Effect Rules and Attention Mechanism of Probability on Immediacy Effect of Intertemporal Choice

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Abstract. Intertemporal choice (IC) refers to relative preferences and trade-offs for costs and benefits that occur over time, which is ubiquitous in human's everyday life. However, due to the risk of waiting, individuals' preferences may be affected by sense of risk. The present study takes a methodical approach to delineate the precise mechanism of probability of IC. Using eye-tracking technique, we examine the process characteristics of the well-studied behavioral effect known as the immediacy effect of IC. In Study 1, we manipulated time condition and probability levels. In Study 2, using the similar paradigm, we investigated the eye movement pattern of decision making. The behavioral result indicated that adding probability to IC options, most probability conditions reduced immediacy effect. The eye-tracking result showed that adding probability to IC options leads individuals to pay more attention to the time attribute, and the eye movement pattern predict individuals' choices.

Keywords: risky intertemporal choice,intertemporal choice, probability, immediacy effect.

1 Introduction

Intertemporal choice (IC) refers to the individual trade-offs between costs and benefits at different time points and the corresponding judgments and choices[1]. Things like vaccinations, quitting smoking, diets, and so on force people to consider if they should try to lower or prevent their chance of contracting an illness in the future. Money, environment, health, and other areas that are important to people's daily lives are all involved in IC. In an IC task, individuals make choices between the smaller-sooner (SS) and larger-later (LL) options. There exists a preference reversal when the SS options have an immediate outcome. This phenomenon is commonly referred to as the immediacy effect. For example:

Program 1. *A. Today, gain $30; B. After 1 day, a gain of $31.*

Program 2. *A'. After 100 days, a gain of $30; B'. After 101 days, a gain of $31.*

When both options become more distant in time, people tend to favor Program 2' delayed option B' over Program 1's immediate option A[2]. In reality, a lot of decisions include a time and risk component, which can be ruled with IC under risk conditions. For instance, in business management, managers must weigh the pros and cons of various scenarios when making decisions about product innovation, technology, or hiring new employees. Similarly,

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in consumer behavior, when a new product is introduced, should I buy it right away at full price or wait for a discount, even though there's a chance it won't be available later? When consumers make such decision, they are gambling with time; in the health domain, smoking is about balancing the pleasure of the now with the possibility of future health harm, whereas vaccinations aim to lower the risk of future illnesses. It is evident that IC under risk conditions widely exists in people's daily life, management, and economic behavior. Specifically, a commonality among IC that is commonly seen in daily life is the inclusion of risk condition in the choice outcome, which is called risky intertemporal decision-making. As Green and Myerson (2004) pointed out: In the real world, most IC scenarios are at risk. Whether from the perspective of theoretical development or application practice, it is crucial to incorporate risk factors into the study of IC[3].

More research is needed to determine exactly how risk influences the immediacy effect of IC. Traditional decision-making theory views risk choice(RC) and IC as two distinct categories of decisions and offers theoretical frameworks for each, or contrasts their commonalities[4][5][6][7]. Studies that specifically look at IC in risky situations are rather rare. In order to establish a theoretical model of IC under risk conditions, existing research typically employed results-based research methods, measured decision-making preferences, looked at the joint effect of time and risk, and developed a theoretical model of IC under risk conditions based on the discount model framework[8][9][10][11]. For example, Baucells and Heukamp (2012) developed a probability and time trade-off model. This model assumes that individual's discounting rate for delayed outcomes decreases as outcomes increase, and derived clean interactions between risk and time preference[8]. There are numerous disagreements regarding the conclusions made regarding the influence of risk on IC, and this kind of research is restricted to behavioral level discussions that concentrate on input and output information in decision-making. Therefore, what is the effect rules of on the immediacy effect of IC under risk conditions? What is its underlying cognitive mechanism? There is still a pressing need for answers to this set of questions.

Process-based research may provide more evidence for exploring the underlying cognitive mechanisms of the impact of the immediacy effect of IC under risk conditions. In the field of behavioral decision-making, process-based research pays more attention to the analysis of the decision-making process, looking for the correlation between information input and output, and directly infers the cognitive process of decision-making[12][13]. Process-based approaches have emerged as a new method in the research of IC under risk conditions in recent years. A few studies have discovered the path dependence phenomena, which states that decision-makers' assessment of the worth of options will vary depending on which processing path they take. Öncüler and Onay (2009) examined decision makers' value assessments of risky intertemporal options using the certainty equivalent task[14]. They discovered that when decision makers were asked to convert risky intertemporal options into certainty equivalent options, they evaluated the option's value higher if they processed the outcome and time first (delay-amount path) and less highly if they processed the outcome and risk first (risk-amount path). The path dependence phenomenon has also been confirmed in recent process tracing study[15][16]. However, although both revealed similar effects of processing order on decision-making results, Öncüler and Onay (2009) and Konstantinidis et al. (2017)reached completely different conclusions regarding the attention switching characteristics of the processing process: the former found that the majority of the switches occur between option amount and time[14][15]. The latter found that the switch occurs more often between option amount and probability. However, these studies have certain limitations. For instance, the study's tasks might not accurately represent the decision-maker's spontaneous decision-making process, and the process features examined might be overly singular[14][15][17]. As a result, research on pertinent core process characteristics is comparatively lacking.

In this regard, we present the following research questions:1. What are the process characteristics of the immediacy effect of IC under risky conditions? 2. What is the manifestation of the link between behavior and decision-making processes? Therefore, the main purpose of the current study is to examine the underlying cognitive mechanism of the immediacy effect of IC under risk conditions from a process perspective.

1.1 The immediacy effect of IC under risk conditions

The discounted-utility model was introduced by the classical theories of IC, which were based on the assumption of unbounded rationality.According to this theory, individuals use a discounting rate to reduce the utility of future time points, and then they add up the discounted utilities over various time periods. The “total utility” for future options is this amount. Ultimately, individuals choose the option with the highest total utility. The discount function and discounted utility equation defined by this theory can be respectively represented by formulas (1) and (2):

$$F(d) = \left(\frac{1}{1+r}\right) d \tag{1}$$

$$DU = \sum_{d=0}^{n} F(d)\mu(c(d)) \tag{2}$$

In formula 1, $F(d)$ represents the discounted-utility function, where d is the time delay and r is the time discount rate. A higher time discount rate (r) results in a reduced weight for the immediate utility at time d, indicating that individuals exhibit less patience and are less inclined to wait for future benefits. In formula 2, c(d) denotes the consumable resources at time delay d, and u represents the utility of these resources[1]. In the research on IC, a classic behavioral phenomenon known as the immediacy effect was observed.

The immediacy effect of IC under risky conditions have been extensively studied. When examining the effect, results-based approaches are typically employed from a behavioral perspective. Risk has been shown in earlier studies to either strengthen or weaken the immediacy effect of IC. The results of current research can be categorized into two groups based on the direction in which risk influences the immediacy effect of IC. On the one hand, previous research has found that risk can eliminate the immediacy effect of IC. For instance, Keren and Roelofsma (1995) discovered that while manipulating time had no influence on the certainty effect, manipulating probability eliminated the immediacy effect, which stated that people value future gains more when faced with risk[18]. Baucells and Heukamp (2012) observed a shift in people's decision preferences from SS to LL options when they added the same probability level to IC including immediate time[8]. On the other hand, risk amplifies immediacy effect of IC. For instance, Anderson and Stafford (2009) discovered that decision makers have a greater time discounting rate and favor SS options when the risk is included to IC[19]. Moreover, Sun and Li, (2010) employed the choice titration procedure and discovered that risk increased the extent to which future rewards are discounted, i.e. the discounting rate of IC under risk conditions was much higher[20]. Vanderveldt et al. (2015) systematically altered the delay and probability parameters of IC under risk conditions and revealed significant interactions between delay and probability factors[21]. That is, the discounting rate of individuals was observed to increase as the delay extended when probability were high. However when probability were lower, there was little or no impact of delay. In addition to the two effect rules mentioned above, researchers had incorporated a gain-loss framework in the investigation of IC under risk conditions. They found that risk did not alter individuals' preferences for delayed rewards but diminished their willingness to defer losses[22]. In conclusion, previous studies on the impact of risk on the immediacy effect of IC have yielded mixed results. We suggest that this may be attributed to varying weights assigned to different probabilty levels. Individuals engage in risk-taking behavior due to the perception that events with low probabilities hold subjectively higher likelihoods of occurrence. Conversely, risk-averse behavior stems from the perception that events with high probabilities are subjectively less likely to transpire[23]. The study by Attari et al. (2022) also elucidates this pattern of behavior. Therefore, the present study further refines probability levels and formulates the following hypothesis to investigate the impact of risk on the immediacy effect of IC, based on this refinement.

H_1: Individuals at low probability levels exhibit differential decision preferences between “with immediate” and “without immediate” conditions; under the “immediate” condition, individuals prefer SS options compared to the “without immediate” condition.

H_2: Individuals at high probability levels exhibit differential decision preferences between “with immediate” and “without immediate” conditions; under the “immediate” condition, individuals prefer LL options compared to the “without immediate” condition.

1.2 The impact of risk on the process of IC

Recently, the center of attention in behavioral decision-making research has transitioned from comprehending the outcomes of individuals' choices to investigating the processes involved in how decisions are made[24], in line with this trend, decision-making process-based research has also drawn more attention. In contrast to result-based research method, process-based research does not employ mathematical models to hypothesize about decision-making outcomes. Instead, it places greater emphasis on scrutinizing the decision-making process, attempting to “open the black box”, establishing an effective path from sensory input to behavioral output, and speculating directly on the intrinsic cognitive processes of decision-making[24]. Therefore, process-based research can more directly and objectively provide significant evidence on the underlying cognitive mechanisms of decision-making and explanation of human behavior, as well as thoroughly investigate data concerning decision-making results and processes[12].

A few studies have used theoretical derivation and experimentation to perform basic research on the process of IC under risk condition, it was discovered that individual choice preferences are strongly correlated with the processing mechanism. For instance, Sun and Li (2010) proposed the “differential editing of risk” hypothesis, suggesting that in an editing process, if risk information is initially integrated with outcome magnitude, it is more likely to result in an increased discounting rate[20]; conversely, if the two are processed with maintained separateness, risk is more likely to lead to a decreased discounting rate. Similarly, Anderson and Stafford (2009) discovered that decision makers displayed less patience when confronted with risk , exhibiting a higher discounting rate[19]. These studies consistently demonstrated that the presence of risk in IC altered the individuals' discounting rate, which in turn affected the decision result. Previous research using eye tracking to examine the IC process have indicated that attentional bias can alter decision-makers' behavior. For instance, Fisher (2021) investigated attentional preferences in IC using eye movement technology, drawing on the drift-diffusion model and decision field theory[25]. They found that directing focus towards the delayed amount attribute was linked to a significant increase in the probability of choosing LL options, whereas shifting attention towards the immediate delay attribute had a sizable effect in choosing SS options. In addition, related research showed that individuals place too much weight on immediate options. Due to the high weight, individuals pay attention to this information for a shorter period of time and may need less in-depth processing[6]. Similarly,researchers had pointed out that individuals tend to disproportionately emphasize salient features when making decisions[26]. It can be inferred that changes in IC under risk conditions may also be caused by attentional bias to attribute.

The present study selected the eye movement index of fixation duration ratio between different attributes to compare the attention allocation of IC and risky intertemporal choice (IRC) tasks. Proportional attention weights will be given to different attributes of processing depth during the decision-making process if the decision maker follows compensatory rule. Conversely, there is a greater likelihood of processing in accordance with non-compensatory rule. Thus, this study hypothesized the following:

H_3: The inclusion of probability may lead to attentional bias between the time and amount attributes for individuals in IC.

2 Study 1

2.1 Participants

Participants in Study 1 were recruited nationwide via the Internet, and a total of 320 subjects were recruited (M_{age} = 22.46, *SD* =4.337, N_{female} = 129). Each participant received a cash reward of CNY 2 for their participation. All participants provided informed consent prior to the commencement of the study.

2.2 Materials and procedure

Study 1 was a 2(time condition: with immediate option or without immediate option) × 6(probability levels: 10%, 30%, 50%, 70%, 90%, 100%) two-factor within-subjects design.

Participants need to choose between two rewards that have distinct acquisition times. One of them is a smaller but sooner reward, i.e., SS options, another is to a larger but later reward, i.e., LL options. According to the parameterization of the immediacy effect, IC task parameters were configured following the rules outlined below[1]: Materials involving the immediate

[1] The immediacy effect in the experimental materials was tested using pre-experiment 1 (*N*=46). The inter-temporal task of study 1 demonstrated the immediacy effect, suggesting that the parameter settings were appropriately chosen.

option condition consisted of one immediate option (Option A) and one delayed option (Option B with a delay of 180 days). Conditions without an immediate option were created by transforming materials containing the immediate option condition, where the time attribute for immediate option A and delayed option B (180 days) were incremented by a specific value (400). This process generated the time values for the alternative options, A' and B', such that the results for A and A', as well as B and B', corresponded to equal outcomes. Based on this, equal probabilities were assigned to the SS and LL options. The probability levels[2] consisted of six possibilities: 10%, 30%, 50%, 70%, 90%, and 100% (e.g., Option A: obtaining $300 today with a 10% probability; Option B: obtaining $400 in 180 days with a 10% probability).

2.3 Results

To investigate whether adding probability would affect the immediacy effect, six probability levels were chosen, and they were added to the IC task. Using SS options as the dependent variable, a two-factor ANOVA was conducted depending on the probability levels (10%, 30%, 50%, 70%, 90%, 100%) and the time condition of the task (with or without immediate options).

The results indicated a significant main effect for the time condition (F (1,318) = 44.29, $p < .001$, $\eta^2 = .002$), a significant main effect for probability levels (F (5, 314) = 5.824, $p < .001$, $\eta^2 = .002$), and a significant interaction between the two (F (5,308) = 2.824, $p = .015$, $\eta^2 = .001$). Post-hoc Bonferroni comparisons revealed that at probability levels of 30%, 50%, and 90%, with or without immediate options did not significantly influence the selection of SS options (p = [0.072,0.454]), see Fig.1. Thus, partially supporting H_1 and H_2. The results suggest that, under most probability levels, increasing the probability in IC diminishes the immediacy effect.

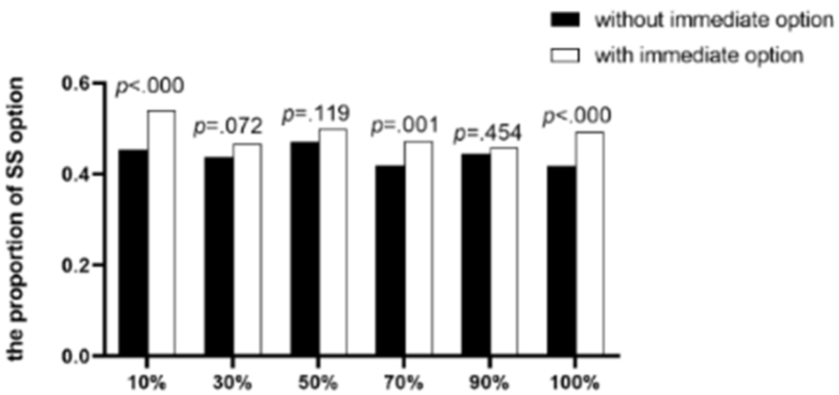

Fig. 1. Proportion of SS options under different probability levels with/without the immediate option (M±SE).

[2] The results of pre-experiment 2 (N=43) illustrated that the presence of the immediacy effect when a 100% probability level was added in the intertemporal task, as well as in the absence of additional probability levels. Consequently, for the sake of symmetry in the options, in subsequent formal experiments, we will articulate the probability of certain options as 100%.

3 Study 2

3.1 participants

The final sample made up of 49 college students from a university in Guangzhou, China (M_{age} = 20.51, SD = 1.9, N_{female} = 29). All participants had normal or corrected-to-normal vision, and no cases of red-green color blindness were noted. Before the study started, the participants signed an informed consent. Participants were rewarded CNY 10 in cash for participation.

3.2 Apparatus

An EyeLink 1000plus eye tracker with a sampling rate of 1000 Hz was used to collect Eye-tracking data. The stimuli were presented on a 19-inch DELL flat-screen monitor with a resolution of 1024 × 768 pixels. The participants' horizontal visual angle from the eyes to the screen edge was 28°, and the vertical visual angle was 21°. Participants responded using keys on the keyboard.

3.3 Materials and procedure

This study was a 2(time condition: with immediate option or without immediate option) × 3(probability levels[3]: small (25%), medium (47%), and large (72%)) within-subjects design.

Study 2 was based on the refined experimental materials from Study 1. The IC task parameterization followed the same approach as in Study 1.

To prevent the stimulus information presentation method from influencing the participants' information search process, there are two presentation formats for probability levels and reward magnitudes. (see Fig.2 and Fig.3). To ensure that participants cannot simultaneously gather more than one piece of information (such as reward magnitude, payment time, etc.) with each fixation (through peripheral vision), all information in the stimuli is presented at the peripheral edges of adjacent information. Specifically, it is located at least 5° visual angle away from the central area of other adjacent information. Schematic representation of the experimental materials is shown in Fig.2 and Fig.3.

Fig. 2. Presentation format 1.

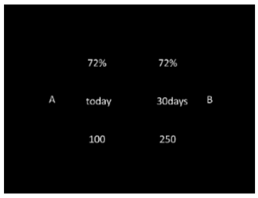

Fig. 3. Presentation format 2.

[3] The selection of probability levels is based on studies on framing effects by Gosling and Moutier (2017)[27] Small probability levels were specified in the study as 20%, 30%, and 40%, therefore, the random integer 25% in the 20%-40% range is chosen by this study as the small probability. Similarly, the high probability level is chosen for 72% of the random integers in the range of 60%-80%, and the medium probability level is chosen for 47% of the random integers in the range of 45%-55%.

Each participant was required to complete IC tasks with added probability, selecting the preferred options by pressing keys. Before the beginning of the experiment, participants read the instructions to understand the task and finished three practice sessions to familiarize themselves with the stimulus presentation. Each block consisted of 30 formal trials, and the presentation order of tasks as well as the order of options within each task were randomized. Participants had ample time for decision-making during each formal trial. The task proceeded as follows: initially, a dot appeared in the center of the screen, and participants focused on the dot (automatic drift correction was performed by the eye tracker). After pressing a key, the formal option pairs were presented. Once a choice was made, the screen displayed feedback on the result, followed by a random blank screen duration lasting between 500 to 800ms.

3.4 Results

Eyelink DataViewer (SR Research, Canada) was used to export and preprocess eye movement data. Each stimulus material was divided into six non-overlapping rectangles of equal area (180 × 117 pixels) as areas of interest (ROI). These regions precisely covered all reward magnitude, the probability and payment time associated with obtaining the money for both options. In this study, there were 1470 trials in total, and 5 (0.34%) of them were removed during data processing. Among them, 3 trials (0.20%) were due to eye tracking errors, and 2 trials (0.13%) had response time of 0ms, resulting in a total of 1465 valid trials. Furthermore, 2830 of the 25942 fixations that were collected (or roughly 10.91%) were not included in the study because their duration was shorter than 20ms and they were beyond the ROI, so a total of 23112 fixations were included.

Difference testing was carried out with SPSS 26.0.

3.4.1 Attention allocation

To confirm the impact of adding probability on the attention allocation on the IC task, a t test was conducted on the fixation duration ratio between different attributes (amount/time). The results revealed that in the IC task, the attention allocation ratio for the small probability condition (*M* = .70, *SE* = .02) was significantly lower than that for the certain (without probability) condition (*M* = .86, *SE* = .02, *t* (80) = 5.443， *p* =.000, *Cohen'd* = 1.226). Similarly, the attention allocation ratio for the medium probability condition (M = .72, SE = .04) was significantly lower than the certain condition (*M* = .86, *SE* = .02， *t* (80) = 18.577, *p* =.000, *Cohen'd* = 4.183). Additionally, the attention allocation ratio for the large probability condition (*M* = .76, *SE* = .04) was significantly lower than the certain condition (*M* = .86, *SE* = .02, *t*(80) = 13.269， *p* = .000, *Cohen'd* = 2.988).

The above results indicate significant differences in attention allocation between IC and IRC tasks under conditions with and without probability. In the absence of probability conditions, relative to the IRC task, more attention is allocated to the amount attribute in the IC task. Introducing different probability levels into the IC task, relative to the amount attribute, results in individuals allocating more attention to the time attribute. These findings support H_3.

3.4.2 Eye movement prediction

To further explore the relationship between attention allocation and participant choices, this study employed SS options as the dependent variable. The logistic regression included attention allocation ratio (amount/time) under different probability conditions as independent variables, as shown in Table 1. More attention was allocated to the quantity property when the ratio was more than 1, and more attention was allocated to the time attribute when the ratio was less than 1.

Table 1. Variables and assignments for individual choice prediction analysis.

Factor	Variables	Assignments
allocation ratio	small probability medium probability large probability	0: ratio less than1 1: ratio more than1

The results indicated that the impact of attention allocation ratio on participant choices is statistically significant under most probability conditions (small: *OR* = 1.64, 95% CI = [1.20,2.22], p = .002; medium: *OR* = 1.92, 95% CI = [1.41,2.61], p < .000; larger: *OR* = 1.10, 95% CI = [.81,1.51], p = .534), as shown in Table 2. This suggested that under conditions of small and medium probability, individuals who allocated more attention on the amount attribute relative to the time attribute are more likely to choose the SS options.

Table 2. Logistic regression analysis for individual choice prediction.

variables	group	*B(SE)*	Wald χ^2	*OR* (95%*CI)*	p
small probability	time attribute *	.49(.16)	9.80	1.64(1.20,2.22)	.002
medium probability	amount attribute	.65(.16)	17.19	1.92(1.41,2.61)	.000
large probability		.10(.16)	.387	1.10(.81,1.51)	.534

* Indicates the control group.

Finally, the logistic model is statistically significant, χ^2=25.59, p<.000, and the model equation is formula (3):

$$logit(p) = 0.49small\ probability + 0.65medium\ probability + 0.2large\ probability - 0.391 \quad (3)$$

4 Discussion

The present study examined the immediacy effect of IC under risk condition and explored the underlying cognitive mechanisms underlying individual decisions at different probability levels. The integrated findings from both studies revealed, at the behavioral level, that adding probability in IC affect the choice preference. Specifically, under most selected probability conditions, the probability diminished the immediacy effect. Additionally, adding probability influenced individuals' attention allocation patterns in IC, leading them to allocated more attention on the time attribute. Furthermore, changes in eye-tracking processing patterns can predict individual choices.

Both studies consistently found that adding probability in IC tasks alters individuals' choice preferences. Under most probability conditions, it leads to a reduction in the immediacy effect, with a greater willingness to wait for LL options. This finding aligns with some prior research[8][18]. In contrast, we extended the range of probability levels to demonstrate the impact of risk levels on IC under different temporal conditions (with/without immediate options). However, this conclusion differs from some prior studies. Notably, Xu et al. (2022) observed that participants' preferences did not change when both options carried risks[28]. Furthermore, some researchers have found that introducing risk in IC tasks decreases participants' patience, leading to an increased discounting rate for LL options[19][20]. This disparity may be ascribed to variations in the design of experimental materials, such as Sun and Li (2010) fixing the probability level at 50% as an experimental parameter, and using relatively larger monetary amounts[20]. Even when choosing the SS options, participants had the opportunity to receive a substantial income, leading to a stronger immediacy effect. This speculation aligns with Read's (2004) study, which found that attention index can highlight different processing approaches to experimental parameters[29]. For instance, in tasks involving choices between loss and gain, information about delayed time is browsed less frequently, which may help explain why discounting rates over time are higher in the gain frame than in the loss frame.

Moreover, at the eye-tracking level, the study found that adding probability in IC tasks altered participants' attention patterns. Individuals allocate more attention to the time attribute relative to the amount attribute. This may be attributed to the specificity of time and probability influencing individuals' processing, indicating that the impact of probability attributes and time attributes on option value is distinct[30]. Additionally, under conditions of small and medium probability, individuals who allocated more attention on the amount attribute relative to the time attribute are more likely to choose the SS options.

The findings of the present study offer the following implications. At the theoretical level, by integrating behavioral experiments and process tracing methods, the study explored the mechanisms through which risk influences IC. It delves into individual choice preferences and psychological mechanisms, providing converging evidence based on both behavior and processes. This effort contributes valuable attempts toward establishing theories of IC under risk conditions. On the applied level, it facilitates an understanding of how individuals make IC under risk. This understanding can aid organizations in making more effective decisions when facing strategic planning, technological innovation, talent acquisition, and other major decisions by balancing timing and risk more efficiently. Furthermore, from an information processing perspective, the study offers effective operational methods for behavioral changes in IC under risk conditions. This has the potential to provide scientific grounds for public policy formulation and offer psychological assistance in understanding, predicting, and intervening in behavior management.

This study has the following limitations. Firstly, the probability levels of the two options in each experimental task were equivalent. Specifically, the present study exclusively concentrated on scenarios wherein both the immediate and future outcomes entailed elements of risk. However, there are many other scenarios for IC under risk conditions. When the immediate involves risk but the future is certain — for example, if you answer the phone while driving, there may be safety hazards in responding to the call immediately. However, it would be safer to answer the phone after reaching the destination. When the immediate is certain but the future is risk — for example, during a significant sale where a product faces a price reduction, should one opt to purchase it now at a presently determined lower price, or wait until the future when the item may become less marketable and the price is potentially reduced? Future research could extend the investigation to other scenarios for IC under risk conditions to provide additional evidence for addressing relevant research disputes. Secondly, employing the same set of IRC tasks for different individuals may make it challenging to eliminate the confounding effects of individual differences on the results. Future research could tailor specific experimental materials for each participant to eliminate differences in individual preferences during decision-making, thus better controlling the potential impact of parameter variations on the results.

5 Conclusion

This study explored underlying cognitive mechanisms through which risk influences the immediacy effect in IC. The study revealed that: (1) Adding probability in IC diminishes the immediacy effect; (2) Adding probability led individuals to allocate more attention on the time attribute in IC, and changes in attention allocation patterns can predict individual preference for choices.

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