the pure or mixed condition. The choice pairs in the pure condition were identical to the choice pairs in Experiment 1, whereas the choice pairs in the mixed condition were the same as in Experiment 1 except that the intervening money was gained instead of lost. Each subject indicated his or her preferences for two pairwise choices in the questionnaire presented on paper (Table 3). The order of choice of each condition was counterbalanced.

In Experiment 3B, in the same manner, the choice pairs in the pure condition were identical to those in Experiment 2; however, in the mixed condition, small rewards occurring after the LL rewards were added to both the SS and LL options, and the added rewards in the SS option were a little greater than the added rewards in the LL option (e.g., gaining CNY 220 in three weeks and gaining CNY 27 in six weeks vs. gaining CNY 270 in five weeks and gaining CNY 21 in six weeks). This difference should make the SS options in the mixed condition more popular than the SS options in the pure condition.

One hundred forty-one students (53 males, 2 subjects did not report their gender;  $M_{age} = 20.25$ ,  $SD = 0.97$ ) from Zhejiang University of Technology participated in this experiment in exchange for course credit and were randomly assigned to either the pure or mixed condition group. Each subject indicated his or her preferences for two pairwise choices in the questionnaire presented on paper (Table 3). The order of choice of each condition was counterbalanced.

### 4.2 Results and discussion

As Table 3 shows, the same effect was found as in Experiment 1 and Experiment 2. The introduction of intervening rewards reduced the subjects' discounting in Experiment 3A, and adding later rewards to both intertemporal options also reduced the subjects' discounting in Experiment 3B even though the prospect of the SS options became objectively better than the LL options in the mixed condition. Both the effects of intervening rewards and later rewards were consistent and robust across different reward sizes. The results of Experiment 3A also helped to exclude the time scale hypothesis because introducing intervening gains did not change the anchoring of the time dimension. Additionally, the results of Experiment 3B helped to exclude the explanation of the preference for improvement because both options in the mixed conditions were framed as decreasing sequences, and the precipitation speed is even greater in the LL options (e.g., from CNY 5000 to 65) than in the SS options (e.g., from CNY 3800 to 86).

These findings are again compatible with the salience account and indicate that, whether the valence of adding outcomes is positive or negative, the money dimension became more salient and affected the choice more.

## 5 General discussion

Based on the effect of the upfront losses and gains found in Jiang et al. (2014), this paper further shows that the introduction of intervening and later losses or gains to both the SS and LL intertemporal rewards could also reduce discounting. Several possible explanations have now been excluded as full explanations of the effects of added losses and

Table 3: Questionnaire items and summary of the results for Experiments 3 ( $\varphi$  is effect size).

Experiment	Item (proportion of responses, 95% confidence interval) (%)		Difference between proportions of LL choices (95% c.i.) (%)	$p$ ( $\varphi$ )
	Pure gain	Mixed condition		
3A	Gaining CNY 210 in a week (70.5, 58.1–80.4) vs.	Gaining CNY 210 in a week and gaining CNY 11 in three weeks (36.2, 25.1–49.1) vs.	34.3 (16.4–49.2)	<0.001 (0.34)
	Gaining CNY 250 in five weeks (29.5, 19.6–41.9)	Gaining CNY 11 in three weeks and gaining CNY 250 in five weeks (63.8, 50.9–74.9)		
	Gaining CNY 3500 in a year (73.8, 61.6–83.2) vs.	Gaining CNY 3500 in a year and gaining CNY 160 in two years (25.9, 16.3–38.4) vs.	47.9 (30.4–61.3)	<0.001 (0.48)
	Gaining CNY 5800 in three years (26.2, 16.8–38.4)	Gaining CNY 160 in two years and gaining CNY 5800 in three years (74.1, 61.6–83.7)		
3B	Gaining CNY 220 in three weeks (65.8, 54.3–75.6) vs.	Gaining CNY 220 in three weeks and gaining CNY 27 in six weeks (45.6, 34.3–57.4) vs.	20.2 (3.8–35.1)	0.018 (0.20)
	Gaining CNY 270 in five weeks (34.2, 24.4–45.7)	Gaining CNY 270 in five weeks and gaining CNY 21 in six weeks (54.4, 42.7–65.7)		
	Gaining CNY 3800 in three years (50.7, 39.5–61.8) vs.	Gaining CNY 3800 in three years and gaining CNY 86 in four years and a week (33.8, 23.7–45.7) vs.	16.9 (0.6–31.9)	0.06 (0.17)
	Gaining CNY 5000 in four years (49.3, 38.2–60.5)	Gaining CNY 5000 in four years and gaining CNY 65 in four years and a week (66.2, 54.3–76.3)		

gains. Jiang et al. (2014) excluded the (normative) exponential model, the (descriptive) hyperbolic discounting model, and the integration hypothesis as explanations for the effect. In this study, we continued to examine other possible accounts and excluded the time scale hypothesis and the preference for improvement. For now, it appears that the salience account is the most tenable explanation at least among these proposed explanations. We hypothesized that all current findings (recorded in this paper and Jiang et al., 2014) could be consistent with the salience account. If the salience account is truly correct, it may imply that, whether the valence of the added outcomes is positive or negative and whenever added outcomes are inserted, the introduction of extra outcomes to the SS and LL rewards would enhance the salience of the money dimension and lead people to assign a greater decision weight on the money dimension, which, in turn, makes the LL rewards more attractive. Similarly, Bordalo, Gennaioli and Shleifer (2012) present a theory of risky

choice in which the decision maker’s attention is drawn to (precisely defined) salient payoffs, and then, the decision weights are distorted in favor of salient payoffs.

If the salience account actually explains the effects of introduced losses and gains in intertemporal choice, it becomes a question that why the introduction of dated losses and gains enhances the salience of the money dimension rather than of the temporal dimension. Previous observations suggested that the amount of money is an attribute difficult to ignore, whereas choices are naturally insufficiently sensitive to certain aspects of time, such as duration. It has been shown that people typically underestimate or even ignore the duration of an event when evaluating its total utility (Frederickson & Kahneman, 1993; Prelec & Loewenstein, 1991; Redelmeier & Kahneman, 1996; Varey & Kahneman, 1992). In risky choice, some theories, such as the equate-to-differentiate theory (Li, 1994), posited that people decide only on the money dimension and neglect the probability



dimension. In the light of the high level of similarity between intertemporal and risky decisions, to the point where risk and delay may be psychologically equivalent (Keren & Roelofsma, 1995; Li, Su & Sun, 2010; Sun & Li, 2010), it is not surprising that the temporal dimension is considerably underweighted compared with the money dimension. However, it is still unclear what cognitive mechanism changes the relative weight of these two dimensions.

Although the account of increasing monetary salience as a result of an extra outcome being added is consistent with the current findings recorded in this paper and in Jiang et al. (2014), we have to admit that the studies did not provide direct evidence for a change in salience of the money dimension. Furthermore, although several possible explanations for the effects of added outcomes have been excluded, other possible accounts could still explain the findings as well. Further studies, therefore, are needed to fully examine the salience account using an independent measure of salience and to carefully explore other possible accounts.

Whereas many real-life choices involve single dated outcomes as well as prospects of multiple outcomes, experimental research on intertemporal choice often focuses on the former. This paper studied the choice of pairwise options of two dated outcomes (e.g., gaining CNY 210 in a week and gaining CNY 11 in three weeks vs. gaining CNY 11 in three weeks and gaining CNY 250 in five weeks), and we proposed the salience account as an explanation for the effects found. However, we thought this account might also explain the violations of dominance found in the choices of a single dated outcome vs. two dated outcomes (Scholten & Read, 2014). Scholten and Read (2014) examined four violations of dominance “in which an intertemporal prospect fares better by making it worse, and fares worse by making it better”. For example, when three waves of subjects were offered one set of options, i.e., “A. Receive £75 today (73%—the percentage of subjects who chose this option) vs. B. Receive £100 in 1 year (27%)”, “C. Receive £75 today and receive £5 in 1 year (44%) vs. D. Receive £100 in 1 year (56%)” and “E. Receive £75 today (64%) vs. F. Pay £5 today and receive £100 in 1 year (36%)”, they showed a change in preference and violated the dominance principle. Adding a delayed reward to an immediate reward (C option) makes the prospect objectively better yet decreases the likelihood it will be chosen; adding an immediate loss to a delayed reward makes the prospect objectively worse (F option) yet increases its attraction. In addition, when the choices were converted to losses, i.e., “A’. Pay £75 today (60%) vs. B’. Pay £100 in 1 year (40%)”, “C’. Pay £75 today (69%) vs. D’. Receive £5 today and Pay £100 in 1 year (31%)” and “E’. Pay £75 today and pay £5 in 1 year (67%) vs. F’. Pay £100 in 1 year (33%)”, the subjects also exhibited a preference shift and violated the dominance principle.

Scholten and Read explained these violations of dominance based on the sequences model developed by Loewenstein and Prelec (1993), which implies preference for improvement over deterioration (C and D’ options are deteriorating sequences, whereas F and E’ options are improving sequences). However, we suspect that the salience account can also accommodate these violations of dominance. Introducing dated money (losses or gains) could make the money dimension more salient and cause people to focus more on the money (i.e., gaining more and losing less) and, therefore, increase preference for the LL options in pairwise intertemporal rewards and for the SS options in pairwise intertemporal losses, although we did not examine the latter.

However, the findings of the present paper and others (Jiang et al., 2014; Scholten & Read, 2014; Urminsky & Kivetz, 2011) are inconsistent with the results in Kirby (2006), who found that the present values of the sequences were approximately equal to the sums of the present values of their component rewards. There was no evidence that the addition of extra dated rewards increased preference for the delayed rewards. Perhaps the reasons for different findings come from the methodology. Kirby (2006) asked subjects to estimate their present values of single real delayed rewards and temporal sequences of rewards rather than to make a choice between two intertemporal alternatives of hypothetical rewards. This method may encourage subjects to adopt a discounting strategy in which the delayed outcomes are discounted and assigned the discounted values. The choice method used in this and the other work may invite subjects to adopt heuristic strategies, such as comparing the difference of two alternatives on the delay dimension with that of the money dimension (Dai & Busemeyer, 2014; Ericson, White, Laibson & Cohen, 2015; Jiang, Liu, Cai & Li, in press; Scholten & Read, 2010; Scholten, Read & Sanborn, 2014). Future studies, however, will be required to ascertain the precise mechanisms behind these two methodologies.

To conclude, this paper may shed some light on the underlying mechanism of intertemporal choices with multiple dated outcomes and may provide some insight into a way to reduce people’s discounting through the introduction of extra dated-money, whether it be a loss or a gain.

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