

# Study on Integrity of Scientific Research Governance in Universities based on Prospect Theory

Binghui Xu

Library and Information Centre, Taizhou Vocational & Technical College, Taizhou, Zhejiang, 318000, China

## Abstract

At present, integrity of scientific research incidents in universities occur frequently, although the universities and relevant departments have taken many means to discipline and stop with little success. Therefore, it is very necessary to deeply explore the psychological motives behind scientific research default, while most of the current studies in related fields stay in the discussion of research ethics in a broad sense, which are usually simple enumerations or generalizations, lacking theoretical basis and not very operable. To address these problems, this paper explores integrity of scientific research governance based on prospect theory, deeply analyzes the fundamental causes of scientific research default, establishes a logical relationship model between the profitability of default and the risk of default, thus proposes relevant strategies to explore a scientific and effective implementation approach for the construction of integrity of scientific research system.

## Keywords

Integrity of Scientific Research; Scientific Research Default; Prospect Theory; Implementation Approach; Strategies.

## 1. Introduction

integrity of scientific research is the quality and virtue that all subjects engaged in academic-related activities should have, and it is also the fundamental of university spirit. As an important position for a country to train future nation builders and successors, strengthening the construction of integrity of scientific research guarantee system in universities affects the future development direction and core competitiveness of the national scientific research field. At present, integrity of scientific research incidents in universities occur very frequently. Although the state has formulated many policies and regulations on regulating scientific research behaviors, and universities have taken various measures to discipline and stop them, the results are still not satisfactory, and scientific research default phenomenon still keeps appearing. Thus, it is necessary for us to deeply explore the psychological motives behind the scientific research default behavior. If thinking from the perspective of prospect theory, the problem of integrity of scientific research in universities is largely caused by the current unreasonable measurement of academic standards, mainly manifested in the singularity of objectives, excessive pursuit of quantification and utilitarianism, etc. Prospect theory takes into account the realistic behavioral motivations of human beings and can better explain the motives for the emergence of scientific research default. This paper introduces prospect theory into the study of scientific research default, analyses the psychological motives for decision making of university teachers' scientific research default based on the full consideration of human realistic behavioral motives, and proposes corresponding governance recommendations.

## 2. Current Status of Research on Integrity of Scientific Research

Many research institutions and scholars have carried out a lot of research work on the issue of integrity of scientific research, and have achieved a series of theoretical results and practical experience.

In *Good Research Practice*, published by the UK Medical Research Council, the general concept of proper research is "a conceptual attitude shown in research", and that every researcher, institution, grant and research council has a responsibility to promote ethical research. *The Rules of Good Scientific Practice* published by the German Max Planck Institute for the Advancement of Science, details the general principles governing integrity of scientific research [1].

Research shows that many countries maintain the academic environment through moral, economic and criminal means by strengthening the investigation and publication of academic misconduct and stopping its funding. At Durham University in the UK, the university imposes appropriate penalties for scientific research default according to different levels, mainly: honor system inspection, temporary suspension, suspension, and permanent expulsion, and detailed provisions are made for each penalty, in addition, the university also specifies the rights and responsibilities of whistleblowers, making reporting highly credible[2]. In countries such as Sweden, academic corruption is seen as a matter of intellectual property, any infringement of intellectual property is a crime, punishable not only by financial penalties, but also by law, and in serious cases, by imprisonment[3].

In the analysis of the causes of the breach of trust in scientific research, in analyzing the causes of scientific research default, Meng Lei pointed out in *A Study on Academic Integrity of Master* that the problem of dishonesty in society is gradually intensifying under the drive of interests, and with the popularity and convenience of the Internet, academics are used as a commodity for personal ambition and the pursuit of fame[4]. In *Research on the Problems and Countermeasures of Scientific Research Management in Universities*, Zhang Ying points out that the current ethics education of academic standards in universities is formal and not systematically elaborated as a compulsory subject, which makes students unable to internalize their behavior in the process of practice[5]. Xiao Wenyong argues in *The Construction of Master Academic Ethics from the Perspective of Master Training System* that the main reason for scientific research default in universities is the imperfection of the supervision system, which is not only a connivance for those who fail to do, but also a blow to some honest scholars doing various honors and competitions[6].

In terms of strategies for implementing the construction of integrity of scientific research, Cao Bei in *Current Situation and Reflection of Research Integrity Construction of Colleges and Universities* argues that in addition to insisting on the importance of scientific research quality, the establishment of a reasonable academic evaluation system also emphasizes the need to modify and improve the unreasonable system according to the changes in society, and to insist on diverse indicators for the assessment of academic level[7]. Yuan Zihan et al. suggested that universities should build an online platform for preventing scientific research default, to popularize and publicize the knowledge of academic behavior standards on the one hand; on the other hand, to collect materials for reporting scientific research default, and to establish a special institution for handling scientific research default at the same time[8].

Overall, existing research on the construction of integrity of scientific research has large limitations:

Firstly, most of the studies on the current situation of integrity of scientific research still discuss research ethics in a broad sense, and most of them are generalized theoretical studies, lacking empirical studies and data to support them.

Secondly, most of the research done so far on the analysis of factors and solutions to integrity of scientific research are simple lists or generalizations, lacking research that further develops theory into practice, and easily resulting in the hollowing out of theory.

Finally, the current study fails to provide a comprehensive exploration of the aspects in terms of the fundamental behavioral motives, making it difficult to propose a complete scientific system for the construction of integrity of scientific research.

To address these limitations, this paper focuses on analyzing the psychological motives for the occurrence of scientific research default based on prospect theory, and fundamentally proposes corresponding countermeasures and suggestions, which are of significant significance to further promote the construction of integrity of scientific research system.

### 3. Prospect Theory

Prospect theory, proposed by Professors Daniel Kahneman and Amos Tversky, applies psychological research to economics and makes a prominent contribution to human judgment and decision making under uncertainty. In response to the long-standing rational person assumption, prospect theory reveals the irrational psychological factors that influence choice behavior from empirical studies on the psychological traits and behavioral characteristics of human.

Prospect theory, through a series of experimental observations, finds that human decision choices depend on the difference between the outcome and the prospect (expectation, scenario) rather than the outcome itself. People make decisions by setting a reference point in their minds and then measuring whether each outcome is above or below this reference point. For gain-based outcomes above the reference point, people tend to show risk aversion and prefer defined little gains; for loss-based outcomes below the reference point, they show risk preference and hope for good luck to avoid losses.

The three basic conclusions derived from prospect theory are as follows.

- (1) Most people are risk aversion when faced with a profit.
- (2) Most people are risk preference when faced with a loss.
- (3) Most people tend to make judgments about gains and losses based on reference points.

This paper carries out research on integrity of scientific research governance based on prospect theory, deeply analyzes the fundamental causes of scientific research default, establishes a logical relationship model between the profitability of default and the risk of default, so as to formulate targeted solutions to curb scientific research default fundamentally and explore a scientific and effective implementation path for the construction of integrity of scientific research system.

### 4. Prospect Theory Model Analysis of Scientific Research Default

#### 4.1. An Analysis of Scientific Research Default Behavior based on the Traditional Expected Utility Theory

According to expected utility theory, if scientific research default has  $\mu$  probability of being detected, it will face a penalty of the amount  $T$ , Then the value of expected benefit from the scientific research default is:

$$P[S(M)] = (1 - \mu)s(M) + \mu s(M - T)$$

Decomposing the expected utility model, it can be deduced:

$$P[S(M)] = s(M) - \mu[s(M) - s(M - T)]$$

According to the law of diminishing marginal utility can be deduced  $s(M) \geq s(M - T)$ , so that it can be concluded that  $P[S(M)] \leq 0$ , as long as the penalties set out are no less than  $s(M)$ , scientific research default is about to lose its space. In practice, however, scientific research default will still exist even with high penalties, and therefore, the expected utility theory cannot provide a fully reasonable explanation for research default. That is, the risk and return faced in comparison to the probability of being found in the view of the scientific research defaulters is not the same as what the expected utility model shows.

#### 4.2. An Analysis of Scientific Research Default Behavior based on the Prospect Theory

Based on the hypothesis of bounded rationality, in which people act rationally but with bounded rationality according to their consciousness, Kahneman and Tversky (1979) studied the judgment and Decision-making performance of decision makers using individual behavior as the object of study, the results show that even though individuals' consciousness is rational, the outcome of their behavior is irrational. [22] Based on the results of this study, Kahneman and Tversky proposed the model of prospect theory.

Prospect theory suggests that if there is uncertainty about external conditions, people will choose behavior that is beneficial to them and make choices that are non-fully rational. Under the condition of uncertain external conditions, the actual decisions people make after making judgments will often be inconsistent with the predictions of expected utility theory, and the actual behavior will often deviate from the behavior predicted by expected utility theory, and there will be deviations between people's actual behavior and the behavior predicted by expected utility theory, and the deviations have regularity.

In fact, it is not only the traditional expected gain that is gained in the expected utility structure of the scientific research defaulter, but he is also faced with a comparison between scientific research default and compliance with research standards, and regards the result of this comparison as a loss. The reference value of this comparison is known in behavioral economics as the reference point. Assuming that the benefit of complying with research standards is  $N$ , the benefit of a scientific research default is  $M$ , and  $N \leq M$ . Also facing a probability of being discovered for a scientific research default of  $\mu$  and being imposed a penalty cost  $T$ , the decision choices faced by university teachers are as shown in Table 1.

**Table 1.** Selection of scientific research default behavior

Probability of being discovered for scientific research default	Benefits of scientific research default	Psychological loss of compliance with integrity of scientific research standards
$1-\mu$	$M$	$N-M$
$\mu$	$\mu(M-T)$	$N-M$

Thus, regardless of whether or not scientific research default behavior is discovered, compliance with research standards faces a definite loss relative to a gain reference point such as a greater expectation after promotion to positional title or position. Because everyone intends to avoid loss,  $w(M) < -w(-M)$ , in anticipation of choosing a definite loss, people often prefer to choose an uncertain loss and take a fluke to obtain the benefit  $M$  from undetected scientific research default rather than a definite loss  $N-M$ . According to prospect theory, when the probability of scientific research default being detected is  $\mu$ , the benefit they expect to obtain can be captured by the following expression:

$$P[W(M)] = (1 - \mu)w(M) + \mu w(M - T)$$

As long as  $P[W(M)] \geq -w(N - M)$ , scientific research default will inevitably occur. Although scientific research default may face losses, it is difficult for people to eliminate the choice of scientific research default as long as its loss of expected benefit is less than the loss of certainty based on reference points when complying with research standards. From this perspective, it is possible to explain why scientific research default still exists when the expected utility model is used to arrive at a negative expected utility. Clearly, as long as there is the possibility of scientific research default going undetected, it is difficult to eradicate it in the face of the psychological loss of a defined relative reference point.

Prospect theory suggests that when people make uncertain decisions, they tend to decompose the expected benefit into a definite outcome plus the probability of a larger outcome minus the difference between a smaller outcome and a larger outcome; thus, the prospect of scientific research default can be decomposed as:

$$W[M - T, \mu; M, 1 - \mu] = w(M - T) + v(\mu)[w(M) - w(M - T)]$$

Even in the face of a definite post-discovery loss, scientific research default will occur as long as there exists a gain utility from the scientific research default that can make the definite loss utility smaller, whether or not there is a true positive gain. This is a common and typical gambler's mentality, which is based on the premise of subjective weighting about the probability of scientific research default being detected. Prospect theory suggests that people tend to weight larger probabilities as smaller probabilities and to weight smaller probabilities as larger probabilities. That is, the probability of being found becomes smaller when weighted, and the probability of being found becomes larger when weighted. The probability weighting formula for prospect theory is :

$$v(\mu) = \frac{\mu^\sigma}{[\mu^\sigma + (1 - \mu)^\sigma]^{1/\sigma}}$$

Generally speaking, the probability  $v(\mu)$ , weighted subjectively by  $\mu = 0.5$ , becomes larger for parts less than 0.5 and smaller for parts greater than 0.5. In layman's terms, even measures that make the probability of scientific research default being detected high, become relatively smaller in the case of scientific research defaulters, thus creating a fluke mentality. And the probability of non-detection becomes high, further enhancing to the fluke mentality of the research defaulters. Thus, when a certain loss is faced, the possibility of loss avoidance becomes greater when the scientific research default is irrationally empowered compared to the expected utility, which makes it difficult to strictly eradicate scientific research default.

## 5. Governance of Scientific Research Default based on Prospect Theory

### 5.1. Decision-making Model

There are only two consequences of scientific research default. Assuming that the probability of being detected is  $\rho$ , the probability of not being detected is  $1 - \rho$ ;  $\rho$  and  $1 - \rho$  are the weight values of the game function. According to prospect theory, the difference between the behavioral value of bounded rationality and the decision value of conscious rationality is denoted as  $\Delta v$ . If  $\Delta v > 0$ , it means that the behavioral value of bounded rationality exceeds the decision value of conscious rationality, i.e. exceeds one's own expectations, and therefore gains additional benefits. Conversely, if  $\Delta v < 0$ , it means that the value of bounded rational behavior is lower than the decision value of the conscious rational, which means that it is lower than

one's own expectations, So the additional losses faced as a result are reflected in the cost of the penalties faced when a scientific research default is discovered.

Therefore, the optimization model for decision making on scientific research default among university teachers and students can be constructed as follows.

$$\max S(x) = v(1 - \rho)w(x) + v(\rho)w(-bx) \quad S(x) \geq 0, x \geq 0$$

$x = \Delta v$  is the possible benefit that university teachers and students can get through scientific research default,  $b$  is the penalty that they will face if scientific research default is discovered.

$$\frac{d\mu}{d\rho} > 0, \frac{dw}{dx} > 0, b > 0, 0 < \rho < 1$$

Thus, when  $x \in [0, x]$ ,  $w(x) < -w(-x)$ , university teachers and students are more sensitive to the potential penalties for scientific research default, and the slope of the loss curve is larger relative to the profit curve near the reference point.

$x > 0, \frac{d^2x}{dx^2} < 0$ , when facing the gain relative to the reference point, it has the characteristic of risk concavity, and the behavior of university teachers and students will tend to choose to avoid or reduce risk at this time.

$x < 0, \frac{d^2x}{dx^2} > 0$ , when facing the loss relative to the reference point, it has the characteristic of risk convexity, and the behavior of university teachers and students will tend to choose to take higher risks at this time.

### 5.2. Analysis of the Impact of Penalty Intensity on Scientific Research Default

Based on the above the optimization model for decision making, the impact of different penalties on individual decision making behavior from the perspective of individual ideals can be analyzed as follows.

$$S(0) = 0$$

$$S'(x) = v(1 - \rho)w'(x) - bv(\rho)w'(-bx)$$

$$S'(x) > 0$$

It follows that

$$v(1 - \rho)w'_+(0) > bv(\rho)w'_-(0)$$

The penalty coefficient is

$$b < \frac{v(1 - \rho)}{v(\rho)} \cdot \frac{w'_+(0)}{w'_-(0)}$$

From this, it is found that the penalty intensity and its payment cost significantly affect the individual's decision. For this reason, the penalty variable is derived from the utility function as follows.

$$\frac{d(\max S(x))}{db} = \frac{\partial S(x_0, b)}{\partial b} = -x_0 v(\rho)w'(-bx_0) < 0$$

According to the analysis of scientific research default, the optimal selection function  $x(b)$  satisfies the condition:

$$\frac{\partial S(x(b), b)}{\partial x} = 0$$

Differentiate both sides with respect to b:

$$\frac{dx}{db} = \frac{\partial^2 S(x, b) / \partial x \partial b}{\partial^2 S(x, b) / \partial x^2}$$

Since the denominator is negative, for:

$$\begin{aligned} sgn &= \frac{dx}{db} = sgn \frac{\partial^2 S(x, b)}{\partial x \partial b} \\ \frac{\partial^2 S(x, b)}{\partial x \partial b} &= -v(\rho)[w'(-bx) - bx \cdot w''(-bx)] = \frac{v(\rho)}{w'(-bx)} \left[ \frac{-bx \cdot w''(-bx)}{w'(-bx)} - 1 \right] \\ &= \frac{v(\rho)}{w'(-bx)} [\gamma(-bx) - 1] \end{aligned}$$

$\gamma(-bx) = \frac{-bx \cdot w''(-bx)}{w'(-bx)}$  is the relative risk aversion measure of measures of risk aversion under expected utility theory.

According to measures of risk aversion under expected utility theory, the relative risk aversion measure mainly examines how people's risky behavior changes with their personal wealth. In the above equation,  $\gamma(-bx)$  denotes the change in risk preferences of university teachers and students towards scientific research default in the face of possible penalty intensity when they commit scientific research default. In the above equation, the decision weight  $v(\rho) > 0$ ,  $w'(-bx) > 0$ , Therefore, the range of values of  $\frac{dx}{db}$  depends on whether  $\gamma(-bx)$  is more than 1. There are three possibilities in terms of penalty intensity b as follows.

When  $\gamma(-bx) < 1$ ,  $\frac{dx}{db} < 0$ , which means that the risk attitude of university teachers and students towards scientific research default is risk aversion, at this time, the supervisory department of integrity of scientific research can effectively inhibit the occurrence of scientific research default if it increases the punishment for scientific research default.

When  $\gamma(-bx) = 1$ ,  $\frac{dx}{db} = 0$ , which means that penalty intensity for scientific research default do not affect the probability of scientific research default, i.e., the regulatory penalties cannot be effective at this time, and it is difficult to suppress the occurrence of scientific research default by taking any penalties.

When  $\gamma(-bx) > 1$ ,  $\frac{dx}{db} > 0$ , which means that the risky attitude of university teachers and students towards scientific research default shows that they are willing to take high risks. In this case, the increase of penalty intensity against scientific research default will, on the contrary, cause the opposite effect and lead them to invest more in scientific research default and thus choose the scientific research default that can gain greater benefits.

### 5.3. Analysis Conclusion

Based on the above model analysis, the following conclusions can be drawn:

(1) The compliance or non-compliance of integrity of scientific research standards is actually a risky choice behavior based on the game basis. If strict integrity of scientific research management can improve the reference point dependence in the game process, and then

improve the penalty cost of scientific research default, then it will be beneficial to effectively avoid the corresponding scientific research default from the outside.

(2) As consciously rational individuals, university teachers and students' predictions and perceptions of game outcomes will directly influence their decision making behavior when making choices about corresponding integrity of scientific research standards. If the probability of being detected is high, it will significantly increase their perception of risk and thus restrain their scientific research default behavior, thus contributing to the establishment of the integrity of scientific research atmosphere.

(3) The existence of the equilibrium point in the regulatory game leads to a regulatory intensity with a corresponding optimal point. If the regulatory intensity is lower than the optimal point, it will be difficult to effectively restrain the irrational choice of individual behavior. On the contrary, if the regulatory intensity exceeds the optimal point, the regulatory failure will also occur. This is important for regulators to take reasonable measures and strengthen the intensity of regulation.

## 6. Suggestions for the Governance of Scientific Research Default Behavior

Based on the results of the above analysis, this paper makes the following targeted governance recommendations:

(1) Formulating the corresponding institutional framework based on the optimal value of regulatory intensity

Due to the existence of the optimal value of regulatory intensity, there exists an optimal solution for the punishment of scientific research default behavior, thus in the design of countermeasures, universities can formulate a corresponding institutional framework, and through the effective operation of the institutional framework, the most reasonable constraints are imposed on scientific research default behavior, and the corresponding punishment intensity and measures are adopted. Universities should formulate detailed methods for dealing with scientific research default behavior in accordance with relevant national policy documents, and set specific penalties for different scientific research default behavior. The problem of subjective probability weighting of teachers' and students' implementation of scientific research default behavior can be largely controlled only if the relevant policies and systems are really put into practice and the regulations are observed, so that the loss caused by scientific research default behavior is no longer an uncertain event, but a definite and clearly accountable event.

(2) Improving the probability of detecting scientific research default behavior by means of information technology

Make full use of modern academic misconduct detection system tools and gradually expand the use of academic misconduct detection systems so as to effectively increase the probability of scientific research default behavior being detected. In addition, there is plagiarism in natural science research, as well as data falsification and fabrication of experimental results. For such research, the review of experimental results should be further strengthened to encourage repetitive experiments and ensure that scientific research results are authentic and valid.

(3) Establishing integrity of scientific research files and expanding the scope of application

Establish the integrity of scientific research file system in universities, expand the coverage of the integrity of scientific research system, strengthen the application scope of the integrity of scientific research system, and fully link the integrity of scientific research with teachers' title evaluation and job promotion, students' award, merit evaluation and employment graduation. A pilot integrity of scientific research point system is included in the comprehensive quality assessment of students and the assessment of teachers' ethics system, and disciplinary



action is taken for scientific research default. For some natural science research, third-party test reports are required to be submitted to avoid falsification of experimental data.

#### (4) Emphasis on systematic education on integrity of scientific research standards

For universities, the importance and necessity of complying with integrity of scientific research standards can be vigorously promoted by conducting lectures and courses related to integrity of scientific research standards, analyzing major cases of scientific research default, and holding a series of knowledge competitions and essay writing activities, so that teachers and students can transform their compliance with scientific research integrity standards from external pressure to internal comprehension, and take professional ethics, academic ethics and relevant legal standards as their basic behavioral standards for engaging in scientific research.

#### (5) Full use of internal regulation

At present, most universities lack internal regulation, and many university academic committees are a formality. Therefore, universities should pay more attention to the regulation and governance of scientific research default while focusing on the publicity and education of integrity of scientific research standards. Universities can further set up special integrity of scientific research committees to clarify their academic management and regulatory work mechanisms, to build professional regulatory and governance of scientific research default to ensure the authority and impartiality of academic management organizations.

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