

Literature Review: A Study on the Influence of Emotions on Intertemporal Decision-Making

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Abstract: In recent years, with the integration and development of psychology and decision science, the research on the influence of emotions on intertemporal decision-making has increasingly emerged, forming a new academic trend. However, the current research in this field is still preliminary, and most of them focus on the revelation of phenomena, while few literatures directly analyze the complex mechanism between emotions and intertemporal decision-making. Therefore, in order to have a more comprehensive understanding of the psychological basis of intertemporal decision-making, and to guide people to use and control emotions more effectively in actual situations to achieve more satisfactory decision-making results, it is necessary to further explore the relationship between emotions and intertemporal decision-making. Such research can not only enrich the connotation of intertemporal decision-making theory, but also provide more scientific guidance for emotion management. This paper summarizes the previous research on the impact of emotion on intertemporal decision-making, and finds some current research areas and shortcomings, such as the lack of investigation of complex emotions, the lack of depth of research from the cognitive process itself, and the limitations of single-point results. For example, to investigate the influence of dynamic emotions, daily emotions and complex emotions on intertemporal decision-making, and to make more attempts and explorations in emotional interventions.

Keywords: Emotions; Intertemporal Decision-making; Decision Science.

1. Introduction:

In daily life, decision-making is indispensable to accomplish something, and any decision is inseparable from people, and only people are the main body of decision-making. With the interdisciplinary integration of psychology, economics and management, the research on intertemporal decision-making has gradually deepened. Intertemporal decision-making refers to the process of making choices based on the trade-offs between costs and benefits that occur at different points in time (Frederick, Loewenstein, & O'donoghue, 2002). Beginning in the 30s, economists and psychologists came up with a series of models to describe the behavior of intertemporal decision-making. In 1937, the Nobel laureate in economics Samuelson (1937) first proposed the discount utility model. According to this model, people will discount the utility at different points in the future at the same rate, and the sum of the future utilities after the discount is the total utility assigned by the individual to the option. However, with the emergence of anomalies that cannot be explained by the discount utility model, researchers have developed different discount models to explain the anomalies by modifying the discount function. However, decisions based solely on sophisticated calculations do not always seem to be in line with reality. When people are in an uncertain world, it is impossible to make final decisions with highly rational computational thinking all the time. It can be seen that if the intertemporal decision-making is blindly emphasized without considering other factors, many problems will arise. So in the process, some factors go from initial neglect to control.

Zhang Lichun (2016) pointed out that there is a "framing effect" in intertemporal decision-making. The framing effect, as a psychological phenomenon, actually reveals that when decision-makers are faced with the same decision-making

task, due to the different ways of task description, they will have different representations of alternative options, and then change their decision-making preferences. For the "framing effect" in intertemporal decision-making, many factors play a role that cannot be ignored. These influencing factors mainly focus on multiple dimensions such as cognitive level, personality traits, age stage, mood fluctuations, and time perception. These dimensions not only influence the generation of framing effects independently, but may also be intertwined with each other and jointly shape the decision-making preferences and behavior patterns of decision-makers. Therefore, it is of great theoretical and practical significance to explore the relationship between these influencing factors and the framework effect to understand the intertemporal decision-making process and optimize the decision-making strategy. As a subjective experience within an individual, emotions are easy to influence people's decision-making behavior. Nowadays, emotions are increasingly influencing intertemporal decision-making, and has developed into an important variable in the field of intertemporal decision-making. As an important psychological phenomenon in psychology, exploring the influence or mechanism of emotion on intertemporal decision-making is a topic worthy of in-depth development, and it also has certain practical and theoretical significance.

2. Research Implications

2.1. Theoretical Implications

In the middle of the 20th century, intertemporal decision-making became a hot field for in-depth exploration in many disciplines such as economics and psychology, and has developed rapidly since then. The research in this field not only promotes the progress of economic theory, but also provides rich practical applications in the field of psychology,

further revealing the psychological mechanism and behavior patterns of human beings in the face of future decision-making. With the deepening of research, intertemporal decision-making has become an indispensable part of modern decision science. It requires decision-makers to make a reasonable trade-off of interests, and is an important decision related to the interests of individual human beings and even the national economy and people's livelihood, and is of great significance in all aspects.

As for the theoretical significance of the influence of emotion on intertemporal decision-making, the theoretical research on emotion and intertemporal decision-making can be further enriched and deepened by in-depth study of the relationship between emotion and intertemporal decision-making. This helps us to understand more fully how emotions affect an individual's decision-making process, especially when it comes to the trade-offs of costs and benefits over different time periods. Intertemporal decision-making involves the trade-off between costs and benefits in different time periods, and emotion, as one of the important factors influencing decision-making, is closely related to trade-off theory. Studying the relationship between emotions and intertemporal decision-making can help to apply trade-off theory to a wider range of fields, especially in explaining and predicting the decision-making behavior of individuals in affective states. The study of intertemporal decision-making behavior can also enrich the theory of social-emotional choice. For example, in the context of the current population aging, in order to analyze the intertemporal decision-making behavior of the elderly, this paper analyzes the social-emotional choice theory, which fully enriches the theory and also has certain reference significance for the elderly pension problem.

2.2. Practical Significance

The practical significance of exploring the relationship between emotion and intertemporal decision-making is that through a deep understanding of how emotions affect intertemporal decision-making, it can help individuals, enterprises and governments to better consider emotional factors when formulating long-term goals and strategies, and the in-depth study of the relationship between emotions and intertemporal decision-making is particularly important in the process of pursuing more informed decision-making. The research in this field will not only help us to deeply understand the psychological mechanism behind intertemporal decision-making, but more importantly, we hope that based on these research results, we can optimize the intertemporal decision-making process of individuals, reduce short-sighted behaviors caused by emotional fluctuations, and improve the quality of decision-making in people's daily life. Through such efforts, we can better understand the role of emotions in the decision-making process and guide practice accordingly to achieve more rational and long-term decision-making goals.

For example, in terms of consumption, is it to live in the present or to enjoy the future? This is a real problem that everyone needs to consider in their daily life. The intertemporal decision-making of consumption reflects the trade-off between current and future consumption of economic agents (Zhu Chao and Yi Zhen, 2021). Economic recovery requires the government to formulate policies to guide national consumption. The study found that the wealthier, older, and poorer the physical condition of the

group, the more inclined to future consumption, the higher the elasticity of intertemporal substitution. If people do not consume, how to promote economic growth, on the contrary, if people consume excessively, how to ensure that they consume ahead of the hidden dangers. With the rapid change of Chinese demographic characteristics, families will be more future-oriented, and policies need to be responded to in advance to avoid people's cross-period decision-making and consumption. Therefore, when the government responds to the change of consumption trend brought about by this subjective preference in advance in policy formulation, in addition to the conventional consumption stimulus policy, it can also slow down the tendency to delay consumption to a certain extent by improving the health level of the whole population (such as increasing public health spending, etc.), and promote national consumption. In China, where the aging population is becoming more and more serious, the problems of old-age care emerge one after another, and intertemporal decision-making is an important dimension of the research on the problem of "housing for the elderly". Wu Zhenxin et al. (2020) constructed an inter-period optimization decision-making model for residents from the perspective of period differences, discussed the impact of the difference in the loan amount of "housing for the aged" on residents' welfare, simulated and calibrated the changes in non-housing consumption, savings and welfare of residents participating in the "housing for the aged" in different periods, and finally concluded that the government should increase its support for the "housing for the aged" business. Residents should also make the decision of "housing for the elderly" as soon as possible to increase their own welfare. In addition, individual intertemporal decision-making is also closely related to adolescent health, Geng Xiaowei (2021) examines the development characteristics of intertemporal decision-making among junior high school students and its relationship with mental health. A well-designed intertemporal decision-making questionnaire and a widely recognized mental health scale were used to comprehensively measure 142 junior high school students. In the data analysis process, the statistical methods of correlation and regression analysis were used to reveal the internal rules. After in-depth data mining, the following significant results were found: there was a significant positive correlation between age and the tendency of junior high school students to choose long-term big interests in intertemporal decision-making. Specifically, as they grow older, their mental health also improves, and they are more inclined to choose long-term and more profitable options when faced with intertemporal decision-making, which highlights their more long-term vision and mature decision-making thinking. This finding is of great significance for understanding the decision-making psychology of adolescents and guiding their healthy growth. (Wu Xiaojun, Junfang Chen, Jiahui Fu, 2020) starts with intertemporal decision-making in the field of health. It is concluded that future research should be dedicated to the development of intertemporal decision-making models and research paradigms applicable in the field of health. This requires not only a deep understanding of the complex relationship between health behaviors and intertemporal decision-making preferences, but also an in-depth analysis of the internal mechanism of intertemporal health decision-making. More importantly, we need to actively try and explore the application of these research results in health behavior intervention and medical and health policy practice.

Such a research path can not only enrich the applicability of intertemporal decision theory in the field of health, but also provide a strong scientific basis for health behavior intervention and medical and health policy formulation. In fact, emotions and intertemporal decision-making are closely related to the mental health of adolescents, and caring for adolescents' emotions and attaching importance to guiding adolescents to make correct decisions is quite important for strengthening the psychological and quality education of adolescents in China.

3. Research Status and Shortcomings

3.1. Research Status

At present, many studies have pointed out that intertemporal decision-making is affected by a variety of factors, including emotional, cognitive, and social environment. Among the emotional factors, emotional states such as anxiety, anger, and awe have been confirmed to affect individuals' intertemporal decision-making preferences. At present, most of the literature mainly divides emotions into negative emotions (such as sadness, fear, anger and disgust) and positive emotions (such as self-confidence, optimism, etc.), and studies intertemporal decision-making.

For example, Li Jiajia 2022 mainly explores the impact of negative emotions and self-depletion on intertemporal decision-making, and concludes that the main effect of negative emotions on the delay discount rate of college students is significant. Qiu Fen (2019) explores the influence of negative emotions on intertemporal decision-making, arguing that the emotional valence research paradigm divides emotions into positive emotions and negative emotions, and the explanation of the decision-making results of this paradigm is that positive emotions are more inclined to positive judgments, while negative emotions are more inclined to negative judgments. In addition, the empirical analysis of the time discount rate in intertemporal decision-making is added, and finally an important revelation is obtained, that is, compared with the anger emotion that is the same negative emotion but the core evaluation theme is different, people should avoid making intertemporal decision-making judgments about money under sadness. In fact, in some studies on emotions and intertemporal decision-making, many literatures have introduced the concepts of time perception and time discount rate, after all, the word "intertemporal" is an important dimension of transtemporality. (Jiang Yuanping, Jiang Chengming et al., 2022) In the process of exploring the influence of emotions on intertemporal decision-making, by introducing the concept of time discount rate into the experiment, it is found that the time discount rate of subjects under positive emotions is lower and has a stronger tendency to choose delayed options. The results verify that the effect of emotion on intertemporal decision-making disappears with the initiation of time and money, which further supports the mediating role of interdimensional difference comparison. From the perspective of decision-making process, the psychological mechanism of emotion influencing intertemporal decision-making is revealed. Zhou Shengqi (2020) also introduced the concept of time discount rate into the experiment to explore the influence of emotions on group intertemporal choice, and found that the time discount rate of participants in positive emotional states showed a lower trend than that in neutral emotional states, indicating that they were more inclined to choose delayed

options in the face of intertemporal decision-making. Further comparison shows that in the neutral emotional state, individuals are more inclined to choose delayed options than when making decisions for themselves, which reflects that they show a more long-term vision and a more prudent decision-making attitude when considering others. This finding not only reveals the influence of emotional state on intertemporal decision-making preferences, but also further reveals the potential influence of decision-making objects (self or others) on decision-making preferences, providing a richer perspective for understanding human decision-making behavior. Han Wansheng (2013) takes the time factor as an important variable in exploring the influence of emotions on the subjective probability of environmental intertemporal risk decision-making, and pays special attention to how time delay can affect the public's environmental risk perception and decision-making by changing the public's subjective probability judgment. In order to understand this mechanism more comprehensively, he introduced emotional factors into his research, and found that emotional states have a significant impact on subjective probability judgments. Specifically, when the participants were in an emotional state of fear and anger, their subjective probability judgment was significantly smaller, which reflected that the public was more sensitive to the perception of environmental risks in the emotional state of fear and anger, and tended to show more risk-averse behaviors, that is, they became more cautious and alert to the occurrence of environmental risks. This discovery not only enriches the academic understanding of the impact of time delay and emotion on decision-making, but also provides a new perspective on risk management and decision-making.

In addition, there are not a few studies that specifically elaborate on the relationship between time and intertemporal decision-making, such as (Jin Miao and Li Jian, 2021) and others who study how time discounting affects time discounting from a limited perspective through the method of intertemporal decision-making behavior experiments. Finally, it is found that with the increase of time from the decision-making date, the discount rate shows a non-monotonic change of first falling and then rising, and people will suddenly become more impatient when they cross 14 months from the decision-making day, so the limited horizon may affect the intertemporal decision-making, which provides a new idea for policy intervention related to important intertemporal decision-making behaviors such as savings and insurance. (Xu Lan, Chen Quan, 2019) found that people with linear time view preferred the near-term option over those with cyclic time view in the unlabeled situation. In the marked context, this effect is attenuated. It reveals that time perception can be used as an influencing factor for individual intertemporal decision-making preference, and enriches the current research on intertemporal decision-making from the perspective of individual subjective time perception. Therefore, it can be judged that the importance of introducing the time factor to consider the influence of emotions on intertemporal decision-making. The psychological mechanism of single-based intertemporal decision-making involves many aspects, including time discount, hyperbolic discount model, and unidimensional dominance model. Time discount refers to the phenomenon that the individual's valuation of future earnings decreases with the increase of delay time, which is one of the core psychological mechanisms of intertemporal decision-making. The hyperbolic discount model is an explanation of

the phenomenon of time discounting, which holds that the time discount rate of individuals is not fixed, but gradually decreases with the increase of delay time. The unidimensional dominance model explains the influence of emotions on intertemporal decision-making from another perspective, arguing that individuals' decision-making preferences depend on the relative advantages of different options.

Compared with negative emotions, there will be fewer literatures on the impact of positive emotions on intertemporal decision-making, and it is found that some literatures have a stronger correlation between negative emotions and positive emotions on intertemporal decision-making, which may be an important reason. However, the importance of positive emotions to compensate for the psychological wear and tear of individuals to make critical decisions cannot be overlooked. (Wei Yu, 2021) In the study of the impact of awe and self-depletion on environmental intertemporal decision-making, it is gradually found that awe has a positive impact on environmental behavior. At the same time, in today's rapidly changing social development, the psychological loss of modern people in the midst of complicated affairs is becoming more and more serious, and positive emotions can compensate for this loss. This allows people to make relatively more critical intertemporal decisions. Of course, not all literature divides emotions into positive and negative or positive, neutral, and negative emotions to explore the impact on intertemporal decision-making. (Jiang Yuanping.) , Sun Hongyue 2019) divided emotions into pre-decision emotion, decision-making emotion and post-decision emotion in the study of the impact of emotion on intertemporal decision-making. The comprehensive integration of behavioral experiments and neuroimaging aims to deeply analyze the behavioral and neural mechanisms of emotions affecting intertemporal decision-making from the two levels of cognitive process and decision-making process. This interdisciplinary, multi-perspective approach not only helps us to better understand the psychological mechanisms of intertemporal decision-making, but also provides effective strategies for people to better utilize and control their emotions to make more satisfying and rational decisions. Through this kind of comprehensive research, it can also provide strong support for the theoretical development and practical application in the field of intertemporal decision-making. It can be seen that although there are more and more studies on the influence of emotions and intertemporal decision-making, the classification of emotions in psychology is relatively complex, and there are dynamic emotions and complex emotions. Therefore, the effect study between the two does not cover all emotions completely. It is inevitable that there will be a lack of influence on the intertemporal decision-making in some emotional states. After all, emotions are not constant, and individuals also involve a variety of psychological processes in the intertemporal decision-making process, such as self-control, emotion regulation, etc. Self-control is an individual's ability to resist instant gratification and choose long-term gains in the face of temptation. Emotional regulation is the ability of individuals to adjust their emotional state and maintain rational thinking in the face of negative emotions. These mental processes also play an important role in intertemporal decision-making. Therefore, it is necessary to supplement and sort out some of the parts of the current research field that have not yet been perfected.

3.2. Insufficient Research

3.2.1. Complex Emotions are Less Examined

However, in practice, people's choices are constantly changing, and the impact of emotions is not fleeting, and the emotions that are often triggered by a short period of time will have a lasting and diffuse impact on subsequent decisions (Jiang Yuanping and Sun Hongyue, 2019). When exploring the influencing factors of intertemporal decision-making, the consideration of the dynamic time dimension is particularly crucial, which helps us to understand the mechanism of emotions more deeply. What is more noteworthy is that the emotions that people experience in daily life do not exist in isolation, but often have one or several dominant emotions as the core, intertwined with other emotions. Therefore, the study of how complex emotions affect intertemporal decision-making will become a key research direction in the future academic field. The exploration of this direction will reveal how people make trade-offs between long-term and short-term benefits in complex emotional states, which in turn can have a profound impact on the decision-making process.

3.2.2. Insufficient Research Depth

First of all, for the research on the influence of emotion on intertemporal decision-making, especially focusing on how emotions act on intertemporal decision-making before decision-making, most of the current results are still mainly at the level of phenomenon description. Although these studies have revealed the association between emotion and intertemporal decision-making, few have directly verified the specific influence mechanism of emotion on intertemporal decision-making from the cognitive process or the decision-making process itself. In view of this, future research needs to be further deepened and the exploration of the mechanism of emotion influencing intertemporal decision-making should be strengthened to understand the role of emotion in the intertemporal decision-making process more comprehensively. This research direction will not only help to reveal the intrinsic relationship between emotions and decision-making, but also provide more scientific theoretical support and practical guidance for optimizing the decision-making process. Therefore, future research can comprehensively use some medical techniques to investigate the neural basis of the influence of emotions on intertemporal decision-making in a dynamic and multimodal manner.

3.2.3. Limitations of Single-point Results

In recent years, researchers have become more consistent and mainstream in the understanding of the psychological process of intertemporal selection with single-point results. However, in real life, decisions are often made at multiple times (Li Jiajia 2022). The intertemporal selection of multi-point results involves the trade-off of two or more multi-point results, which is closer to the decision-making situations that people encounter in real life. For example, individuals need to consider income and expenses at different points in time when planning their finances, not just a comparison of two single points in time. Moreover, the study of multi-point results can reveal more complex decision-making effects, such as the hidden zero effect, the symbolic effect, the extra amount effect, the front-end amount effect, and the sequence effect. These effects may not be fully observed in studies of single-point outcomes. Therefore, more attention should be paid to empirical research on multi-time point intertemporal selection in future research.

4. Future prospects

It is important to know that the mechanism between emotion and intertemporal decision-making is a complex and important research field, involving knowledge and theories from multiple disciplines. Future research can further explore the influencing factors and psychological mechanisms of intertemporal decision-making, and deepen the understanding of intertemporal decision-making. At the same time, the application of intertemporal decision-making theory needs to be further expanded and deepened to better serve social development and human progress. In the study of intertemporal choice, we can deepen the research perspective to different frameworks of gain and loss, and comprehensively explore the specific impact of emotions on the decision-making process under these frameworks. In real life, individuals are not only constrained by time factors, but also often affected by the interaction of multiple additional variables, which makes the decision-making process more complex. Therefore, in order to more accurately reveal the internal mechanism of intertemporal selection, we should fully consider the differences between individuals when designing research experiments, and reduce experimental errors as much as possible through reasonable design and methods, so as to ensure the reliability and validity of research results. This rigorous research attitude and method will help us to understand the nature of intertemporal selection more deeply and provide strong theoretical support for practical application. The research content on the influence of emotions on intertemporal decision-making in different fields still needs to be enriched. In the current academic research, the influence of emotions on intertemporal decision-making mainly focuses on the field of money. However, in order to understand the role of emotions in intertemporal decision-making more comprehensively, future research can be expanded and deepened from a number of different fields. Specifically, the influence of emotions in environmental intertemporal decision-making and the role of emotions in healthy intertemporal decision-making can be explored. Such cross-disciplinary research will help us to understand more comprehensively the mechanism of emotion in different types of intertemporal decision-making, and provide more scientific guidance for the practice of related fields. In the process of promoting intertemporal decision-making research, it is also necessary to further improve and expand the existing methods and technologies, aiming to achieve a higher level of standardization and stronger operability. In addition, in order to broaden the boundaries of research and enhance its practical value, we can actively explore and develop a series of innovative methods and technologies, such as biofeedback training and neurofeedback training, which are expected to provide new perspectives and tools for the study of emotions and intertemporal decision-making. Through such efforts, it is also hoped that the research results can more accurately serve the improvement of individual decision-making ability, and then have a positive impact on the overall well-being of society.

5. Conclusion

This paper summarizes the previous research on the impact of emotion on intertemporal decision-making, and finds some current research areas and shortcomings, such as the lack of investigation of complex emotions, the lack of depth of

research from the cognitive process itself, and the limitations of single-point results. For example, to investigate the influence of dynamic emotions, daily emotions and complex emotions on intertemporal decision-making, and to make more attempts and explorations in emotional interventions.

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