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Toward Contextualized Research Integrity in Higher Education: A Fuzzy-Set Analysis of Individual and Organizational Configurations Among University Faculty

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Abstract

Amidst growing concerns over research misconduct in academic institutions, this study examines the complex causal mechanisms that influence research integrity among university faculty. In this article, we explore how the interplay between personal attributes and institutional environments influences ethical research behavior, drawing on perspectives from both individual and organizational dimensions. We analyzed data from 109 university teachers across six key conditions, including factors related to individual endowment and the organizational environment, using fuzzy-set Qualitative Comparative Analysis (fsQCA). The results revealed that no single factor is a necessary condition for ensuring research integrity. Four distinct causal pathways were identified as sufficient to promote integrity, reflecting the principle of equifinality. These findings revealed the various combinations of internal and external factors that can yield similar positive outcomes. Based on

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the results, promoting research integrity requires a contextualized approach, where universities should tailor interventions and institutional policies to the specific characteristics and needs of their faculty members. This configurational understanding enhances theoretical insights into ethical behavior in academic settings and offers practical guidance for fostering a culture of integrity in higher education.

Keywords: Research integrity; Fuzzy-set Qualitative Comparative Analysis (fsQCA); Configurational analysis; Individual characteristics; Organizational behavior;

1. Introduction

Research integrity is the ethical cornerstone of scientific advancement and academic credibility, ensuring that knowledge production is governed by honesty, transparency, and accountability. Not only does research integrity help validate scientific outcomes, but it also contributes to maintaining public trust in academic institutions [1,2]. However, the global rise in research misconduct, including data falsification, plagiarism, and unethical authorship practices, is increasingly threatening the credibility of academic research [3]. Particularly noteworthy is the new trend where risks to research integrity are becoming more complex and concealed due to the proliferation of Generative AI technologies. Emerging issues, including authorship ambiguity caused by AI and digital academic misconduct, such as sophisticated plagiarism enabled by technology, are challenging traditional ethical boundaries and governance frameworks [4,5]. This troubling trend erodes scientific legitimacy, distorts academic culture, and reflects profound structural and behavioral challenges within higher

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education systems.

Despite increased regulatory oversight and scholarly attention, current approaches to safeguarding research integrity remain largely fragmented. The literature tends to isolate the problem along two dimensions: individual factors (e.g., ethical awareness, academic pressure, competitiveness) and organizational factors (e.g., performance evaluation, institutional norms, leadership) [6–8]. While valuable, these unidimensional explanations fall short of capturing the complexity of how integrity is practiced or eroded within real institutional contexts. Moreover, simplistic interventions based on linear causality are often insufficient in addressing a phenomenon as contextually embedded and behaviorally dynamic as academic misconduct.

Qualitative Comparative Analysis (QCA) is a case-oriented research method designed to identify causal patterns across multiple cases by examining how different configurations of conditions lead to specific outcomes [9]. A fuzzy-set extension of the QCA method, fuzzy-set QCA (fsQCA), enables partial membership in causal sets, providing greater nuance in analyzing complex social phenomena. To move beyond the limitations of traditional linear models, this study adopts a configurational and systems-oriented perspective to address a critical theoretical and practical question: how do specific combinations of individual and organizational conditions jointly foster or inhibit research integrity in university settings? Guided by complexity theory and employing fsQCA, we

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analyzed empirical data from 109 university faculty members to uncover multiple, equally effective pathways to ethical research behavior. Rather than assuming a single causal route, this approach adopts the principle of equifinality, demonstrating that integrity can emerge through distinct yet functionally equivalent constellations of personal traits and institutional contexts.

This research contributes to the organizational behavior literature by reconceptualizing research integrity as a multi-causal, context-dependent behavioral outcome. It also provides actionable insights for higher education leaders and policymakers, highlighting the importance of aligning individual faculty characteristics with institutional structures and policies. The remainder of this paper is organized as follows: Section 2 reviews the relevant literature and constructs the theoretical framework, Section 3 explains the fsQCA methodology, Section 4 presents empirical results and analysis, Section 5 discusses the findings with implications for fostering ethical cultures within academia, and Section 6 concludes the paper.

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2. Literature Review

Recent research highlights the growing use of fuzzy-set and intelligent modeling methods to understand configurations of research integrity and performance in higher education institutions. Carrasco-Garrido et al. [10] introduced a Mamdani Fuzzy Inference System to evaluate university quality, finding that configurations combining transparency, innovation, and stakeholder engagement optimize academic

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integrity outcomes in complex decision environments. Similarly, Radovanović et al. [11] employed spherical fuzzy AHP and grey MARCOS models to assess faculty performance, demonstrating that multidimensional criteria yield more equitable and reliable assessments of professors. Liu [12] used fsQCA to examine how technology adoption and emotional factors influence faculty well-being in Chinese universities, emphasizing that institutional support and individual acceptance jointly sustain ethical practice and academic integrity in AI-integrated environments. Likewise, Wen and Harms [13] applied fsQCA to explore transformational leadership transitions in higher education, revealing that specific combinations of leadership transition quality and entrepreneurial orientation foster ethical and innovative faculty behaviours.

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2.1 Individual-Level Factors Influencing Research Integrity

Research integrity refers to adherence to ethical standards and scientific values, including honesty, transparency, rigor, and responsibility, in all aspects of scholarly activity [14,15]. While this is an evolving concept, it consistently emphasizes the avoidance of fabrication, falsification, plagiarism, and other forms of misconduct [16]. Recent studies have increasingly examined the factors that influence research integrity, with individual characteristics recognized as a primary determinant of research integrity. These include personal morality, value preferences, academic motivation, and psychological responses to professional pressure [6,17,18].

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Value preferences reflect researchers' internalized norms and moral reasoning. Teachers who prioritize academic honesty tend to maintain ethical conduct even in the face of competitive pressures. In contrast, those who exhibit opportunistic values may justify misconduct as a means to an end [2,19]. Another key component of individual endowment is access to academic resources, including funding, experimental facilities, and research data. While sufficient resources promote ethical behavior, output-driven funding structures or inadequate research support can lead to anxiety and encourage shortcuts, thereby increasing the risk of misconduct [3,20,21]. In addition, research capability, which includes methodological proficiency, familiarity with academic norms, and scientific literacy, plays a crucial role in upholding research integrity. Educators with strong academic training are less likely to commit misconduct [22], whereas those with limited expertise may engage in data manipulation, plagiarism, or contractual fraud to meet unrealistic performance expectations [23,24]. Notably, even individuals with strong ethical intentions may violate integrity standards if they lack the practical skills required to satisfy institutional demands. Therefore, individual endowment encompasses not only moral disposition, but also technical competence and material support.

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2.2 Organizational Environmental Factors and Their Role

The organizational environment plays a critical role in shaping, supporting, or undermining research integrity. This environment encompasses institutional policies, research evaluation mechanisms,

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administrative oversight, and training systems [7,25,26]. Academic climate, a component of the organizational environment, refers to the shared values, behavioral norms, and social expectations that shape daily research activities [27]. Faculty are more likely to adhere to high standards when institutions foster a culture of transparency, collaboration, and ethical accountability. Conversely, an environment dominated by hyper-competition, unrealistic performance targets, or tolerance for misconduct can normalize unethical behavior [28]. Overemphasis on quantitative metrics, such as publication counts and journal impact factors, has been found to distort academic priorities, leading faculty to adopt results-oriented shortcuts [29,30].

Organizational policies, particularly those governing research evaluation, rewards, and sanctions, are equally influential. Institutions lacking credible mechanisms for detecting and penalizing misconduct may inadvertently reward unethical behavior. In contrast, universities with clear codes of conduct, transparent enforcement processes, and balanced reward structures can cultivate a more ethical research culture [26,31]. Education and training initiatives, especially those that incorporate case studies and publicized instances of misconduct, can enhance faculty awareness, promote self-regulation, and instill a sense of collective responsibility [32–34]. Leadership plays a critical role in shaping the ethical climate by signaling acceptable behavior and reinforcing integrity norms through formal and informal mechanisms. In particular, reward systems, promotion

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criteria, and performance evaluation metrics significantly influence faculty behavior. Institutions that prioritize quantitative outputs without adequate ethical safeguards may inadvertently incentivize misconduct, whereas balanced evaluation systems can promote integrity [35,36].

Importantly, the organizational environment and individual characteristics do not operate in isolation from one another. For example, a morally upright researcher may still deviate from ethical norms if they observe systemic injustice or see colleagues advance through dishonest means. Likewise, a well-designed institutional policy may fail to curb misconduct if individual actors lack the necessary awareness, skills, or incentives to comply with it.

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2.3 Toward a Configurational Understanding of Research Integrity

Although the literature has extensively explored the determinants of research integrity, most studies have examined these factors independently, relying on linear causal models. This approach overlooks the complex and dynamic interactions between individual endowments and organizational environments. Key questions remain unanswered: Under what specific conditions do strong moral values and skills translate into ethical behavior? Can a supportive institutional context compensate for weak individual competencies? Do multiple favorable conditions lead to different integrity outcomes depending on their combination?

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Addressing these gaps requires a shift from isolated factor analysis to a configurational perspective. In this study, we employ fsQCA to investigate how various combinations of individual and organizational factors jointly contribute to research integrity outcomes among university teachers. Our findings identify several equifinal pathways, advancing a more nuanced understanding of research integrity as a behavior shaped by the interaction of systems, contexts, and human agency.

2.4 Theoretical Framework

Research misconduct, including data fabrication, plagiarism, and unethical publication practices, continues to threaten the integrity of scientific research and the reputation of academic institutions. Traditional models in the literature often rely on correlational logic and isolate the net effects of single variables, such as personal morality, institutional pressure, or access to resources. According to Open Systems Theory, university teachers are not isolated actors but are situated within an open system continuously interacting with their institutional environment. Research integrity is not a linear result of a single factor but rather the product of mutual adaptation and alignment between individual and environmental elements. Traditional linear approaches are insufficient to explain the complexity of faculty behavior in real-world academic environments, where multiple factors frequently interact and reinforce one another. This gap not only limits theoretical understanding but also hinders the development of targeted, practical strategies for promoting research integrity.

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To address this problem, the current study adopts a configurational approach, presented in Figure 1, which conceptualizes research integrity as the outcome of complex and interactive relationships between individual-level attributes and organizational-level conditions. Based on configurational theory, this framework acknowledges that ethical or unethical research behavior is shaped not by isolated influences but by combinations of interdependent elements. These configurations of antecedent conditions are best examined through methods such as fsQCA, which allows for the identification of multiple concurrent causal paths, equifinality, and causal asymmetry [37,38].

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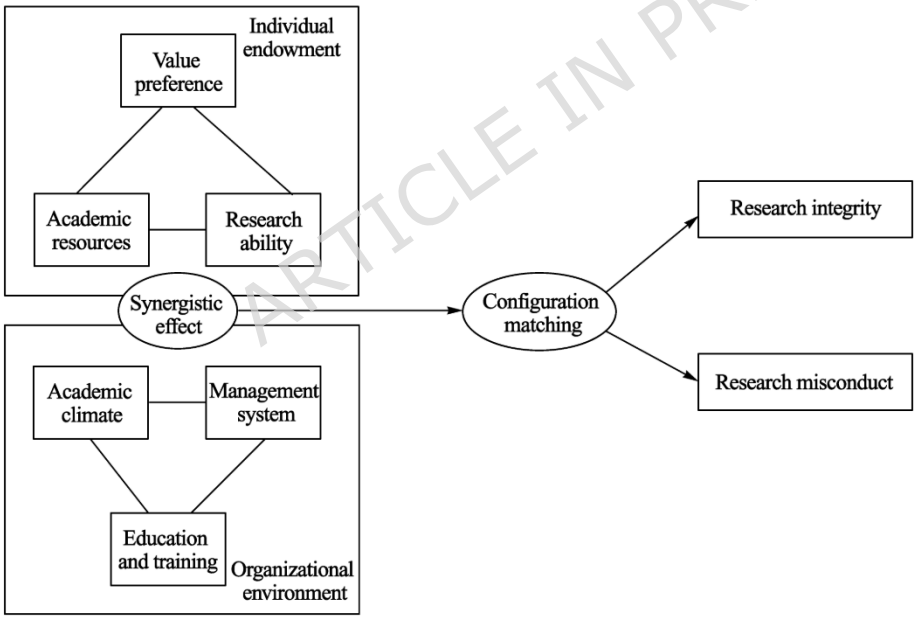

Figure 1 Framework of influencing factors.

As shown in the figure, two primary domains influence faculty research behavior: individual endowment and organizational environment. An individual's endowment encompasses not only moral dispositions but

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also acquired capabilities developed through socialization. Value preference is a relatively stable psychological trait, primarily comprising moral reasoning and ethical sensitivity, that reflects an individual's internalized moral cognitive structure. Typically established early in an individual's career, this structure provides strong stability and serves as the internal ethical benchmark for making judgments in ethical dilemmas. In contrast, research ability and academic resources are defined as capabilities and capital developed through socialization. Specifically, research ability manifests as methodological proficiency and professional competence, acquired through long-term academic training and professional practice; academic resources, meanwhile, represent accumulated capital. Stable traits (such as value preference) often serve as a baseline constraint, whereas acquired capabilities (such as research ability) provide the technical assurance necessary for compliant operation.

The organizational environment consists of academic climate, management systems, and education and training. The academic climate reflects the normative culture and shared expectations within the institution. According to Social Learning Theory, individuals learn by observing others' behaviors and their consequences. If teachers observe colleagues who benefit from research misconduct without being punished, or in an atmosphere permeated by opportunistic values, their own moral standards may shift. In addition to Open Systems Theory and Social Learning Theory, this study is further grounded in Institutional Theory,

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which emphasizes the role of normative pressures, legitimacy, and organizational expectations in shaping individual behavior. Faculty members often align their research practices with institutional norms to gain legitimacy and advance their careers, thereby reinforcing the influence of organizational structures on ethical conduct. Management systems include evaluation procedures, oversight structures, and mechanisms for addressing misconduct. In the university context, management systems are a primary source of normative pressures. To gain legitimacy and recognition for career advancement, teachers often align their behavior with the institution's dominant values and norms. When the institutional environment emphasizes quantitative performance metrics while neglecting ethical norms, teachers may perceive instrumental legitimacy in achieving results through improper means, thereby inducing violations. Education and training focus on enhancing faculty awareness of ethical standards and equipping them with the tools to navigate integrity-related challenges. These elements are likewise interdependent. A favorable academic climate can reinforce the effects of training, while strong management systems are necessary to ensure policies are applied consistently and fairly.

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At the core of the framework is the concept of configuration matching. This refers to the alignment or misalignment between specific combinations of individual endowment and organizational environment, which collectively determine whether research integrity is upheld or violated. Configurational theory emphasizes that multiple pathways can lead to the same outcome.

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For instance, research integrity may be achieved through self-discipline when value preference, academic climate, and training are well-aligned. Alternatively, integrity may be ensured through external control when research ability, resource availability, and institutional oversight are emphasized. These examples reflect the principle of equifinality. Additionally, the absence of these configurations does not necessarily lead to misconduct, highlighting the asymmetrical nature of causality.

To the best of our knowledge, this is the first paper that proposes a conceptual framework integrating faculty characteristics and institutional contexts to explain research integrity outcomes using fsQCA. Figure 1 presents this novel framework as a response to the limitations of traditional explanatory models, offering a foundation for the empirical analysis that follows. By identifying specific configurations that lead to either integrity or misconduct, this approach contributes both to the theoretical advancement of ethical behavior research and to the practical governance of academic integrity.

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3. Methodology

3.1. Qualitative Comparative Analysis

Aligned with the principles of configurational theory, this study adopts Qualitative Comparative Analysis (QCA), a methodological approach developed by sociologist Charles Ragin, designed to analyze causal complexity by examining how combinations of conditions lead to specific

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outcomes. QCA is inherently case-oriented, treating each case as a holistic configuration of causal conditions rather than linearly isolating variables [39,40]. Grounded in Boolean algebra, QCA identifies patterns of set membership across cases, enabling the detection of cross-case regularities and the derivation of generalized causal models from limited or medium-sized samples.

Over the past two decades, QCA has gained increasing prominence in empirical research across diverse fields including political science, sociology, management, and international relations [41]. Depending on the nature of the data and variables involved, QCA techniques can be categorized into crisp-set QCA (csQCA), multi-value QCA (mvQCA), and fuzzy-set QCA (fsQCA). Among these, fsQCA is particularly well-suited for social science research due to its ability to capture gradations in set membership. Unlike binary approaches, fsQCA calibrates raw data into continuous membership scores ranging from 0 to 1, thereby preserving the nuance and richness of empirical information during the analytic process.

The fsQCA approach was selected for this study due to its methodological advantages. Firstly, fsQCA allows for the systematic investigation of complex causal relationships involving multiple concurrent conditions, making it well-suited to contexts where outcomes may be produced by diverse combinations of factors. Secondly, the method treats all causal conditions as analytically equivalent, enabling the exploration of interaction effects and the identification of multiple, functionally equivalent

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causal pathways. Third, fsQCA distinguishes between core and peripheral conditions, allowing researchers to assess the relative importance and configuration-specific roles of antecedent factors. Importantly, it accommodates causal asymmetry, recognizing that the conditions leading to the presence of an outcome are not necessarily the inverse of those leading to its absence [42]. This makes fsQCA particularly valuable for research problems in organizational and behavioral sciences, where equifinality and asymmetry are often empirically observed but theoretically underexplored.

Overall, fsQCA offers a robust framework for examining the configurational dynamics underlying research integrity. By capturing multiple concurrent causal paths and emphasizing the interplay between individual and contextual conditions, it aligns closely with the theoretical and empirical objectives of this study. To enhance methodological transparency and replicability, the fsQCA analysis was implemented using fsQCA 3.0 software and cross-validated in R (QCA package). The analytical procedure followed four key steps: (1) calibration of raw data into fuzzy-set membership scores using direct calibration; (2) construction of the truth table based on all logically possible configurations of the six antecedent conditions; (3) application of frequency and consistency thresholds(frequency ≥ 2, consistency ≥ 0.80) to filter empirically relevant configurations; and (4) Boolean minimization to derive complex, parsimonious, and intermediate solutions. To ensure robustness, alternative consistency thresholds (0.80 -0.85) were tested, and the resulting

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configurations remained stable, indicating the reliability of the findings. Furthermore, contradictory configurations were carefully examined and resolved based on theoretical plausibility and empirical consistency. The research steps of fsQCA are shown in Figure 2.

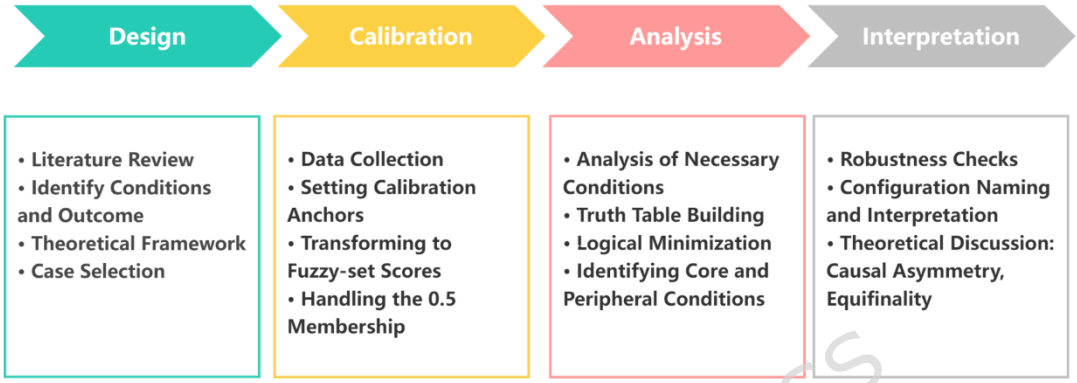

Figure 2. Research steps of fsQCA.

3.2. Data Collection

This study relied on primary data collected through a web-based questionnaire distributed to university lecturers via WeChat. Both case-based data assignment and questionnaire surveys are commonly employed for data collection in the context of fsQCA [43]. Given the sensitive nature of research integrity and the hesitance of universities and faculty members to disclose potentially compromising information, this study adopted an anonymous survey design. Anonymity was intended to safeguard respondent confidentiality and promote honest, uninhibited participation.

Specifically, the Institutional Review and Ethics Committee at the Office of Academic Affairs, and the Office of Student Affairs, School of

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Management Engineering, Xuzhou University of Technology, approved an online questionnaire-based survey involving voluntary adult participants (age 18 and above). All research procedures complied with the Declaration of Helsinki and the institutional ethical protocols governing studies with human participants. Written informed consent was obtained digitally through an online consent form embedded at the beginning of the questionnaire, and participants were informed about the study's purpose, voluntary nature, confidentiality assurance, and their right to withdraw at any time before submission. Only individuals aged 18 years or older were allowed to participate. No minors were included, no identifying personal data was collected, and no vulnerable populations were involved. No physical, medical, psychological, or invasive procedures were included. More importantly, the study involved no risk beyond minimal online survey participation.

To enhance the generalizability and robustness of the findings, we applied a stratified sampling approach, targeting faculty members across diverse geographical regions, institutional types (including research-intensive and teaching-oriented universities), and academic disciplines. The questionnaire was distributed online using secure survey platforms, and participation was entirely voluntary and confidential. A total of 145 responses were received. After screening for completeness and internal consistency, 36 questionnaires were excluded due to invalid or missing

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data, resulting in a final sample of 109 valid cases, yielding an effective response rate of 75.17%.

This sample size is methodologically sound for fsQCA analysis. According to Ragin's guidelines, the minimum number of cases required for meaningful fsQCA results should satisfy the formula $2^{(k-1)}$, where k is the number of antecedent conditions. Given that this study includes six conditional variables, the minimum threshold is 63 cases. The final sample of 109 valid responses exceeds this requirement, providing adequate coverage for reliable configurational analysis and supporting the exploration of multiple causal pathways with sufficient empirical diversity.

3.3. Variable Measurement and Calibration

In line with the requirements of fsQCA, this study carefully operationalizes and calibrates both the outcome and conditional variables. Each variable is measured based on theoretically grounded constructs and calibrated to reflect set membership scores, allowing for meaningful comparative analysis.

3.3.1 Outcome Variable: Research Integrity

The outcome variable in this study is research integrity among university faculty, measured through respondents' perceptions of and attitudes toward common research misconduct behaviors. These behaviors include data fabrication or tampering, multiple submissions of the same manuscript, inappropriate authorship (e.g., honorary or mutual co-signing),

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and fabrication of peer-review reports. Participants evaluated their stance toward these behaviors using a four-point ordinal scale:

(1) “Non-compliance, resolute opposition”;

(2) “Things happen for a reason, but I would not engage in them”;

(3) “Things happen for a reason, and I occasionally engage in them”;

(4) “I accept such behavior and would engage in it”.

These responses serve as indicators of an individual’s integrity orientation and are subsequently calibrated into fuzzy-set membership scores.

3.3.2 Conditional Variables

Six antecedent (conditional) variables are included in the analysis, representing both individual endowment and organizational environment.

(1) Value Preference: This variable assesses the ethical orientation of faculty when confronted with performance evaluation pressure or peer success through misconduct. It reflects the extent to which a faculty member adheres to integrity in the face of institutional stress.

(2) Academic Resources: Measured by institutional type, this variable captures access to resources, including funding, platforms, and research infrastructure. It is categorized based on the hierarchical status of the respondent's university (e.g., key national vs. ordinary local institutions).

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(3) Research Ability: This variable is operationalized through the highest level of research projects independently led by the respondent, capturing academic competency and research leadership experience.

(4) Academic Climate: Evaluated using a five-point Likert scale, this variable measures perceptions of the prevalence of misconduct among colleagues (e.g., commonality of mutual authorship, frequent multiple submissions), thereby indicating the normative research environment.

(5) Management System: This dimension encompasses indicators related to the university's integrity management practices, including the presence and enforcement of evaluation policies, reward and sanction systems, and formal investigative procedures.

(6) Education and Training: Measured through reported exposure to activities such as research integrity workshops, training programs, and promotional campaigns, this variable assesses the institutional commitment to integrity education.

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3.3.3 Calibration Procedure

All data were calibrated into fuzzy-set membership scores ranging from 0 (full non-membership) to 1 (full membership) to prepare variables for fsQCA. For the outcome variable (research integrity) and the conditional variables (academic resources and research ability), four discrete membership scores: 1, 0.67, 0.33, and 0, were used, corresponding to the four ordinal response categories described earlier. For the remaining conditional variables (value preference, academic climate, management

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system, education and training), a five-point Likert scale was employed. Direct calibration was used to anchor the thresholds for full membership, the crossover point, and full non-membership for all variables at the 95th, 50th, and 5th percentiles of the empirical case distribution [44]. The scores for the conditional and outcome variables are shown in Figure 3, and the calibration anchors for each variable are presented in Table 1. To address attribution ambiguity in fsQCA when a membership score equals exactly 0.5, a technical adjustment was made, assigning such cases a value of 0.501, following the guidelines of Du and Jia [42]. This ensures computational robustness and accurate inclusion of borderline cases in the final configurational analysis.

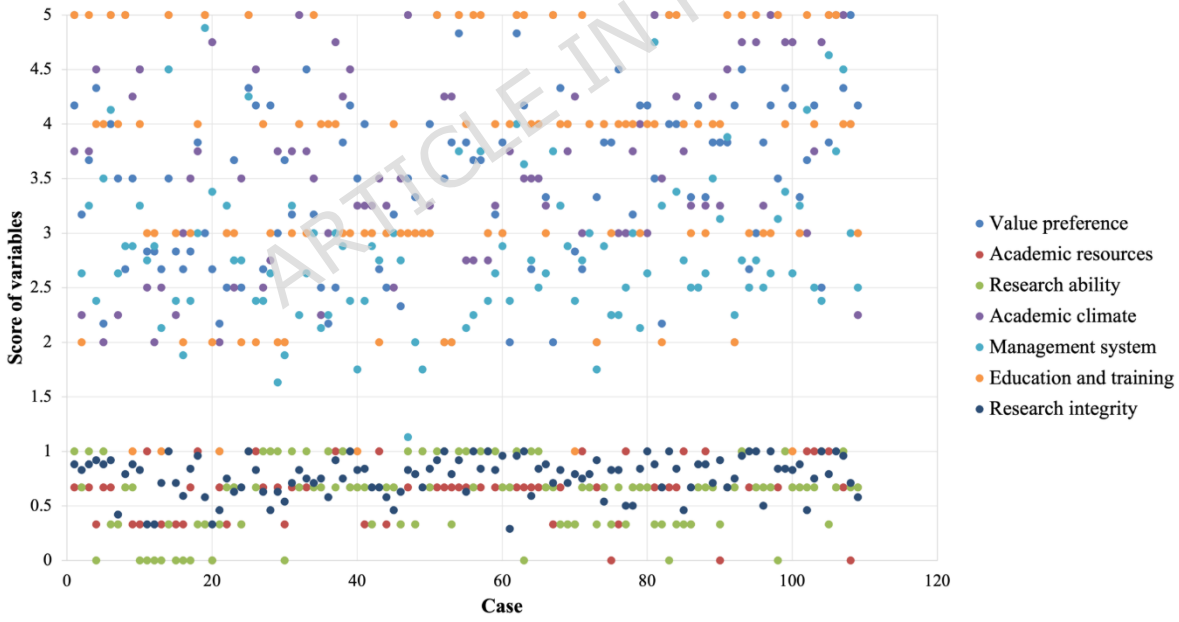

Figure 3. Score of the conditional and outcome variables.

Table 1. Anchor points of variables.

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Variables	Full member	Crossover	Non-member
Research integrity	1	0.83	0.46
Value preference	4.50	3.50	2.23
Academic resources	1	0.67	0.33
Research ability	1	0.67	0
Academic climate	5	3.50	2.10
Management system	4.58	2.75	1.80
Education and training	5	4	1

4. Results and Analysis

4.1. Necessity Analysis of Single Conditional Variables

Before conducting the configurational analysis of the antecedent conditions leading to high research integrity among university faculty, it is essential to examine whether any single condition constitutes a necessary prerequisite for the outcome. An essential condition is defined as one that must be present whenever the outcome is observed in fsQCA. Formally, this implies that the outcome set is a subset of the condition set, and the presence of the condition is required across all cases where the outcome occurs [40].

The key metric used to assess necessity is the consistency score. According to methodological standards, a consistency value of 0.90 or greater is typically regarded as evidence that the condition is necessary for the outcome [45]. Table 2 presents the results of the necessity analysis for each of the six antecedent conditions under investigation: value preference,

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academic resources, research ability, academic climate, management system, and education and training.

Table 2. Analysis of necessary conditions.

Conditions	Research integrity		Research misconduct	
	Consistency	Coverage	Consistency	Coverage
Value preference	0.772	0.681	0.583	0.580
~Value preference	0.524	0.526	0.680	0.771
Academic resources	0.838	0.617	0.760	0.633
~Academic resources	0.502	0.649	0.540	0.790
Research ability	0.777	0.608	0.690	0.611
~Research ability	0.503	0.590	0.557	0.739
Academic climate	0.763	0.677	0.586	0.587
~Academic climate	0.535	0.533	0.677	0.763
Management system	0.673	0.681	0.572	0.654
~Management system	0.658	0.576	0.721	0.713
Education and training	0.693	0.701	0.546	0.625
~Education and training	0.629	0.551	0.739	0.731

Note : “~ ” denotes the logical symbol “not”.

The results indicate that none of the individual conditions reaches the consistency threshold of 0.90. This finding suggests that no single antecedent condition can be considered a necessary condition for achieving high levels of research integrity among university teachers. The absence of any required condition supports the notion that isolated factors do not drive research integrity, but instead it is driven by the interplay of multiple conditions operating simultaneously.

This outcome reinforces the theoretical rationale for employing a configurational approach, confirming that the behavioral foundation of research integrity is inherently complex and systemic. Since individual factors alone cannot account for the presence of the outcome, it becomes imperative to examine how specific combinations of conditions, rather than single elements, contribute to the manifestation of research integrity.

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Therefore, the subsequent analysis focuses on identifying sufficient configurations in which various antecedent conditions interact to produce the desired outcome.

4.2. Adequacy Analysis for Combinations of Conditions

Following the necessity analysis, the next step involves identifying combinations of antecedent conditions that are sufficient to explain high levels of research integrity among university faculty. The purpose of this adequacy, or sufficiency, analysis is to uncover distinct causal configurations that can lead to the same outcome, consistent with the concept of equifinality in configurational theory.

Given that data were collected through a self-administered questionnaire, there is a potential risk of noise or random error due to inattentive or non-deliberate responses. To mitigate this issue and improve the reliability of the analysis, a case frequency threshold of 2 was adopted. This threshold ensures that only configurations supported by at least two cases are retained in the truth table. In addition, a consistency threshold of 0.80 was applied, which aligns with methodological recommendations for sufficiency analysis in fsQCA [40,45]. Configurations that fell below this consistency level were excluded from further analysis, as they did not meet the criteria for sufficient explanatory power.

After applying these thresholds, the calibrated fuzzy-set data were processed to construct a truth table, which represents all logically possible configurations of the six antecedent conditions. The Boolean minimization

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procedure was then used to simplify the truth table and derive three types of solutions: the complex solution, parsimonious solution, and intermediate solution. The complex solution encompasses all causal conditions without any simplifying assumptions, whereas the parsimonious solution utilizes all possible logical remainders (i.e., combinations not observed in the data) to minimize the configuration. The intermediate solution represents a balance between empirical grounding and logical parsimony, incorporating only theoretically plausible remainders.

Conditions that appear in both the parsimonious and intermediate solutions are identified as core conditions in the fsQCA framework, reflecting their central and robust role in producing the outcome. Conditions that appear only in the intermediate solution, but not in the parsimonious solution, are referred to as peripheral conditions, indicating a supporting but less essential role in the configuration. Table 3 presents the sufficient configurations associated with research integrity and research misconduct among university faculty based on the fsQCA results. These configurations represent multiple, functionally equivalent pathways through which research integrity can be achieved, demonstrating the configurational and multidimensional nature of ethical behavior in academic settings.

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Table 3. Conditional configurations.

Conditions/ Configurations	Research integrity				Research misconduct				
	I1	I2	I3	I4	M1	M2	M3	M4	M5
Value preference	●	●	●	●		v	V	v	V

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Academic resources	□	□		□	V		v	V	□
Research ability	□	□	v		V	V	V		□
Academic climate	●		●	●	v	v		v	V
Management system	v	V	□	□	v	v	v	□	
Education and training		●	□	□	V	V	v	V	□
Raw coverage	0.365	0.322	0.294	0.444	0.310	0.312	0.278	0.238	0.288
Unique coverage	0.078	0.035	0.024	0.094	0.051	0.028	0.019	0.014	0.088
Consistency	0.846	0.839	0.837	0.865	0.931	0.931	0.949	0.944	0.906
Overall solution coverage	0.619				0.524				
Overall solution consistency	0.826				0.898				
Frequency cut	2				2				
Consistency cut	0.830				0.912				

Note: ● indicates the presence of core conditions, □ indicates the presence of peripheral conditions, V indicates the absence of core conditions, v indicates the absence of peripheral conditions, and blanks indicate that conditions are dispensable.

4.3 Interpretation of Configurational Results

As shown in Table 3, the overall solution consistency scores are 0.826 and 0.898, which exceed the standard threshold of 0.80, indicating that the identified configurations are highly sufficient to explain the presence of research integrity and research misconduct among university teachers. Furthermore, the consistency of each configuration exceeds 0.830 and 0.912, suggesting that each causal pathway has a strong explanatory relationship with the outcome. The overall solution coverage is 0.619 and 0.524, which demonstrates that the model accounts for more than half of the empirical instances of research integrity and research misconduct. These findings confirm the robustness and empirical relevance of the configurational model.

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4.3.1 Configurations of research integrity

Based on the distribution of core and peripheral conditions, the four configurations can be categorized into distinct causal mechanisms underlying research integrity. Each configuration reflects a unique pathway composed of different combinations of individual endowment and organizational environmental conditions.

Configuration 1: Integrity driven by individual endowment under the guidance of academic climate

In this configuration, the core conditions of individual value preferences and organizational academic climate are present, along with the peripheral conditions of educational resources and research ability. In contrast, the management system is absent as a peripheral condition. The operating mechanism of this path lies in the combination of an excellent academic climate and an individual's intrinsic drive, resulting in a highly self-disciplined research model. A strong organizational academic climate establishes clear, universally recognized behavioral norms for faculty. At the same time, the correct value preference, specific research ability, and educational resources that teachers themselves possess constitute their intrinsic capital for practicing research integrity. Along this path, even in the absence of a management system, the strong intrinsic drive and external cultural pressure are sufficient to restrain behavior.

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Configuration 2: Integrity driven by individual endowment under the guidance of education and training

In this configuration, the core conditions of individual value preferences and organizational education and training are present, along with the peripheral conditions of academic resources and research capacity. At the same time, the management system is absent as a core condition. This path reveals that when the formal management system is lacking, the organization can successfully activate and strengthen teachers' individual endowments through continuous education and training, a non-formal means, to maintain research integrity. Here, education and training are not simply information transmission, but an empowerment process of value awakening, belief reinforcement, and behavior guidance. It complements the lack of a system by providing academic support, ensuring that university teachers who already have the right value preferences and research abilities can continue to receive positive incentives and clear guidance, without losing their way.

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Configuration 3: Integrity driven by organizational climate under the premise of value internalization

In this configuration, the core conditions of individual value preference and organizational academic climate are present, along with the peripheral conditions of management system and education and training. In contrast, research ability is absent as a peripheral condition. The core mechanism of this path lies in the strong organizational climate, which

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provides a comprehensive "moral safety net" for teachers with limited research skills. Teachers' internal recognition of research integrity is the premise for accepting organizational empowerment. On this basis, when teachers' research abilities are limited, a rigorous academic climate, a standardized management system, and continuous education and training together form a strong, supportive, and constraining environment. This environment not only clearly informs "what cannot be done," but also guides "how it should be done," effectively compensating for individual ability risks and preventing "immorality" caused by "incompetence."

Configuration 4: Integrity driven by individual-organization collaborative governance

In this configuration, the core conditions of individual value preference and organizational academic climate exist, along with the peripheral conditions of educational resources, management system, and education and training. This path is the ideal governance model of systematic and comprehensive collaboration between individual endowments and organizational atmosphere elements. It requires teachers to have strong values and sufficient academic resources, while the organization provides a positive educational atmosphere, robust guarantees, and continuous education and training. In this system, individual self-discipline, organizational heteronomy, cultural permeation, and resource guarantee reinforce each other, forming an efficient ecosystem for the production of research integrity.

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To strengthen the interpretive rigor of the findings, each identified configuration is explicitly linked to its corresponding theoretical and practical implications. For example, Configuration 1 demonstrates that the joint presence of strong value preference and supportive academic climate constitutes a norm-driven integrity path, where ethical behavior is reinforced through internalized values and peer influence. Configuration 2 highlights a training-supported path, in which education and training compensate for variability in organizational conditions. Similarly, Configuration 3 reflects a context-reinforced path, where institutional climate plays a dominant role, while Configuration 4 suggests a comprehensive alignment path, combining multiple favorable conditions. These mappings illustrate how distinct causal recipes correspond to different mechanisms of achieving research integrity, thereby empirically grounding the study's conclusions.

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4.3.2 Configurations of research misconduct

Based on the distribution of core and peripheral conditions, the five configurations can be categorized into distinct causal mechanisms underlying research misconduct. Each configuration reflects a unique pathway composed of different combinations of individual endowment and organizational environmental conditions.

Configuration 1: Misconduct caused by the comprehensive absence of individuals and organizations

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In this configuration, the core conditions of academic resources, research ability, and education and training are absent simultaneously, along with the peripheral conditions of academic climate and management system. This is the most dangerous situation: teachers lack both the resources and ability to conduct research, as well as value guidance and rule reminders from the organization. At this time, the binding force of value preferences may be overwhelmed by survival pressures, while the absence of an academic climate and management system leaves the organization in a state of neglect. This is a combination of "inability to comply" and "no one to remind," a systemic and comprehensive failure, which is highly likely to lead university teachers to take short-sighted actions for survival or to complete tasks.

Configuration 2: Misconduct caused by the dual absence of ability and education under the distortion of value

In this configuration, the core conditions of individual research ability and organizational education and training are absent, along with the peripheral conditions of individual value preference, organizational academic climate, and management system. At this time, teachers' values have already become loose, while the organization fails to correct and reinforce them through effective publicity and education, and also fails to improve their research abilities. The absence of an academic climate and management system together constitutes an environment that supports research integrity violations rather than inhibits them.

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Configuration 3: Misconduct caused by the dual absence of value and ability under the scarcity of resources

In this configuration, the core conditions of individual value preferences and research ability are absent, along with the peripheral conditions of individual academic resources, organizational management systems, and education and training. This path emphasizes that, under the extreme scarcity of educational resources, if teachers themselves lack research ability and have unstable value preferences, research integrity violations are likely to occur. It is worth noting that the academic climate does not play a constraining role in this path, while the absence of a management system and education makes the situation more serious.

Configuration 4: Misconduct caused by the dual absence of resources and education under the suspension of rules

In this configuration, the core conditions of academic resources and education and training are absent, along with the peripheral conditions of individual value preference and organizational academic climate. Although the management system exists as a peripheral condition, its effectiveness is weakened by the absence of an academic climate. At the same time, teachers face the dual pressures of value orientation deviation and scarcity of educational resources. The lack of education and training means that the organization gives up risk prevention in advance. Teachers are in an environment of having rules but no power. Under the joint pressure of

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resource constraints and vague values, it is easy to foster a psychology that challenges the bottom line of rules.

Configuration 5: Misconduct caused by the abnormal incentives due to the loss of value

In this configuration, the core conditions of individual value preferences and organizational academic climate are absent, while organizational education and training are a core condition, and the peripheral conditions of individual academic resources and research ability are present. This is the most alarming path. It shows that when teachers lose their fundamental faith in integrity, even if individuals have academic resources and research ability, and the organization vigorously carries out education and training, research integrity violations may still occur. This implies that the education and training at this time may be distorted in content, or the form may outweigh the content, thus creating an abnormal incentive. The absence of an academic climate provides the soil for this.

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4.4. Robustness Analysis

A robustness test was conducted to ensure the reliability and stability of the configurational results obtained through fsQCA. Following best practices in the field, the consistency threshold used to determine sufficient configurations was raised from 0.80 to 0.85, and the truth table was reanalyzed accordingly. This approach follows the guidelines proposed by

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Du and Jia [42], who recommend systematically varying analytic thresholds as a standard method for assessing the robustness of QCA solutions.

A new set of configurations was derived and compared with the original results after recalculating the truth table under the more stringent consistency criterion. The findings indicate that no essential changes occurred in the core structures of the configurations. Specifically, the key causal pathways remained consistent with the original solution set, and the core conditions identified in each configuration were preserved. Although some peripheral conditions exhibited minor variation, such changes did not alter the interpretive logic or theoretical implications of the results.

These outcomes confirm that the original fsQCA results are robust to moderate adjustments in analytical parameters and that the identified configurations of individual and organizational conditions leading to research integrity among university faculty are highly reliable. The consistency in causal structure across threshold conditions enhances confidence in the validity of the findings and supports the stability of the configurational explanations presented in this study.

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5. Discussion

Research integrity serves as a foundational pillar of scientific advancement and technological innovation. The existing literature on this topic has predominantly focused on identifying influencing factors from various analytical levels. For instance, Roje et al. [2] categorized these factors into three broad levels: the individual researcher, the organizational

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context, and the broader scientific system. Similarly, Li and Cornelis [46] and Wang and Li [47] examined the role of culture and professional scientific societies in shaping norms of academic conduct. While valuable, many of these studies adopted either a hierarchical view of influence or rely on conventional correlational methods that emphasize the net effects of isolated variables.

In contrast, the present study introduces a configurational perspective, drawing on fsQCA, to explore how combinations of individual endowment and organizational environment jointly influence research integrity among university faculty. Our findings underscore the presence of multiple concurrent causal pathways and emphasize that no single factor constitutes a necessary condition for achieving research integrity. Instead, distinct combinations of antecedent conditions, which may compensate for the absence of others, can lead to the same positive outcome. This illustrates the principle of equifinality and affirms the value of configurational theory in capturing the complexity and multidimensionality of academic ethical behavior.

Overall, the findings demonstrate a strong alignment between configurational theory and empirical evidence. The results confirm that research integrity is not driven by isolated factors but emerges from the interaction between individual endowments and organizational environments. This integrative perspective bridges theoretical assumptions

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with empirical observations, reinforcing the validity of the configurational approach adopted in this study.

5.1 Symmetry and Asymmetry of Conditions

In all four paths driving research integrity, value preferences are a core condition; in all five paths leading to research integrity violations, value preferences are mostly absent, either as a peripheral or a core condition. This strong symmetry confirms that the individual's intrinsic integrity values are the benchmark for research behavior orientation. It is not only a core condition for promoting research integrity, but also a high-risk factor for research integrity violations when it is absent. This strongly supports the classic assertion that internal causes are fundamental, placing individual moral endowments at the center of the governance system.

Most influencing factors show more asymmetry. For example, academic resources and research ability are often peripheral conditions in research integrity paths, but in research misconduct paths, they are usually core conditions that are absent. This indicates that strong individual endowments can compensate for limited resources to some extent, but extreme resource scarcity can easily undermine the foundation of integrity. More complex is the role of education and training. It can replace the management system in the research integrity configuration 2. Still, in the research misconduct configuration 5, it is a core condition and coexists with the outcome of research misconduct. This warns us that education and training, which are detached from the value core and may be reduced to

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pure performance pressure, are not only ineffective but may also become a breeding ground for strategic misconduct. Organizational elements can act as a guardian mechanism for research integrity. Still, they may be co-opted into a field that poses normative risks, depending on whether they align with the correct value orientation.

5.2 Roles of Academic Climate and Institutional Environment

The results of this study highlight the critical role of academic climate and institutional environment in shaping research integrity, which can be further elucidated from two dimensions: leadership signals and reward system design. First, leadership signals serve as a crucial directional guide in shaping the academic climate. Social Learning Theory posits that individuals internalize norms by observing the behaviors of role models and their consequences. In the university context, the behaviors of academic leaders possess a significant signaling effect. When leaders reinforce integrity norms through decisions consistent with their words and actions—such as handling academic misconduct cases impartially and adhering to a quality-oriented approach in resource allocation—they transmit clear ethical signals to the organization, thereby enhancing the binding force of the academic climate as a core condition. Conversely, if leaders focus solely on performance metrics while neglecting process compliance, such “tacit approval” signals weaken the faculty’s psychological contract. Consequently, even when formal management systems exist (as shown in

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research misconduct configuration 4), rules may lose their practical efficacy due to inconsistent leadership signals.

Second, reward systems and performance metrics constitute a guiding mechanism for research behavior. This study identified pathways in which a lack of ability and resource scarcity can induce misconduct, revealing potential risks within current evaluation systems. When reward systems rely excessively on quantitative performance metrics (e.g., publication counts, impact factors), they tend to create a “results-oriented” high-pressure environment. If the design of performance metrics fails to fully account for the cyclical nature and uncertainty of research activities, faculty with insufficient resources or limited ability will face high compliance costs. Under such circumstances, unreasonable reward structures not only fail to incentivize innovation but may also become an institutional trigger for “strategic misconduct.”

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5.3 Challenges Posed by Emerging Technology

The findings of this study hold new implications in the digital era. With the widespread intervention of Generative AI, the boundaries of research integrity are becoming increasingly blurred. First, regarding the reconstruction of “research ability,” in the AI era, traditional research abilities (such as data collection and paper writing) are increasingly being replaced by technological tools. The pathway revealed in this study, where “lack of ability induces misconduct” (e.g., Misconduct Configurations 1 and 3), may evolve into researchers’ over-reliance on technology in the context

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of AI. Specifically, teachers lacking core research capabilities may use AI-generated content to mask their lack of expertise, thereby triggering authorship disputes and reproducibility crises.

Second, regarding the lag in “management systems,” existing systems often struggle to effectively address the new risks introduced by rapid technological iteration. For example, contract cheating and AI-assisted writing significantly undermine the effectiveness of traditional plagiarism-detection methods. This study emphasizes the constraining role of management systems; however, in the face of new forms of digital misconduct enabled by AI, systems urgently need to expand beyond solely outcome-based monitoring to include process monitoring and technical ethical norms. It is essential to clearly define the boundaries for the use of AI tools and authorship rules to prevent technology from becoming an instrument of academic opportunism.

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5.4 Governance Path Expansion

The practical value of this study lies in its simultaneous provision of a construction guide and a risk map. The research integrity configurational paths offer a diverse menu of positive governance options. The four equivalent integrity paths indicate that universities can choose different governance strategies based on teachers' individual endowments and organizational environments. Whether relying on academic style guidance for cultural permeation, depending on education and training for continuous empowerment, or pursuing collaborative governance for system

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optimization, the goal can be achieved. This gives managers complete policy flexibility and choice.

The research misconduct configurational paths reveal the priority matters of bottom-line governance. The five integrity violation paths are like a clear risk map, pointing out the bottom line that governance must strictly guard against. They jointly point out that it is not allowed for the loss of individual values and the long-term simultaneous absence of organizational core support to coincide. In particular, when the core cornerstone of value preferences is shaken, the effectiveness of any other organizational means will be significantly discounted and may even produce the opposite effect. Therefore, the priority of governance should be: first, to consolidate the value bottom line of the teacher group; second, to ensure fair access to basic research resources and support for abilities; and finally, to systematically optimize all organizational atmosphere elements.

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6. Conclusions

This study examined the complex antecedents of research integrity among university faculty by integrating the dual perspectives of individual endowment and organizational environment through the lens of fuzzy-set Qualitative Comparative Analysis (fsQCA). Drawing on data from 109 university teachers, it explored how distinct combinations of personal attributes and institutional conditions interact to foster or hinder ethical academic behavior. The configurational approach adopted in this research provides a nuanced understanding of the multiple concurrent causal paths

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that lead to research integrity, offering insights beyond what traditional variable-centered methods can reveal.

Four key conclusions can be drawn from this study:

First, none of the six individual or organizational antecedents functions as a necessary condition for research integrity in isolation; namely, value preference, academic resources, research ability, academic climate, management system, and education and training. This confirms that no single factor alone is sufficient to explain ethical behavior, reinforcing the need to examine configurations of interdependent conditions.

Second, the formation of research integrity exhibits characteristics of multiple equifinality, while the occurrence of research misconduct stems from a key weakness effect. The empirical study identified four functionally equivalent configurational paths for research integrity, revealing that, under the premise of relatively stable value preferences, the organizational environment can interact with individual endowments through differentiated mechanisms such as academic climate guidance (configuration 1), education and training empowerment (configuration 2), or systematic element collaboration (configuration 4). In contrast, research misconduct shows five risk combinations, whose common feature is the absence of individual value preference and the collapse of one or more organizational core support elements. These two sides show that integrity

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construction needs to build strengths, but more importantly, it needs to avoid weaknesses.

Third, functional substitution exists among the elements of the organizational environment. As evidenced by research integrity configurations 1 and 2, systematic education and training, together with a sound academic climate, can, to a certain extent, compensate for the regulatory and guiding functions when the management system remains underdeveloped. Conversely, research misconduct configuration indicates that the absence of organizational support significantly amplifies the risk of individual norm-violating behavior. These findings reveal the complexity and resilience characteristics of organizational governance systems, suggesting that university administrators should attend to the synergistic effects and compensatory mechanisms among elements to optimize governance efficacy.

Fourth, the management enlightenment lies in precise, adaptive governance. Administrators should first diagnose the strengths and weaknesses of individual endowments and the organizational environment in their universities, and then choose a matching governance path: strengthening cultural guidance, focusing on educational empowerment, or building a compensatory protection network. The ultimate ideal direction is to build a research integrity ecosystem with value anchoring as the foundation and system collaboration as the goal, to achieve the organic unity of individual consciousness and organizational heteronomy.

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Despite these contributions, several limitations must be acknowledged. First, the measurement of research integrity relied on self-reported perceptions of research misconduct, which may introduce subjective bias. Future studies could triangulate findings with documented misconduct cases or audit-based data to enhance validity. Second, although this study focused on six carefully selected antecedents from both individual and institutional dimensions, additional variables e.g., leadership style, peer influence, or national regulatory context, may further enrich the analysis. Third, the present study adopted a static fsQCA model. Future research could incorporate dynamic QCA approaches to explore how configurations evolve over time and under changing institutional pressures. Also, this study has several limitations that should be acknowledged. First, the sample is limited to 109 university faculty members, which may constrain the generalizability of the findings across different institutional and cultural contexts. Second, the use of self-reported survey data introduces potential response bias, despite anonymity safeguards. Third, while fsQCA is well-suited for analyzing configurational causality, the method does not capture dynamic temporal changes in research integrity behavior. Future research could integrate longitudinal designs or mixed-method approaches to address these limitations.

The results reaffirm that safeguarding research integrity is not solely a matter of imposing controls or promoting idealism in isolation. It is a matter of designing environments, empowering individuals, and

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orchestrating conditions that collectively shape ethical behavior. Recognizing this complexity enables institutions to deploy more effective, evidence-based integrity policies that are sensitive to diversity, dynamic in structure, and sustainable in practice. While the findings provide meaningful insights into the configurational drivers of research integrity, they should be interpreted within the context of the study's methodological and empirical scope.

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Ethics approval and consent to participate: The Institutional Review and Ethics Committee at the Office of Academic Affairs, and the Office of Student Affairs, School of Management Engineering, Xuzhou University of Technology, approved an online questionnaire-based survey involving voluntary adult participants (age 18 and above). All research procedures complied with the Declaration of Helsinki and the institutional ethical protocols governing studies with human participants. Written informed consent was obtained digitally through an online consent form embedded at the beginning of the questionnaire, and participants were informed about the study's purpose, voluntary nature, confidentiality assurance, and their right to withdraw at any time before submission. Only individuals aged 18 years or older were allowed to participate. No minors were included, no identifying personal data was collected, and no vulnerable populations were involved. No physical, medical, psychological, or invasive procedures were included. More importantly, the study involved no risk beyond minimal online survey participation.

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