EVALUATING ORGANIZATIONAL RESEARCH CLIMATE TO ASSESS RESEARCH INTEGRITY

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The undersigned, appointed by the dean of the Graduate School, have examined the dissertation entitled:

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DEDICATION

This dissertation is dedicated to my husband, Jerry Kennett. He has been patient and supportive throughout this journey. He has been an inspiration, for his kindness, his caring and the effort he puts into all he does. He has endured the up and downs and encouraged me through them all. He has been unfaltering in his faith that I could succeed. My life is blessed to have such an amazing partner.

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Evaluating Organizational Research Climate to Assess Research Integrity

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Abstract

Failure of the scientific research enterprise to adequately define and respond to research misconduct and detrimental research practices constitutes a significant threat to scientific research. Lapses in research integrity erode trust in the scientific process and have serious consequences, potentially reducing funding sources, research subject willingness to participate, and research quality. Few studies have examined the empirical issues surrounding the role of culture and climate in promoting research integrity. This means there is a limited understanding of the organization's role in research integrity and how we can utilize that knowledge to build targeted education interventions and organizational change initiatives. The first aim of this dissertation study was to quantify differences in perceived climate between academic units to measure heterogeneity or homogeneity of research integrity across subunits in a multi university academic system, including a healthcare system. Second, to determine whether the additional pressure of maintaining rankings affect research integrity among universities of a multi-university system that are and are not members of the American Association of Universities (AAU). Using a validated, online survey, SOuRCe, 2,183 participants representing a variety of statuses within the research enterprise across a four-campus university system participated in the study. This study found that the subunit and department/program accounted for more than

half of the variance explained in each of the SOuRCe scales. Gender and age impacted the scales while campus and ethnicity did not. Further research with interventions at the department level will help guide change initiatives targeted at specific levels of the organization to promote research integrity.

CHAPTER ONE

GENERAL INTRODUCTION

Highly visible research scandals and growing evidence that research results are not reproducible pose a significant threat to the research enterprise, suggesting that failures of research integrity within the research enterprise lead to faulty science (Baker, 2016a; Consoli, 2006; Fang FC et al., 2012; Ioannidis, 2012). Recent reports have outlined the vital role that organizations play in fostering research integrity, creating and sustaining a research culture that fosters integrity, monitoring the integrity of research environments, ensuring that organizations have the capacity to effectively address allegations of research misconduct, and ensuring that senior leadership are actively engaged in these activities (National Academies of Sciences, 2017; Phillips et al., 2018). Yet, it is unclear whether and how this is occurring. The purpose of this study is to describe the perceived research climate differences within and across higher education organizations to assess the organizational climate of research integrity within and among those organizations.

Research Integrity

Research integrity is premised on 'the adherence to identified core values, objectivity, honesty, openness, fairness, accountability, and stewardship. Integrity in research results from the planning, proposing, performing, reporting, and reviewing of research in accordance with these values (Steneck & Bulger, 2007). Research misconduct results when participants in the research enterprise deviate from the norms and accepted practices of science. Research misconduct is an outcome that arises from

individual actions and while this issue needs to be appropriately addressed, the larger issue is research integrity. To address research integrity, there must be a creation of a system to address integrity in science at the organization level.

Impacts of Research Misconduct

The research enterprise realizes support for science when the public views scientific research as acting in the public's interest. Historically, the public placed their trust in the scientist, relying on the scientific community to maintain high standards through self- regulation (Anderson, 2008). Concerns have been raised, fostered by the perceived replicability crisis as described by Baker (2016b) and Begley and Ioannidis (2015) that the public trust in the scientific enterprise is eroding. Lack of reproducibility coupled with high profile misconduct cases such as William Summerlin; Sloan-Kettering Institute, NY; Hwang Woo-suk, South Korea; and Duke University and scientist Erin Potts-Kan have strengthened this thinking. Michalek (2010) estimated that the direct and indirect costs of investigating a single case of research misconduct to be approximately $525,000. In addition to the financial costs, there are other serious consequences. Such behaviors threaten to damage organizations' reputations and result in the loss of public trust in the research enterprise, affecting research participation and funding. Research that is not replicable potentially advances faulty science into human trials and places human subjects at risk without the possibility that their contribution will advance science (Hudson et al., 2016; Redman & Caplan, 2016). Science has given us many advances; diseases have been prevented, controlled, or cured. Moreover, it is expected that published science be reliable, that the research be socially valuable, and ethically conducted (Yarborough, 2014). The modern research enterprise has changed

the ways research is conducted, and knowledge is produced; it is faster, larger, more global, and more competitive, (National Academies of Sciences, 2017; Zwart, 2008). Research increasingly is carried out by large networks of interdisciplinary teams. These emerging characteristics of the modern research environment have previously been suggested to be risks to the integrity of the research enterprise. Large, multidisciplinary research groups can create environments where no one member understands the entirety of the science, leading to lapses of research integrity if infrastructure is not in place to address the separate contributions. Likewise, different cultures may present difficulty in clarifying expectations and values across the team, making it difficult to prevent or respond to lapses in integrity (Anderson, 2008; National Academies of Sciences, 2017). Research misconduct, fabrication, falsification, plagiarism, and questionable research practices must be dealt with. Underlying the concept of research misconduct is research integrity, which requires assessing and supporting systems where researchers are educated and perform their work. To improve our understanding of research misconduct there needs to be recognition of the organizational context in which it takes place.

Organizational Climate for Research Integrity

Research enterprises, where research is carried out, can be viewed as social networks embedded in political and cultural environments. Achieving organizational integrity, the alignment between the stated mission/values, decision-making, and behaviors at all levels of the system consist of two components: the climate and the culture (Silverman, 2000). Organizational climate is defined as the shared perception of the way things are, and perceptions of formal and informal organizational policies, practices,

and procedures (*Organizational Climate and Culture*, 1990). Organizational climate is conceptually distinct from organizational culture; the culture of an organization is the shared set understandings about the organization and its problems, goals, and practices (Schein, 2004). Yet, the two concepts are intimately connected: climate is a manifestation of organizational culture as a system of shared meanings, assumptions, and underlying values (Schien, 2017). Within an organization's culture and climate exists a dynamic system where outputs and outcomes affect future inputs and resources. This system is composed of several key elements that interact with one another. Inputs provide resources for organizational functioning. Structures and processes define the organization and its operations. Outputs and outcomes include knowledge and trained people, e.g., completed research, publications, and number of students graduated. These elements make up the internal environment of a research organization, which is in turn, is affected by the external environment (National Research Council, 2002). As described by Gorman and Conde (2007), within an organization questionable research practices spread through a department or discipline and escalate in a non-linear fashion. This involves irreversible behaviors (e.g.., publishing a paper) of researchers who share a work environment or are otherwise closely connected, and whose actions result in a response from others (e.g., increased competition) that affects their further actions (e.g., further use of questionable research practices) and the norms of the discipline they work in (e.g., a publish or perish). It has been suggested that the very complexities of the interrelationships and interdependencies of this research system complicate the task of creating structures and interventions to promote research integrity (National Academies

of Sciences, 2017). A systems model can be used to address the threats to research integrity within this dynamic system and the effectiveness of proposed solutions.

Systems thinking is lens through which this complex, interconnected network of interdependent groups of people and processes with common purpose can be addressed. The very framework of systems thinking is designed to provide a way of understanding the system by contemplating the whole, not the isolated parts. In systems thinking the focus is not on individuals, but on interrelationships, structures, and processes that control and monitor behavior to produce different behavior through systems change (Senge, 1990; Silverman, 2000).

Conclusion

The purpose of this dissertation project was to assess the dimensions of research climate to address risks to research integrity. Research misconduct resulting from lapses in adherence to the values inherent in research integrity potentially involves significant harms across the scientific enterprise, including serious societal harm (Faria, 2015). With the recognition that the research environment is ever changing, issues of globalization, competition, complexity, and expansion of regulatory requirements raise questions of the role organizations have with respect to research integrity (Anderson, 2008; Faria, 2015; Heitman, 2000; Zwart & Ter Meulen, 2019). This dissertation project facilitates building on previous work to provide evidence needed to build our understanding about the dimensions of the research integrity climate to address risks to research integrity. Findings from this study will be used to inform future interventions and research.

The following chapters in this dissertation (Chapters 2-5) are components of this dissertation project. Chapter two is a systematic review of the literature providing a synthesis of the empirical data surrounding the role of organizational culture in promoting research ethics and integrity. There are very few research reviews related to organizational ethics and research integrity. The reviews that do exist are primarily related to responsible conduct of research (RCR) education and training (Heitman & Bulger, 2005; Marusic et al., 2016) or ethical leadership (Brown & Treviño, 2006). This review reported on the influence of academic research organization's ethical climate and that impact on organizational integrity and recognized the need for further empirical research. Chapter three is the research proposal supporting this work and was funded by the Research on Research Integrity Program, an Office of Research Integrity/National Institute of Health collaboration. Chapter four is the preliminary manuscript reporting the results and findings from this study. Finally, Chapter five provides a synthesis of the overall dissertation project and the findings and significance to all engaged with the enterprise of research.

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CHAPTER TWO

ORGANIZATIONAL ETHICS AND RESPONSIBLE RESEARCH: A SYSTEMATIC REVIEW OF THE EMPIRICAL RESEARCH

This manuscript has been submitted to, Research Ethics

Abstract

Background: While repeated reports suggest the importance organizations play in fostering research integrity, it is unclear how and if this is occurring. This systematic review provides a synthesis of the empirical data surrounding the role of organizational culture in promoting research ethics and integrity. Methods: A systematic review was conducted according to PRISMA guidelines. Databases including ERIC, PubMed, SCOPUS, Web of Science, and JSTOR business were searched using a combination of search terms. Empirical data from eligible studies were abstracted and organized on a data matrix. Results: Nineteen studies were included in the review. Four primary themes emerged: (1) assessing research climate, (2) importance of leadership, (3) predictive risk factors for scientific misconduct, and (4) relationship between ethical cultures and ethics programs. Conclusions: The organizational culture plays an important role either in fostering or undermining research integrity. Leadership commitment is needed to promote an ethical climate based on formal compliance standards that incorporates a value-based cultural approach. There is a need for organizations to move away from individual blame to a climate of organizational research integrity. This broader organizational view will allow for the assessment of outcomes of responsible conduct of

research training at the subunit level and be able to bridge the gap between diagnosing an organizational problem and implementing methods to mitigate those problems.

Keywords: organizational ethics, research ethics, research integrity, organizational integrity, organizational culture, organizational climate

Until recent years, research misconduct was viewed as rare instances of data fabrication, falsification, or plagiarism committed primarily by individuals or 'bad apples' who would ultimately be dealt with through the self-correcting nature of the scientific community (Ioannidis, 2012). The increasing number of retractions and lack of reproducibility raise concerns that these measures are not effective in today's scientific environment (Baker, 2016b; Martinson et al., 2005; Titus et al., 2008). The modern research environment is complex and changing, made up of universities and other organizations that educate, employ, and train researchers. Government, foundations, and industries that sponsor research and medical journals, book publishers, and scientific societies that disseminate research findings. These organizations are poised to either support or undermine the integrity of research (National Academies of Sciences, 2017). There is compelling evidence to suggest that the context of the organizational environment where researchers conduct their work can influence the responsible conduct of research (Committee on Assessing Integrity in Research Environments, 2002).

Since the 1980s, highly visible cases of alleged research misconduct prompted the U.S. Congress and other federal agencies to issue policies mandating that individual research organizations develop policies and programs to promote research integrity and address research misconduct (Phillips et al., 2018). Yet, five years after the National Sciences Foundation (NSF) called for funded organizations to implement training and oversight in the responsible conduct of research, it was found that the majority of top U.S. research universities have not implemented best practices for responsible conduct of research instruction (Phillips et al., 2018).

Evidence today supports the proposition that research misconduct and other behaviors damaging to research, known as detrimental research practices (DRPs), constitute a significant threat to the research enterprise (National Academies of Sciences, 2017). Issues such as inadequate or inappropriate research design, dropped observations or data points, and failures to maintain the integrity of data may jeopardize the integrity of research directly and affect the accuracy of the scientific record (Martinson et al., 2013). Such behaviors threaten damage to organizations' reputations and result in the loss of public trust in the research enterprise, affecting research participation and funding. Research that is not replicable potentially advances faulty science in human trials and potentially places human subjects at risk without the possibility that their contribution will advance science (Hudson et al., 2016; Redman & Caplan, 2016). The American public takes pride in the advances science has given us; diseases have been prevented, controlled, or cured but along with this trust, there are expectations that published science be reliable, socially valuable, and was conducted ethically (Yarborough, 2014). Whitbeck (1995) suggested that the trust relationship in research requires not only control of outright research misconduct but also an awareness by researchers of practices that may cause behavior that is irresponsible or untrustworthy. It is necessary to identify areas where this trust is misplaced.

The current focus on research integrity is turning from the individual 'bad apple' and is turning toward the environment where science is conducted (Committee on Assessing Integrity in Research Environments, 2002; DuBois et al., 2012). The 2017 report, "Fostering Integrity in Research," highlights the central role research organizations play in fostering research integrity. First, research organizations have the primary

responsibility of creating and sustaining a research culture that fosters integrity and encourages best practices. Second, organizations must monitor the integrity of research environments to build the understanding about how organizational structure, context, and incentives interact to encourage or detract from research integrity. Third, organizations have an obligation to implement improvements to their research environments-based results of the monitoring process. To fulfill these responsibilities organizations must ensure the active engagement of senior organizational leaders.

Research reviews directly related to organizational ethics and research integrity are limited. The reviews that do exist are primarily related to responsible conduct of research (RCR) education and training (Heitman & Bulger, 2005; Marusic et al., 2016) or ethical leadership (Brown & Treviño, 2006). While these reviews are informative, they do not directly speak to organizational ethics and research integrity. This review will report on the influence of academic research organization's ethical climate and that impact on organizational integrity.

Terms and Definitions

Despite their common use, there is no consensus regarding the definition of researchers 'ethical behavior' (Steneck, 2006). The following discussion will define the terms used in the course of this review.

Researchers are professionals who conduct their work according to norms, codes and guidelines. The responsible conduct of research (RCR) is broadly conceptualized as conducting research in ways that fulfill the professional responsibilities of researchers, as defined by their professional organizations, the organizations in which they work, and when relevant, the government and public (Steneck, 2006).

Research behavior is then further subdivided into research behavior measured and guided by professional standards or measured and guided by moral principles. Research integrity is the quality of possessing and steadfastly adhering to high moral principles and professional standards, as outlined by professional organizations, research institutions, the government, and/or the public (Steneck, 2006). Research ethics (RE) is defined as the critical study of the moral problems associated with or that arise while pursuing research (Steneck, 2006).

The 1992 report of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine defined categories of behavior that had the potential to impact scientific integrity. Misconduct in science is defined as, "fabrication, falsification or plagiarism in proposing, performing, or reporting research (National Academy of Sciences (US) et al., 1992, p. 27). Questionable research practices were defined as, "actions that violate traditional values of the research enterprise and that may be detrimental to the research process" (National Academy of Sciences (US) et al., 1992, p. 28). The 2017 report, "Fostering Research Integrity" refers to these as detrimental research practices (DRPs). Other misconduct is defined as "forms of unacceptable behavior that are clearly not unique to the conduct of science, although they may occur in the laboratory or research environment" (National Academy of Sciences (US) et al., 1992, p. 28).

Organizational ethics is operationally about achieving organizational integrity, how organizations ought to act with respect to their moral obligations towards society and organizational integrity is the soundness of and adherence to those moral principles. Organizational integrity involves a commitment to achieve a strong alignment between

the stated mission/values statement and decision-making and behaviors at all levels of the system (Silverman, 2000).

The terms culture and climate are often used interchangeably but have distinct meanings. Schein (2004) provided a widely accepted definition of organizational culture, " a pattern of shared basic assumptions that have been invented, discovered, or developed by a given group as it learns to cope with its problems of external adaptation and internal integration…that has worked well enough to be considered valid and therefore to be taught to new members as the correct way to perceive, think and feel in relationship to those problems." Organizational climate is a manifestation of the culture, the sense, feeling or atmosphere people get in the organization, the perceptions and attitudes of the people in the culture.

Ethical culture is differentiated from ethical climate in that culture is normative and climate is descriptive. Ethical culture refers to shared assumptions about how things are done. Ethical climate is the shared set of understandings about what is correct ethical behavior and how ethical issues will be handled (Silverman, 2000). Ethical leadership then is the demonstration of normatively appropriate conduct through personal actions and interpersonal relationships and the promotion of such conduct to followers through two-way communication, reinforcement, and decision-making (Brown et al., 2005).

Current methods of addressing research integrity fail to adequately recognize that research integrity is as much an organizational issue as an individual one. This review examines the empirical issues surrounding the role of organizational culture in promoting research ethics and integrity. The primary aim of the review is to examine the existing empirical evidence around how organizational culture affects research integrity within the

academic research organization. The review provides a synthesis of existing empirical data addressing research integrity and the culture and climate existing within research institutions.

Methods

Search Methods

A literature search was conducted utilizing the following databases: PubMed, SCOPUS, Eric, JSTOR business and Web of Science. Databases were searched including a start date through February, 2021. Ancestry searches were also conducted from existing publications that met the inclusion, exclusion criteria. Tables of contents of the following journals that routinely publish on research integrity topics were hand searched through electronic tables of contents: Journal of Empirical Research on Human Research Ethics, Science and Engineering Ethics, Accountability in Research, and Journal of Academic Ethics. The search combined key terms including, ethical climate, ethical culture, academia or academics, research institution, research organization, organizational integrity, research integrity, organizational culture, and ethical leadership.

Inclusion/Exclusion Criteria

The studies were limited to empirically based studies, excluding review papers and editorials aimed at understanding the organization's role in research integrity. In addition, only studies in the English language and conducted in the United States were considered for inclusion. The search was not limited by date, while the body of literature on research integrity is widening, the field is still largely dominated by non- empirical publications. Therefore, the decision was made to be as inclusive as possible.

Study Selection

Initially, titles and abstracts of qualitative and quantitative studies were screened for relevance based on inclusion criteria as described above. Full text of the remaining studies was then reviewed using the same process based on inclusion criteria. Eighteen studies were selected for analysis. Data were extracted using the matrix method describe by Garrard (2017) (Table 1) and analyzed using the following categories: (1) the research question; (2) the instrument or theory used; (3) study design; (4) description of the study population/sample; (5) significant findings; (6) impact of the findings. Included studies were then reviewed by author and a colleague for appropriateness of inclusion and specific abstracted content. The numbers of studies reviewed and included/excluded are reported using Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Page et al., 2021).

Results

The search identified 281 unique citations, of which 44 were determined to meet the inclusion criteria after title and abstract review. After full text review an additional 25 studies were excluded, 18 remained were included in the analysis, none were excluded due to quality issues. (see Figure 1).

The studies included in the review were primarily conducted in the United States (n=18) and published between 1988 and 2017. Sample sizes ranged from 18 to 11,455 participants. Twelve studies utilized quantitative methods employing survey/questionnaire instruments. One study utilized only semi-structured interviews and the remaining five combined structured or semi-structured interviews with survey/questionnaire instruments. Only one study was an intervention evaluation.

Four broad themes emerged from the studies reviewed: (1) assessing research climate, (2) importance of leadership, (3) organizational culture as a predictive risk factor for scientific misconduct, and (4) relationship between ethical cultures and ethics programs.

Assessing Research Climate

Early work by Victor and Cullen (1988) around organizations' work climate supports the notion that ethical climate affects organizational performance factors such as individual performance and satisfaction. Likewise, Cooke (1988) suggested that the norms and expectations measured through the Organizational Culture Inventory (OCI) while perceived in consistent ways by individual members of an organization are actually measuring organizational not individual constructs.

The 2002 Institute of Medicine report, Integrity in Scientific Research, found gaps in the empirical research on factors that promote integrity and a lack of established measures to assess integrity in the research environment. To address this knowledge gap, the Survey of Organizational Research Climate (SOuRCe) was created. The SOurRCe survey is based on the Organizational Climate for Research Integrity (OCRI), which later became the Survey of Organizational Research Climate (SORC). Six studies identified in this review involved the development and testing of the SOuRCe survey. This survey was initially developed and tested in Academic Health Centers and provides a measure of how participants perceive the quality of their research environments and the extent to which their organizational units support responsible research practices and research integrity (Crain et al., 2013; Martinson et al., 2017; Martinson et al., 2016; Martinson et al., 2013; Thrush et al., 2007; Wells et al., 2014). Thrush (2007) established the content

validity of the survey and Martinson (2013) demonstrated internal and external reliability. The SOuRCe survey was later moved beyond healthcare organizations and was successfully implemented in large academic centers across a broad range of fields of study, department types and individual roles. It was also successfully tested and used within the VA system, moving it further away from traditional academic setting (Martinson et al., 2016; Wells et al., 2014).

The survey does not provide indicators of individual performance or behavior but provides group level perceptions of the environment (organizational climate). Crain (2013) established that positive perceptions of the research climate correlated with positive research practices. Therefore, the survey provides not only assessment of the research climate but also provides some indication of research practices, providing valuable information to the organization to aide in quality improvement activities. Martinson (2017) in a pilot study, identified that the proportion of leaders taking action on the survey feedback was twice as high when also receiving verbal feedback, this suggests an opportunity to move beyond using the survey to merely assess the environment but also to use the knowledge gained for ongoing improvement.

Importance of Leadership

Studies of leadership's impact on creating an ethical organization consistently cited integrity, humanistic values and the commitment of leadership at all levels as essential for performing research effectively (Antes et al., 2016; Eisenbei & Brodbeck, 2014; Souba & Day, 2006; Trevino et al., 1999). Souba (2006) and Eisenbei (2014) found that ethical leaders realized the interconnectedness of human beings, the importance of promoting the well-being of others, and that integrity was highly

correlated with humanistic values (Souba & Day, 2006). The social orientation of ethical leaders goes beyond the organization, transcending the affiliation boundaries of any specific organization (Eisenbei & Brodbeck, 2014). The ethical behavior of top leadership is important to organizational outcomes (Riivari & Lamsa, 2014). Positive outcomes such as reduced misconduct and higher job satisfaction are attainable by promoting a moral organization through the action and speech of leaders (Andreoli & Lefkowitz, 2009). Yet, researchers indicated that traditional academic training in research, mentoring and graduate training, did not adequately prepare them to navigate the complex social and organizational elements of their scientific careers (Antes et al., 2016).

Organizational Culture as a Predictive Factor for Scientific Misconduct

The organizational culture plays an important role in either fostering or undermining research integrity. Compliance with regulations is only one of several important factors in organizations' ethical culture. Regulatory compliance, even in a highly regulated environment sets a bare minimum for accountability practices (Yarborough et al., 2009). Geller's (2010) findings reflect that the structure of federal regulations places responsibility at the individual and not the institutional level. Additionally, Geller's study noted a discrepancy between faculty and fellows' opinions about who is responsible for ensuring research ethics and integrity principles are followed and identifying who needs more training. Additionally, fear of punishment and issues of power differential between principal investigators and junior researchers and staff were reported, suggesting that progress toward a culture of research integrity might be hindered by power imbalances and the absence of blame free reporting systems. Swazey

et al. (1993) found that scientific misconduct, narrowly categorized as fabrication, falsification, and plagiarism, takes place less frequently than behavior that falls into the National Academies definition of detrimental research practices (DRP's), also referred to as questionable research practices (QRP's), which are types of ethically wrong or questionable behavior. Matinson et al. (2010) reported that engagement in the most serious misbehavior wase associated with interpersonal factors (e.g., over commitment) and environmental factors e.g., organizational justice/injustice. Reducing a person's exposure to strains such as organizational injustice (individual perceptions about the fairness of decision-making, resource distribution, and behavioral consequences) would potentially reduce the occurrence of non- normative behavior.

Fanelli's (2015) work also supports the fact that national policies, socio-cultural conditions, research environment and situational factors are all significant determinants of responsible and irresponsible practices, while policies to reduce pressure to publish might be ineffective. Potentially, the best mechanism to protect the integrity of science may be in restructuring how allegations of misconduct are handled, promoting transparency among colleagues and increasing training and mentoring for young researchers. The identification of predictive factors for research misconduct can be used to target interventions aimed at reducing engagement in research misconduct and questionable research practices.

Relationship between Ethical Cultures and Ethics Programs

Employees in low ethical climates but with high levels of compliance programs reported higher levels of misconduct than those working in organizations with low levels of compliance programs (Andreoli & Lefkowitz, 2009). The distinction

between formal compliance practices (written codes, training, and reporting) and informal ethical climate (leaders setting the example talking about the importance of ethics) represent independent precursors of ethical behavior (Andreoli & Lefkowitz, 2009). Simply following the rules in a compliance -oriented culture of research may not be enough to prevent problems in research ethics and integrity. Looking at factors such as organizational culture may be useful in directly addressing factors that can influence research ethics and integrity (Geller et al., 2010). Organizations that fostered a climate that encouraged ethical behavior used compliance-based programs that went beyond legal compliance (Paine, 1994). There are two orientations to ethics/compliance programs, the first uses a compliance-based approach focuses primarily on preventing, detecting, and punishing violations. The second, a values-based approach, defines organizational values and encourages individual commitment to ethical goals (Paine, 1994). Studies indicated that value-based cultural approach to ethics/compliance was perceived by employees to be most effective when shared organizational values were present (Eisenbei & Brodbeck, 2014; Trevino et al., 1999).

A value-based, cultural approach to compliance management was noted to work best especially when the approach is complementary to other programs (Eisenbei & Brodbeck, 2014; Trevino et al., 1999). It was viewed as most effective when a value-based program was supplemented with legal/regulatory components. Trevino (1999) found that the most important components leading to an effective compliance program were, follow through and the broader ethical culture of the entity. In order to better understand the relationship between ethics programs and ethical culture the dimensions

of each need to be unpacked in order to achieve an in depth understanding of the multifaceted nature of each and the relationship between them (Kaptein, 2009).

Discussion

This systematic review suggests that while organizational culture plays a role in the underlying research integrity of an organization there is a failure to adopt widespread assessment of organizational climate, which are the manifestations of culture, and use that knowledge to improve research integrity through a quality improvement lens. The four themes identified in the review were, (1) the value of assessing research climate, (2) importance of leadership, (3) identification of organizational culture as a predictive risk factor for scientific misconduct, and (4) relationship between ethical cultures and ethics programs. These themes also reflect the recommendations from the National Academy report (2017), Fostering Integrity in Research.

Assessing research climate as a mechanism to promote research integrity can be accomplished through organizational assessment using survey, interviews and/or focus groups. A survey, such as the SOuRCe survey, which is the only validated survey to date for this purpose may be used to quantify the differences in perceived climate between units and/or serve as a benchmark across organizations. Furthermore, organizational leaders can use the survey to gauge employee's perceptions of the research environment. A better understanding of the subunits within an organization and the climate within them will aide in targeting appropriate educational interventions and organizational change initiatives. While the SOuRCe survey has been validated and tested across different organizations there is still research that could be done to further refine the survey and

explore its potential in evaluating the research climate and provide important clues as to how to more effectively address best practices in responsible research.

The importance of leadership as discussed by Andreoli and Lefkowitz (2009) suggests that positive outcomes such as reduced misconduct can be attained through the actions and speech of organizational leaders thus promoting a moral organization. While there exists fairly robust research on workplace psychology and organizational behavior there is little research about the psychology of scientific work. This research might focus on management practices and productivity of scientific lab teams, and identify what practices yield high scientific productivity and still support the quality and integrity of the work. Antes (2017) suggested that while these are important questions it is difficult to determine who will conduct such a study, fund and publish the work since there is not a clear funding or publication outlet for research about scientific integrity.

Predictive risk factors for scientific misconduct are important in that these take our concerns and move beyond standards and conduct. Even when official definitions of scientific misconduct are not in question, other types of conduct (questionable research practices (QRP's) and detrimental research practices (DRP's) it has been suggested are as harmful or more harmful to the scientific enterprise as scientific misconduct. There are no standards for acceptable behavior regarding QRP's, more research needs to be done in this area to establish criteria, policies and procedures. Future research also needs to further explore the role of individual exposure to strains such as perceptions of fairness in decision-making and resource and workload distribution within organizations. There is also a need to address power imbalances which create reluctance on the part of researchers to question superior's mistakes or acknowledge their own. Mechanisms to

reduce tensions between junior faculty, staff and mid-career or senior faculty researchers would be a place to start the culture shift. This shift is away from systems of belief, values, and behavior norms that have come to be taken for granted in a groups accumulated learning (Schien, 2017).

The final theme is the importance of the relationship between ethical culture and ethics programs. The content of the ethics program should be flexible, and determinations of cultural dimensions noted to be in need of improvement should be identified through routine assessment. There needs to be a movement away from the focus on compliance to an understanding of the moral reasons behind the rules. Education needs to be focused not solely on the regulatory aspects of compliance but also on ethics and integrity. As noted by Kaptein (2008) ethics programs are strongly related to the ethical culture of organizations and can be effective in improving the ethical culture, However, not all components of an ethics program have positive impact on the institutions culture. The relationships between the components of ethics programs and the dimensions of ethical culture differ as to nature, strength and significance (Kaptein, 2009). As multi-dimensional constructs, ethical programs and ethical culture must first be assessed to determine what aspects of the ethical culture needs to be improved. The content of the ethics program should be determined by the cultural components that need to be improved. Therefore, an assessment needs to occur identifying the dimensions in need of improvement.

Gaps in the Empirical Evidence

To continue to improve research integrity across research organizations empirical data about how best practices are developed, implemented, and evaluated needs to come

into widespread use. This review identified important gaps in the empirical literature. While a validated tool (SouRCe) now exists which has been used in a variety of research settings it has only been used by the developers and not been adopted by organizations and scientists for widespread use. Only one study in the review involved an intervention and evaluation, all other studies were exploratory descriptive studies involving untested questionnaire/survey instruments or structured/ semi structured interviews. While suggestions for best practices were included no studies explored the development of best practices by an organization to improve research integrity.

Strengths and Limitations

This review sheds light on the status of empirical work looking at the effects of organizational culture on research integrity. It begins to identify how future work might lead to identification and implementation of best practices on a widespread scale.

One limitation of the studies reviewed is that the terminology continues to be inconsistent and poorly defined, making it difficult to interpret results. Limitations also include the fact that systematic review in the bioethics literature is new, especially when it comes to the normative literature, although it has been argued it is necessary to move the discipline forward (McDougall, 2014; Mertz et al., 2016). Identification of search terms can prove to be more challenging, in that a diversity of terms may be relevant to a bioethical question contrast at times sharply with the specificity of biomedical terminology.

Conclusion

Developing mechanism to support research integrity which focuses not on external constraints, regulation and sanctions, but on the impact of organizational

dynamics on the ethical behavior of organizations and their members is long overdue. Systems thinking focuses not on individuals as objects of improvement but rather on examining interrelationships, communications, ongoing processes, and underlying causes of behavior with an eye toward changing interaction or redesigning the system to produce different behaviors. While monitoring individual behavior is important, it is insufficient and will not result in significant change. The complexity of relationships in organizations requires that the ethical climate be proactively managed to achieve organizational integrity (Silverman, 2000). This review examined the empirical issues surrounding the role of organizational culture in promoting research ethics and integrity. The review provides a synthesis of existing empirical data addressing research integrity and the culture and climate existing within research organizations.

In the current literature review the literature documented the development, validation and subsequent studies utilizing the SOuRCe survey in a variety of settings and across units. This demonstrated the versatility and possible uses of the survey as a quality improvement tool to enhance research integrity both locally and globally. Making the SOuRCe survey available with potential availability of comparative data expands the potential for institutional benchmarking. Further research is needed in this area to better understand the organization's role in research integrity and how we utilize that knowledge to promote integrity in research.

Conflicting interests

The authors declare no competing interests

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PRISMA Flowchart of Number of Documents in the Literature Review

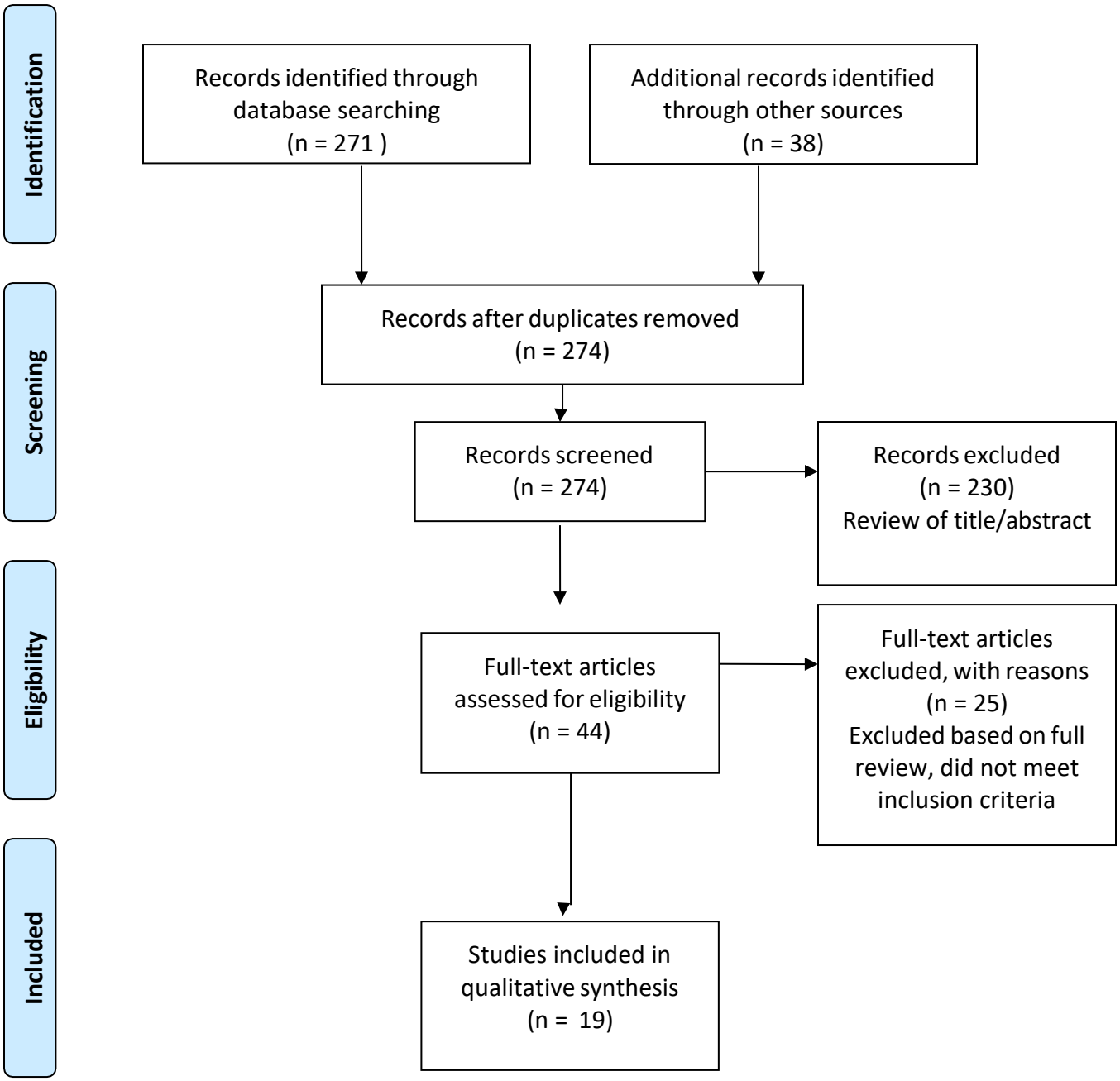

Figure 1: Preferred Reporting Items for Systemic Reviews and Meta-Analysis (PRISMA) diagram

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). *P*referred *R*eporting *I*tems for *S*ystematic Reviews and *M*eta-*A*nalyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal. pmed10000

TABLE 1
STUDY DESCRIPTION

Author(s) last name, first initial	Purpose of the study	Instrument/ Theory	Method/Design	Population/Sample	Significant Findings	Impact
Martinson, B. C., Mohr, D. C., Charns, M. P., Nelson, D., Hagel-Campbell, E., Bangerter, A., . . . Thrush, C. R (2017)	HO: research leaders randomized to the enhanced intervention group will be: a. more likely to plan or attempt to make organizational changes than research leaders randomized to the basic feedback group. b. more likely to plan or attempt to make organizational changes responsive to the results of the survey. 2: Facility level of receptivity to quality improvement input will be correlated with the likelihood that research leaders took action in response to the enhanced feedback intervention.	Survey of Organizational Research Climate (SOuRCe) 32-item instrument. First validated survey instrument specifically designed to assess the organizational climate of research integrity in academic research organizations/ Organizational theory	Experimental, SOuRCe survey, intervention, qualitative interviews/ Pilot randomized trial (two-arm, randomized trial) of the uptake and effectiveness of two methods of reporting feedback, written feedback or written feedback plus a call	42 VA facilities (e.g., Hospitals/Stations) with medium to large research services were recruited for survey. N=41 facilities yielded n = 5,200 usable surveys. Results from this survey informed intervention portion of this study that provided feedback to research leaders at the 41 VA facilities.	No statistically significant differences between study arms, due in part to the limited sample size for this pilot study. Concluded survey-based feedback has the potential to motivate and direct positive organizational change in research integrity climates.	Increased recognition of the vital importance of institutional responsibility in maintaining research integrity and avoiding research misconduct. The climate survey provides research leaders way to identify concerns within their organization.
Martinson, B. C., Nelson, D., Hagel-Campbell, E., Mohr, D., Charns, M. P., Bangerter, A., . . . Wells, J. A. (2016)	HO: Behavior of researchers is influenced by the organizational climates in which they work, efforts to assess the integrity of research climates and share such information with research leadership in VA may be one way to support research best practices.	Survey of Organizational Research Climate (SOuRCe)	Quantitative survey	Research-engaged employees in the research services of a random selection of 41 VA, N=5200	SOuRCe has excellent internal reliability & consistency with traditional academic research settings. Findings suggest that SOuRCe is a suitable instrument for evaluating research integrity climates in VA.	SOuRCe is as suitable an instrument for assessing the research integrity climates in the VA and is consistent with findings from traditional academic research settings.

Antes, A. L., Mart, A., & Du Bois, J. M. (2016)	Identified if PIs perceived leadership and management activities as essential to conducting effective research and how prepared were they to assume these activities after completing their scientific training? Secondarily identified management practices used by successfully, funded investigators and inquired about their openness to an intervention aimed at fostering effective lab practices.	None	Qualitative, semi-structured interviews	Biomedical researchers conducting diverse types of research (e.g., lab, human, and animal) funded across NIH institutes but sharing a common focus on genetic or genomic science/N=32	Leadership and management are essential to performing effective research. scientific their basic preparation did not prepare researchers for these activities	Leadership and management are essential for performing research effectively. The scientific community must better prepare scientists to navigate the social and organizational elements of their Organizations.
Fanelli, D., Costas, R., & Lariviere, V. (2015)	This study was designed to confirm whether the occurrence of a retraction or a correction could be predicted by study characteristics that reflect the following risk factors: policies, culture, pressure to publish, peer control, early-career, gender.	None	Retrospective study design/conditional logistic regression	Set of bibliographic data retrieved from the Web of Science on all co-authors of papers that have been retracted or corrected in 2010–2011 and compared them to control papers matched by journal and issue/ N = 611 retracted papers, N = 2226 corrected papers, and N = 1181 and N = 4285 matched controls,	Scientific misconduct is more likely in countries that lack research integrity policies, in countries where individual publication performance is rewarded with cash, in cultures and situations were mutual criticism is hampered, and in the earliest phases of a researcher's career	Recommendation are to establish policies and structures to handle allegations of scientific misconduct, promote transparency, promote constructive criticism of work between colleagues, bolster training and mentoring of young 4
Wells, J. A., Thrush, C. R., Martinson, B. C., May, T. A., Stickler, M., Callahan, E. C., & Klomparens, K. L (2014)	Descriptive analysis to characterize differences on SOuRCe scales across depts., fields of study and status categories	Survey of Organizational Research Climate (SOuRCe)	Survey/analysis employs both univariate and multivariate approaches.	Faculty, postdoctoral scholars, and graduate students/N=11,455 respondents.	It is feasible to implement this instrument in a large university setting across, fields, departments, and individual roles within academic units	Variability to be explained in research integrity climates –most explained at the dept./program level, less explained by individual status or by field of study.

Eisenbei, S. A., & Brodbeck, F.(2014)	Identify cross-cultural and cross-sectional commonalities and differences in international executives' perceptions of ethical and unethical leadership	Empirical descriptive tradition	Qualitative explorative approach, semi-structured interviews	Executives from Western and Eastern cultures working in private or public sector/N=36	Social orientation of ethical leadership transcends organizational boundaries. Points to a values based understanding of ethical leadership. Complementary to compliance orientation.	Limited support for compliance-oriented perspective on ethical and unethical leadership, trend towards value-oriented perspective.
Martinson, B. C., Thrush, C. R., & Crain, A. L (2013)	Assess reliability, internal test, retest of SOuRCe, and measures of perceptions of organizational justice	Survey of Organizational Research Climate (SORCe)	Quantitative /web/mail-based survey	Biomedical and social science faculty and postdoctoral fellows-251 departments who have received NIH funding within 40 academic centers. In US/N=2836	Acceptable internal consistency (Cronbach's α ranging from 0.81 to 0.87) test, retest reliability, (Pearson r ranging from 0.72 to 0.83). both construct and discriminant validity. (unadjusted regression coefficients ranging from .13 to .95)	SOuRCe can be used to generate comparative data about perceived performance of subunits within an institution also within fields across institutions.
Crain, A. L., Martinson, B. C., & Thrush, C. R. (2013)	Assess perceptions of factors specific to universities and departments, relate those to research related behaviors	Survey of Organizational Research Climate (SORCe)	Quantitative /web/mail-based survey	Biomedical and social science faculty and postdoctoral fellows-251 departments who have received NIH funding within 40 academic ctrs. In US/N=2,836	Positive perceptions associated. with higher likelihood of desirable research practices	Significant association between department level perceptions of organizational climate and range of desirable and undesirable research related behavior suggesting the survey can serve as an effective tool for faculty reporting and feedback. Provide greater awareness to organizational leaders

						of where and how their organizations are weak.
Geller, G., Sugarman, J., Ford, D. E., & Boyce, A. (2010)	To contribute data to scholarship concerning the role of institutional culture in promoting research ethics and integrity.	Convenience sample surveys Course evaluations Semi -structured interviews	Descriptive, exploratory that occurred in three phases Phase I: surveys (quantitative, qual. comment) Phase II: Course evaluations (quan. qual. comment, focus group interviews) Phase III: key informant interviews/ qualitative.	Phase I. convenience samples of research faculty and staff, n = 151 Phase II: faculty and fellows working in in clinical research, n = 700 Phase III: two IRB chairs, one IRB director, and one individual with a senior role in research administration, n =4	Findings support the observation made by others that progress in the culture of biomedical research is hampered by (a) power imbalances, (b) absence of "blame-free" reporting systems, (c) structure of federal regulations on reporting support placing responsibility at the individual, not the organization	Research culture would benefit from better communication between researchers at different levels of the hierarchy. Shift from dominant culture of compliance to a culture that emphasizes the moral reasons behind the rules.
Martinson, B. C., Crain, A. L., De Vries, R., & Anderson, M. S. (2010)	Identify association between self-reported behavior of biological, medical, life science and social science researchers and their perceptions of organizational justice and injustice.	Thompson's classic theoretical work on organizational environments, organizational justice theory.	Quantitative survey	Faculty at 50 top tier research universities/N=1,703	Perceptions of justice in one's workplace are positively associated with self- reported ideal behaviors and negative association with misbehavior and misconduct. Perceptions of fair treatment in the work environment appear to play important roles in fostering or undermining research integrity. .	Suggest reducing individual exposure to strains such as organizational injustice to reduce the occurrence of non-normative behavior (scientific misconduct).

Andreoli, N., & Lefkowitz, J (2009)	1. Is there a relationship between level of moral development and level of observed misconduct by others? 2: Is there a difference between part-time and full-time employees in amount of own misconduct or observed misconduct by others?	Developed by the authors based on: *Defining issues test *2003 National Business Ethics Survey (NBES) of employees	Survey	Employed graduate and undergraduate students in a large urban college/N=145	Organizational factors not personal characteristics were significant precursors of misconduct and job satisfaction. Respondents reported observing more misconduct than they engaged in (Means =1.75 and 1.15, t=9.59, 144 df, p<.001). Organizational ethical compliance practices and organizational ethical climate were significantly correlated, the effect size was moderate (r=.24, p<.01).	Importance of promoting a moral organization through words and acts of senior managers and supervisors independent of formal mechanisms such as code of conduct.
Kaptein, M. (2009)	Whether treating ethical culture and ethical programs multi-dimensionally each with adequate content validity leads to more in depth understanding of the relationship between ethical cultures and ethics programs.	Solomon's virtue-based theory of business. Corporate ethics virtues model.	Survey	Adults working for US organizations with at least 200 employees/n=4,056	Relationship between the individual components of ethics programs and ethical culture. The regression coefficient (ß) between ethics programs and ethical cultures was 0.5 (with $p < 0.01$), the broader the scope of an ethics program, the better the ethical culture.	One or more components of ethics programs can have a positive relationship to a given dimension of ethical culture while the relationship of other components is negative.

Thrush, C. R., Putten, J. V., Rapp, C. G., Pearson, L. C., Berry, K. S., & O'Sullivan, P. S. (2007)	Develop and establish content validity of an instrument designed to measure the organizational climate for research integrity in academic health centers.	Instrument design-evaluation of 64 survey items for relevance and clarity	Quantitative survey with additional open-ended comments for each question	Research integrity scholars and administrators/N=27	Study resulted in the development of the Organizational Climate for Research Integrity (OCRI) survey, a 43-item fixed-response survey with established content validity. 17 items failed to meet any of the three statistical content validity criteria. The elimination of these items resulted in a CVI value of .90 for the survey overall, representing strong agreement in regard to content validity.	Ability for academic leaders who are interested in implementing institutional self-assessment practices and promoting research integrity in their institution.
Souba, W. W., & Day, D. V (2006)	Gain an understanding of guiding core values deans of Association of American Medical Colleges (AAMC's) consider essential to their leadership.		Qualitative, quantitative, values Q sort methodology	Deans of US colleges of Medicine or AAMC's/n=18	Concerns include financial constraints, common core value most essential to their leadership, integrity.	Dynamic tension between humanistic values and performance-based core values.
Swazey, J. P., Anderson, M. S., Lewis, K. S., & Louis, K. S. (1993)	Effect of misconduct on the academic environment.	quantitative survey	Survey-quantitative	Doctoral candidates and their faculty from 99 largest graduate programs in chemistry, civil engineering, microbiology and sociology n =2000.	Scientific misconduct narrowly defined takes place less frequently than other types of ethically wrong or questionable behavior. However, the occurrence of plagiarism,	Misconduct is more pervasive than many believe, there are also significant differences among disciplines in the frequency and types of questionable behaviors observed.

					falsification is not rare.	
Trevino, L. K., Weaver, G. R., Gibson, D. G., & Toffler, B. L. (1999)	What do ethics and legal compliance programs accomplish relative to ethics and compliance management.	Survey - quantitative	Survey- quantitative	Administered to 10,000 employees from 6 large US companies across industries	Specific characteristics of the formal ethics or compliance program matter less than broader perceptions of the program's orientation toward values and ethical aspirations. What helps the most are consistency between policies and actions as well as dimensions of the organization's ethical culture such as ethical leadership, fair treatment of employees, and open discussion of ethics	There are ways to measure the end results of corporate ethics and compliance programs. Values based cultural approach to ethics/compliance management works best. Requires commitment of leadership at all levels.
Victor, B., Cullen, J.B. (1988)	Ethical work climates have organizational bases separate from individual perceptions and evaluations.	ECQ- Ethical Climate Questionnaire/ organization and economic theory	Survey	Employees from 4 firms, different sizes and industries, n=1183, 872 useable surveys	Confirmed the multidimensionality of ethical climate and evidence for three distinct sources of ethical climate: sociocultural, bureaucratic-structural, and firm-specific.	Ethical climates identify the normative systems that guide organizational decision making and the systemic responses to ethical dilemmas.

Cooke, R. A., & Rousseau, D. M. (1988)	Assessment of a specific aspect of organizational culture, the shared norms and expectations that guide thinking and behavior of members.	Organizational Culture Inventory (OCI)	Survey	The data reported reflect 3 types of samples: (1) approximately 1,800 individuals whose OCI scores are used to establish a normed "benchmark" profile. Data provided by a subgroup of this sample (n = 661) were used to assess the psychometric properties of the inventory (including reliability and factor structure) and to test the effect of organizational level on OCI scores. (2) a descriptive sample of selected organizations used here to illustrate distinct cultural patterns observed using the OCI. Data from three organizations and 1,085 individuals are presented. (3) Ideal profile descriptions obtained from 91 people in five firms who were asked to describe the thinking and behavioral styles that should be expected in their organization.	The eta-squared statistics, measuring within-unit consistency in OCI scores, indicate that there is intraorganizational consensus regarding perceived norms and expectations. The amount of agreement is not great and varies across cultural styles. The results suggest that the cultural inventory is measuring organizational level phenomena.	Behavioral norms do vary across organizations and levels and in ways consistent with the focal organization's management style. In contrast to the traditional use of qualitative assessments in the study of culture this research assessed behavioral norms quantitatively. Quantitative methods facilitate large-scale studies or organizations, replication, and triangulation of other forms of assessment. Results of the present study suggest that the behavioral norms and expectations are amenable to quantitative assessment.

CHAPTER THREE

METHOD

The following research proposal is a modified version of the proposal which was submitted for and successfully funded by the Research on Research Integrity Program, an ORI/NIH collaboration.

Specific Aims

Several recent publications (National Academies of Sciences, 2017; National Science Foundation, 2017; Phillips et al., 2018) have raised concerns regarding scientific integrity including issues of reproducibility, questionable research practices and misconduct. There are billions of dollars of investment in the modern research enterprise which includes universities and other research institutions that educate, employ, and train researchers; government, foundation, and industry sponsors of research; and publishers. This complex and integrated system poses challenges to upholding standards of research integrity. Failure of the scientific research enterprise to adequately define and respond to research misconduct and detrimental research practices constitutes a significant threat to scientific research (National Academies of Sciences, 2017). New strategies to support research integrity in academic research environments must be considered as the knowledge generated is of enormous benefit to society including better health, increased knowledge, and new technologies. Lapses in research integrity erode trust in the scientific process and have serious consequences such as potentially reducing funding sources, research subject willingness to participate, and research quality.

The application of systems theory to the research enterprise would improve the integrity of the research process by continuously monitoring the structures and processes that influence ethical behaviors (Silverman, 2000). In systems theory, the focus is not on individuals as objects of improvement, but on the interrelationships, communications, ongoing processes, and underlying causes of behavior to change interactions and/or redesign systems to produce different behaviors. The culture and climate of organizations are influenced by the quality and responsiveness of their systems. Response to failures within that infrastructure should be focused on faulty systems and processes and not on individuals.

Thrush et al. provided basis for the development of the first validated survey, Survey of Organizational Research Climate (SOuRCe) designed to assess the organizational climate for research integrity in academic health centers (Thrush et al., 2007). The SOuRCe provides valuable information for academic administrators (i.e., deans, department chairs, division heads) about their employees' perceptions of the research climate. When administrators better understand subunit similarities and differences, targeted educational interventions and organizational change initiatives can be developed within an institution (Thrush et al., 2007). This proposed cross-sectional study of four universities within a multi university academic system will compare perceived differences in research climate across institutions and subunits within institutions. It will also contribute to understanding how external factors such as the pressure of maintaining AAU membership influences perceived research climate. Each university in the system identified participants for the study which included all graduate students, postdoctoral fellows, and research personnel, 13,447 participants were invited to

participate in the survey. The National Center for Professional and Research Ethics indicates other studies utilizing the survey report 15-50% response rate. The purpose of this study was to quantify differences in perceived climate between academic units to measure heterogeneity or homogeneity of research integrity across subunits in a multi university academic system, including a healthcare system. The specific aims guiding this study were:

Specific Aim 1. To obtain comparative data within and across institutions to improve the institutional environment supporting research integrity.

Research Question 1: What are the perceived research climate differences between subunits across institutions?

Research Question 2: Is there heterogeneity or homogeneity of research integrity across subunits?

Research Question 3: Does the additional pressure of maintaining AAU status affect research integrity between universities of a multi-university system that do and do not have AAU status?

This research will fill critical gaps in the body of empirical research involving research integrity that focuses on the influence of a multi-university system on individual universities' research integrity programs and identify ways to build toward targeted education interventions and organizational initiatives. Findings from this study will be used to inform the creation of a body of best practices available to organizations to improve research integrity and foster sound research environments.

Anticipated Difficulties in Conducting the Study

One anticipated difficulty was non-response. This was addressed through communication throughout the organizations. Strategies to improve response included explanations of protections of privacy, appeals to loyalty and altruism, letting respondents know that their responses will help to make the research environment a better one in which to work and conduct research, and reminders to complete the survey (Wells et al., 2014).

Innovation

The current approaches to integrity, including responsible conduct of research (RCR) training and compliance programs are inadequate and, in some cases, ineffective in systematically addressing the problem (Geller et al., 2010; Kaptein, 2009; Silverman, 2000).

A new lens to research integrity needs to be applied, informed by practices and conceptual frameworks from other sectors and other approaches. A systems theory applied within the research enterprise would improve the integrity of the research process by continuous attention to structures and processes that influence ethical behavior (Silverman, 2000). With systems thinking, the focus is not on individuals as objects of improvement, but rather, on examining interrelationships, communications, ongoing processes, and underlying causes of behavior with an eye towards changing interactions or redesigning the system to produce different behaviors (Silverman, 2000). This is vastly different from how we typically approach research integrity; typically, individuals are regarded as the problem, thereby failing to consider organizational influences (Giganti, 2004). Maturation towards organizational accountability will result in a shift

from isolated blame of individuals for misconduct to continuous efforts toward improving organizational climate to foster best practices (Carroll et al., 2002).

Approach

Research Design and Methods

Procedure

A cross-sectional design was employed in this study. Participants from each university of a multi-university academic system were invited to participate via e-mail through a link to the online SOuRCe survey administered via the REDCap platform. This population list was generated from each university and includes all graduate students, faculty, post- doctoral fellows, and all research personnel.

Table 2	
Sampling	
Inclusion Criteria	Exclusion Criteria
Graduate students in research master's programs	Individuals in status categories that would not adequately expose them to the research environment
Graduate student in doctoral programs;	
Postdoctoral trainees/research associates	
Faculty, not tenure-track	
Tenure-track faculty, not tenured	
Tenure-track faculty, tenured	
Research scientists/staff/technicians	

A census approach was taken to invite study participants, each university generated a comprehensive listing of their members; including all graduate students, all faculty, all postdoctoral fellows, and all research personnel to be surveyed. In the census approach each unit of the population is researched. The census method is known as a complete enumeration survey method (Singh & Masuku, 2014).

Recruitment

Each university provided a list of e-mail addresses and names of faculty, research scientists, postdoctoral researchers, and graduate students, which was used to send a pre-survey notification e-mail, under the signature of each university's respective graduate school dean and Vice Chancellor for Research, to prospective participants to introduce the survey and indicate they would be contacted. The e-mail survey was then sent over approximately a 4-week period with weekly follow-ups occurring up to the point at which the individual responded or the survey period was closed. An additional follow up was added as the survey period extended into the holidays, therefore an additional follow up occurred at the end of the winter break. The invitation and follow-up e-mails included a URL link to the survey and provided respondents with a unique personal identification number to protect privacy and to ensure that the intended respondent completed the questionnaire.

Instrument

SOuRCe began as a 32-item survey designed to assess an individual's perception of the organizational climate for research integrity both in one's general organizational setting and in one's specific affiliated department or division. Exploratory and confirmatory factor analyses yielded seven scales of organizational research climate, all of which demonstrated acceptable internal consistency (Cronbach's α ranging from .81 to .87) and adequate test–retest reliability (Pearson's r ranging from .72 to .83). SOuRCe has also demonstrated predictive validity, showing that SOuRCe is predictive of self-reported research behaviors (Crain et al., 2013). The final validated version of the SOuRCe contains 32 items, 28 items comprising seven scales, two institutional scales and five departmental level scales and 4 items assessing global perceptions of RCR (Table 3).

Table 3		
Scales	#Items	Measure of Perception
Institutional Level Scales		
The Responsible conduct of Research (RCR) Resources scale	6	Effectiveness and accessibility of RCR educational opportunities & resources.
Regulatory Quality scale	3	The degree to which regulatory committees treat researchers fairly and with respect, and understand the research they review.
Department or Graduate Program Level		
The Integrity Norms scale	4	The extent to which scholarly integrity is valued in the department/program
Integrity Socialization scale	4	The departmental commitment to effective socialization of junior researchers
Advisor–Advisee Relations scale	3	Fairness, respect, and the availability of advisors
Integrity Inhibitors scale	6	Extent to which conditions produce negative effects in a department/ program.
Departmental Expectations scale	2	Impact of departmental expectations on publishing and obtaining external funding

Assessment of Global Perceptions		
Institutional environment	2	Global perception of the institutional environment
One's dept./program	2	Global perception of one's department/program.

SOuRCe items were rated by respondents using a 5-point scale: (1) not at all (2) somewhat (3) moderately (4) very (5) completely. A 6th option is offered, "no basis for judging, for respondents who have no response about a specific perception.

Data Collection

The SOuRCe was administered via REDCap as an online, web-based survey. REDCap is a secure web application for building and managing online surveys and databases. REDCap can be used to collect virtually any type of data (including 21 CFR Part 11, FISMA, and HIPAA-compliant environments), and is specifically geared to support online or offline data capture for research studies and operations.

On the recommendation from reviewers a qualitative interview was

added, Research question #3 was addressed through qualitative interviews conducted with the Vice Chancellors of Research representing each of the four system campuses. An interview guide was developed, and interviews were conducted by zoom. Topics included; how do you view research integrity, pressures of meeting research and scholarship expectations, how university polices support research integrity, what are the pressures of achieving sufficient research productivity both on the system and on individuals within the system, what do you see as the metrics for research productivity, have you perceived COVID has affected research integrity, and how do you perceive that the additional pressure of maintaining AAU status at one campus affects researchers/departments across the system.

Data Management

Survey data was managed within REDCap. Scores were only computed for individuals who provided valid scores for at least half of the items for a given scale. Responses were not analyzed when the respondent gave the same response for every item. This type of response was not useful to the analysis because they do not reflect answers that are based on the respondents' true feelings or behavior (Piedmont, 2014).

Data Analysis

The analysis utilized univariate and multivariate approaches. Frequency distributions of status (e.g., faculty, postdoctoral, graduate students) were reported. The mean, standard deviation, and reliability coefficients for each of the integrity scales were calculated overall, by university, and then by broad fields of study and narrow fields of study. Since factors were nested within others, a multivariate hierarchical, fixed effects analysis of variance using, General Linear Model in SAS with the integrity scales as the

outcome variable was used to estimate effects, variance, and tests of significance. Hierarchical modeling allowed for an estimate of main and interaction effects of the classification variables (e.g., narrow and broad field of study). Each variable was added to the model sequentially; the climate scale was be broken down into components that attribute to status including broad field of study, narrow field of study, and department or program. We analyzed the interactions between status and the hierarchical variables broad field of study, narrow field of study, and department/program to account for possible differences in responses to the scales that may have attributed jointly to individual status and affiliated organizational subunit. Explanatory factors that were not statistically significant were omitted from the model.

After hierarchical modeling of main and interaction effects of the classification variables, the models were refitted, which included a random university and department within university effect. The fixed factors were university status, age, ands, sex to better partition errors thus eliminating potential bias and type I error. The interclass correlation coefficient (ICC) was calculated to identify how much of the variation was due to campus, to establish if campus should be included in the model. Based on the results, campus was not included in the model. All models excluded the system (which has no department) and missing department responses.

Human Subjects Involvement and Characteristics

Researchers, research faculty and graduate students from each university of a multi university system were invited to participate in the online SOuRCe survey, a census approach was taken to invite study participants. We anticipated inviting approximately

18,400 participants over four universities, but this was an overestimate and ultimately 13447 e-mail invitations were sent.

	UMSL	S&T	MU	UMKC
Anticipated number recruited	1568	1434	12,700	2653

Participants were informed that the survey would take approximately 5 minutes to complete online. The research was exempt under category 2 of the Common Rule, 45 CFR 46. This research includes interactions involving survey procedures, where the following criteria was met:

(i) The information obtained is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained, directly or through identifiers linked to the subjects.

Source of Materials

The research data was collected via online survey, obtained under a license granted by Dr. Carol Thrush. The URL and a unique personal identification number was provided potential respondents, and up to four reminders were sent in follow-up to those who had not responded. The results were not identifiable to individual participants. Data was stored and analyzed within REDCap. Analysis was completed using SPSS.

Potential Risks

The anticipated physical, financial, legal, and other risks to participants was low. Although the purpose of the study was to evaluate how research integrity operated and was fostered within and among institutions all participants were informed that their participation was voluntary and that their data would be kept confidential.

Recruitment and Informed Consent

Each university provided a list of e-mail addresses and names of faculty, research scientists, postdoctoral researchers, and graduate students, which was then used to send a pre-survey notification e-mail, under the signature of each university' respective Graduate School dean and the System President for Research and Economic Development, to prospective participants to introduce the survey and indicate they would be contacted. The e-mail survey was sent out with an e-mail invitation and follow-up e-mails explained the study and included a URL link to the survey. Each respondent had a unique personal identification number to protect privacy and to ensure that the intended respondent completed the questionnaire. The survey remained open for a 4-week period with weekly follow-ups occurring to the point at which an individual responded, or the survey period closed. The collection period extended into the holiday, and it was decided to extend the collection period with an additional follow-up at the end of the winter break.

A census approach to sampling was used. This approach used the entire population as the sample. In a census, data are collected through complete enumeration, hence the sample size is equal to the population size. A census eliminates sampling error and provides data on all the individuals in the population (Singh & Masuku, 2014).

Protection Against Risk

Participants were given unique identifier to assure to protect privacy and assure that the intended respondent and no one else completed the survey. The cover letter on the survey explained to participants the voluntary nature of taking the survey and answering questions, along with the information that their data would be kept

confidential. All related study data were kept either in locked file cabinets or password protected files accessible only by the PI.

Potential Benefits to the Participants and Others

The benefits to be attained through the administration of this survey were twofold, first to better understand how research integrity operates and is adopted both within and among institutions. Secondly the information provides insight into how to manage research quality through the evaluation of ethical organizational research climates. This information allows the institutions to identify where change would be beneficial, target interventions to specific issues or needs and be able to evaluate the effectiveness of interventions.

Project Management

The PI had day-to-day responsibility for the conduct of this project. The PI is the Institutional Official and Research Integrity Officer. In this role the PI is committed to the evaluation of research integrity and the opportunity to determine where targeted educational activities might be needed and what role the organization fills in promoting research integrity. In addition, the PI, prior to conducting the project assured that all collaborators had the required responsible conduct of research training. All compliance trainings are managed within an electronic submission system. Dr. Jeni Hart, as Dean of the Graduate School and Vice Provost for Graduate Studies, brings a perspective on academic climate and the significance of responsible conduct of research in academics. Dr. Lori Popejoy provides expertise on systems management and brings a wealth of research experience to the project. These collaborations helped to assure that the goals

were met, and the knowledge attained from this project is contributory to the field of research integrity.

Environment

Research Environment and Support

The University of Missouri (UM) is one of the nation's largest higher education institutions, with more than 73,000 students on four universities, a health care enterprise, and an extension program with activities in every county of the state. Comprised of four universities in Columbia, Kansas City, Rolla, and St. Louis – each with their respective strengths – together these institutions form one single system with a common vision of excellence in teaching, research, and engagement. In addition to its four universities, the UM System is comprised of a statewide health care system, multiple research parks and incubators, agricultural research stations, and a vast network of Small Business & Technology Development Centers, Extension Centers, telehealth network sites, and MoreNet sites. Projected FY 2018 research expenditures for the UM System total $313,497,689 with $249,178,098 in federal research expenditures.

Research Computing

Robust research computing, technology resources, and security protocols are in place to support research activities across the universities.

University of Missouri-Columbia (MU)

Research Environment and Support

Located in Columbia, Missouri, the University of Missouri (MU) is the flagship university of the University of Missouri System. MU is a major land-grant institution and is Missouri's largest public research university. Considered one of the nation's top-tier

institutions, MU has a reputation of excellence in teaching and research and is the largest university of the four-university University of Missouri System. MU offers more than 300-degree programs among its 18 colleges and professional schools and has a total enrollment of more than 33,000 students. MU is designated "Highest Research Activity" by the Carnegie Classification of Institutions of Higher Education and is a member of the prestigious American Association of Universities (AAU). MU is one of only six universities nationwide with schools of medicine, veterinary medicine, law, engineering, agriculture, and a university hospital all on the same university campus, and MU is one of only 13 universities with both an accredited school of medicine and an accredited college of veterinary medicine. FY 2018 Projected research expenditures at MU are $205,337,845 with over $168,233,692 in federal expenditures.

MU has an outstanding research environment that fosters interdisciplinary and collaborative research efforts. Fundamental to MU's strategic approach to research and education is the premise that solutions to complex issues require multidisciplinary, multi-institutional teams of excellence. Only a handful of other institutions have schools/colleges of veterinary medicine, medicine, agriculture, engineering, and human environmental sciences on a single university. In addition, MU claims the nation's top-ranked School of Journalism, hospital and clinics for clinical trials, the world's most powerful university-based nuclear research reactor, field laboratories, and an agricultural experiment station. Furthermore, MU has an extensive library system that provides over 400 on-line databases, 3.1 million volumes, over 50,000 print and electronic serial subscriptions, and access to a network of libraries that participate in inter-library loans

and special borrowing privileges. This combination of resources offers one of the nation's most responsive, integrative academic environments.

MU offers a myriad of supports and training including grant writers in most colleges as well as department level grants and contracts support. Extensive investigator supports are available, particularly for junior faculty that build intellectual rapport, promote best practices, and facilitate successful research agendas. Research seminars cover a variety of topics including current research trends, grantsmanship, and compliance.

Institutional Environment: Best practices in research are of high priority at MU. There are numerous administrative offices and committees to ensure MU faculty are trained with the most up-to-date knowledge on human subject's research and project management. The MU IRB offers training opportunities and individual consultation to ensure research is conducted in an ethical manner. The MU Office of Research additionally offers nine online modules of instruction in the area of responsible conduct in research. These programs were developed by the Collaborative Institutional Training Initiative and include such topics as Responsible Conduct, Data Acquisition and Management, Conflict of Interest, and Responsible Authorship. The Office of Research also has a Research Integrity Officer who works to foster responsibility in the conduct of university research and scholarship in compliance with federal, state, and university regulations and guidelines. The focus of the Research Integrity Officer is to be a resource for university faculty in their research-related activities through training and technical assistance. The MU Conflict of Interest Committee helps to assure compliance with federal, University, and sponsoring agency policies governing conflict of interest. The committee evaluates

reports submitted by university personnel and provides communication regarding any identified conflicts, appropriate disclosure requirements, and management strategies. Finally, the MU Office of Sponsored Program Administration has a post-award staff of 16 individuals who oversee grant and contract expenditures of over $210 million annually. A full set of standard operating procedures and internal controls are in place to monitor spending and compliance for grants and contracts.

REDCap: REDCap (Research Electronic Data Capture) is a web application created by Vanderbilt University to facilitate data acquisition and management for a wide variety of projects, especially Institutional Review Board (IRB)-approved clinical research and basic research. Data collected during the research are managed by the program and can be analyzed separately by commonly used statistical packages, including SAS, Stata, SPSS, and R.

University of Missouri-St. Louis (UMSL)

Research Environment and Support

The University of Missouri-St. Louis (UMSL) is the only public research university in St. Louis providing high quality and accessible education and research experiences to a diverse student body. Classified by the Carnegie Foundation of Higher Education as a public doctoral university with higher research activity, UMSL is also classified as an engaged university by the Carnegie Community Engagement Classification. UMSL has projected FY 2018 research expenditures of $21,635,145. UMSL has nine colleges and schools and more than 50-degree programs including several nationally ranked graduate programs in Biology, Business, Counseling, Criminology and Criminal Justice, Nursing, and Social Work.

UMSL has a strong core of productive research faculty spread across several departments. Core research strengths include brain science, addiction, mental health, trauma, drug discovery, chemical synthesis, glycoscience, molecular biology, and evolutionary ecology. The institution is home to the region's only cyber security program designated by the National security administration (NSA) and Department of Homeland security as a Center of Academic Excellence in Cyber Defense Education and one of the few veterans and military studies programs.

UMSL has several outstanding resources to support investigator research including a full cycle of grant writing services, technology transfer, university and department peer review, internal seed funding, strong industry relationships and networks, robust opportunities for collaboration with sister universities, a year-long junior faculty mentoring program, and a junior faculty research symposium. UMSL's emerging role as an anchor institution, along with strong community engagement infrastructure through the Des Lee Collaborative Vision that consists of established relationships with over 100 partner and community organizations in the St. Louis region and worldwide provide outstanding opportunities for translating research to practice.

University of Missouri-Kansas City (UMKC)

Research Environment and Support

The University of Missouri-Kansas City (UMKC) is an urban university with 14 schools and colleges, 150-degree programs, and an enrollment of 16,699 students (FY 2015). With a nationally recognized health sciences programs, UMKC is one of fewer than 30 U.S. universities, and the only university in Missouri to have four health sciences education programs (nursing, medicine, pharmacy, and dentistry) located on one

university. This unique environment enhances academic collaboration and emphasizes three of UMKC's missions: 1) to lead in the life and health sciences; 2) to develop a professional workforce; and 3) to collaborate on urban issues and education. UMKC has a robust infrastructure and uses several internet-based communication and information-delivery systems to present instructional content and foster virtual learning communities. UMKC has 2018 projected research expenditures of $30,525,608.

Missouri University of Science and Technology

Research Environment and Support

Missouri S&T, founded in 1870 as one of the first technological institutions west of the Mississippi has approximately 6,800 undergraduate students and 1,800 graduate students enrolled. Missouri S&T has two colleges and 99-degree programs. As the engineering school in the University of Missouri System, Missouri S&T is committed to improving the world through the study and application of advanced sciences and technology.

Research at Missouri S&T focuses on four signature research areas including Advanced Manufacturing, Advanced Materials for Sustainable Infrastructure, Enabling Materials for Extreme Environments, and Smart Living. Multiple interdisciplinary centers, state of the art equipment and technology, and a highly collaborative research environment supports researchers. Projected research expenditures at Missouri S&T include $31,600,130 for FY 2018.

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CHAPTER FOUR

ORGANIZATIONAL IMPACTS ON RESEARCH INTEGRITY

As the primary author, my colleagues and I plan to submit for publication to Science and Engineering Ethics

Abstract

Failure of the scientific research enterprise to adequately define and respond to research misconduct and detrimental research practices constitutes a significant threat to scientific research (National Academies of Sciences, 2017). Lapses in research integrity erode trust in the scientific process and have serious consequences such as potentially reducing funding sources, research subject willingness to participate, and research quality. Recently, there has been a transformation in the ways knowledge is produced and how research is conducted. Research is now a global enterprise resulting in increased competition, pace, and scale, with differing expectations (Zwart, 2008).

A systems approach, looking at the way researchers' actions, perceptions and interpretations shape and are shaped by organizational culture are important determinants in achieving organizational integrity. Previously, the tendency has been to focus on personal ethics and motivations of individuals, but this fails to consider the daily challenges and organizational contexts of most researchers. Using a validated, online survey, SOuRCe, which assesses individuals' perceptions of research climate in the organizations and within departments/programs, 2,183 participants, representing a variety of statuses within the research enterprise across a four-campus university system,

participated in the study. In addition to characterizing differences on the integrity scales across departments, fields of study, and status, I also conducted analyses to investigate differences by status, age, sex, and department within the university. The study provides insight that informs strategies to address research integrity at the organizational level. These strategies may then work toward changing interactions and redesigning systems to produce different behaviors.

Concerns have escalated in recent years about scientific integrity including issues of reproducibility, questionable research practices, and misconduct (De Vries et al., 2006; Martinson et al., 2005; National Academies of Sciences, 2017; National Science Foundation, 2017; Phillips et al., 2018; Titus et al., 2008). These concerns raise questions as to how integrity challenges in contemporary research can be effectively addressed in increasingly complex, integrated, and costly systems (National Academies of Sciences, 2017; National Science Foundation, 2017; Phillips et al., 2018). Investment in the modern research enterprise exceeded $656 billion in the United States for 2019 (National Center for Science and Engineering Statistics, 2021) and included (a) universities and other research organizations that educate, employ, and train researchers; (b) government, foundation, and industry sponsors of research; and (c) publishers. The complexity of the research enterprise calls for a shift in perspective from a focus on individual researchers, to an emphasis on social and organizational structures that influence how researchers conduct their research (Breit & Forsberg, 2016; Paine, 1994; Zwart, 2008). This recognizes research is conducted as part of a larger social enterprise or system and is linked with notions of organizational culture (Breit & Forsberg, 2016; National Academies of Sciences, 2017). The modern research environment requires that we take into account the daily challenges and organizational contexts of researchers (Zwart & Ter Meulen, 2019).

The current state of scientific ethics is based on the premise that research is carried out by individual, autonomous persons who have responsibility for their own research and make their own decisions (Zwart, 2008). Therefore, there is a tendency to focus integrity conversations on individual ethics and the motivations of individuals

(Paine, 1994; Zwart & Ter Meulen, 2019). In contemporary practice, research is highly dependent on teamwork and collaboration leading to mutual dependence and is often carried out by interdisciplinary and/or international teams comprised of large networks of researchers (Zwart, 2008). This change in research practice has moved research ethics away from being a personal issue into an organizational issue. Acknowledgement of the local organizational context, which recognizes that researchers' actions, perceptions, and interpretations shape and are shaped by organizational culture, will lead to better understanding of contemporary research misconduct.

In systems thinking, the focus is not on individuals as objects of improvement, but on the interrelationships, communications, ongoing processes, and underlying causes of behavior of these individuals, to change interactions and/or redesign systems to produce different behaviors. Ethical accomplishments or failures result from the complexities of multiple individuals composing the system (Silverman, 2000). Senge (1990) described systems thinking as concerned with the interrelationships, structures, and processes that control and monitor behavior of a system, which is an interdependent group of items, people, or processes with a common purpose. Organizations shape individual behavior through culture, structure, and processes. Organizational integrity is then achieved through the culture, with the underlying values that drive decisions and climate as part of the organization's infrastructure (Silverman, 2000).

Both organizational culture and climate address the ways in which an organization's members make sense of their environment (*Organizational Climate and Culture*, 1990). Organizational cultures are seen as systems of shared meanings, assumptions, and underlying values that drive decisions for that organization.

Organizational climate is a manifestation of the organizational culture; infrastructure; and shared perceptions of organizational policies, practices, and procedures (Schien, 2017). The culture and climate of organizations are influenced by the quality and responsiveness of their systems. An organization is a common platform where individuals from diverse backgrounds come together and work as a collective to achieve certain objectives and targets. An organization consists of individuals with different specializations, educational qualifications and work experiences all working towards a common goal (Ashkanasy et al., 2000). Within the academic system we are looking at in this study each campus will be identified as an individual organization.

Response to failures within an organizational infrastructure should first be focused on faulty systems and processes, not on individuals. The application of systems theory to the research enterprise would improve the integrity of the research process by continuously monitoring the structures and processes that influence ethical behaviors (Silverman, 2000). In this manuscript are reported the findings of a study describing the perceived research climate differences within and across higher education organizations to assess the organizational climate of research integrity within and among those organizations embedded in a common system.

Methods

Design and Setting

This is a cross-sectional study of four campuses of a multi-campus academic system to assess how research integrity operates within organizations, while comparing perceived differences in research climate across organizations and across subunits between organizations. The university system is composed of four universities, a health

system, and an extension division. Participating universities ranged from annual enrollment of 7,700 to 31,000 and annual research expenditures of $4.7 to $355 million. Universities A and D serve large urban areas, university C is in a rural area, and university B is in a city. One of the universities is an Association of American Universities (AAU) member.

Survey Design

The Survey of Organizational Research Climate (SOuRCe) (see Supplement 1 & 2) is a 32-item survey, with 7 subscales comprised of 28 items. The additional four items not included in the subscales include two assessing global perceptions of respondent's department or program and two items assessing global perceptions of the organizational environment (Table 4). This survey was designed to assess an individual's perception of the organizational climate for research integrity both in respondents' organizational setting and within affiliated departments or program.

Part 1 of the survey contains a series of 11 questions focused on the perceptions of research climate in the organization. Part 2 contains 21 questions answered about respondent's primary program or department. Each section begins with two questions about the respondent's perceptions of their department and the organization regarding 1) commitment to maintaining standards of research integrity, and 2) the degree to which the overall climate of integrity values responsible conduct of research (RCR). All items of the survey are rated on the following five-point scale: 1) not at all 2) somewhat 3) moderately 4) very 5) completely, and a 6th option 'no basis for judging'.

A series of classification questions was added to the beginning of the survey to facilitate analysis. These demographic items included university, department or program

respondents are most closely affiliated with, status within the department or program, age range, sex, and race/ethnicity. A preliminary question was asked to determine whether the respondent was engaged in research sufficiently to continue the survey, thus avoiding situations where there was insufficient experience with the research climate to participate in a meaningful way. The mean scores for fields of study represented by fewer than three departments were redacted to maintain departmental and organizational confidentiality. For additional insight not previously captured within the survey, a free-text comment field was included.

The instrument has demonstrated internal consistency and test-retest reliability (Crain et al., 2013). Previous analysis (Crain et al., 2013) showed acceptable internal consistency (Cronbach's α ranging from .81 to .87) and adequate test-retest reliability (Pearson's *r* ranging from .72 to .83). Wells et al. (2014) demonstrated the survey is a feasible tool to collect research integrity climate information in large academic settings, across abroad ranges of fields of study, department types, and individual roles within those academic units.

A qualitative aspect to the study was added and, using purposive sampling, I emailed each campus's research administrator. X number agreed to participate. I then interviewed them using Zoom and audio recorded and transcribed the interviews Interviewees represented each campus in the university system. The purpose of the interview was to explore the question of pressure brought to bear on researchers, including external pressure through maintenance of AAU status, Carnegie classification, and other ranking systems. AAU membership is evaluated on factors including competitively funded research expenditures, National Academy memberships, faculty honors, and scholarly citations. The Carnegie classification and other ranking systems serve a

frameworks for classifying colleges and Universities. There is diversity in what rankings set out to measure, but the ranking industry has become highly influential in higher education (O'Meara & Meekins, 2012). Other focused interview questions were aimed at further exploring areas that influence research integrity across organizations and the departments within organizations. Additional interview questions included:

- What does research integrity mean to you, especially in your role with the organization?
- What are the pressures of meeting research/scholarship expectations on the system?
- How do you perceive COVID's influence on research integrity?
- How do you see the additional pressure of maintaining AAU status (at one campus) and other national rankings affecting researchers/departments?

Study participants. A total of 13,447 research personnel were invited to participate in the optional, anonymous, Web-based survey using the Research Electronic Data Capture (REDCap) application (Harris et al., 2009). A census approach was used to invite study participants (Singh & Masuku, 2014) and each university's human resource office generated a comprehensive listing of participants to be surveyed. This comprehensive list included all graduate students, faculty, postdoctoral scholars, and other research personnel. The list was used to send a pre-survey notification e-mail (see Supplement 3 & 4), under the signature of each university's respective graduate school dean and research administrator, to prospective participants to introduce the survey and indicate they would be contacted. The e-mail survey was then sent out and responses were collected over a four-week period (see Supplement 5). Weekly follow-up reminders occurred up to the point the

individual responded, or the survey period was closed (see Supplement 6). The invitation and follow-up e-mails both included a URL link to the survey and provided respondents with a unique personal identification number to protect privacy and ensure that the intended respondent completed the questionnaire. Institutional Review Board (IRB) approval was obtained prior to initiation of the study.

Interviews were conducted after explaining the study and obtaining consent to conduct and record the interviews via zoom (see Supplement 7& 8). The five interviewees represented a diversity of backgrounds and administrative experience. All five interviewees come from STEM backgrounds, four had previous administrative experience. Two interviewees have more than 30 years of experience with their respective organization; the others have been with the organization less than 10 years. All have been in their research administration role with the organization less than 5 years.

Analysis. Only completed surveys were analyzed; completed refers to nonmissing data with a date or the result is not completed. Frequency distributions of status (e.g., faculty, postdoctoral, graduate students) were reported. The mean, standard deviation, and reliability coefficients for each of the integrity scales were calculated overall, by university, and then by broad and narrow fields of study. As outlined in Wells et.al. (2014), a multivariable hierarchical, fixed effects analysis of variance using General Linear Model in SPSS was conducted for each of the seven SOuRCe scales as the outcome variable. Hierarchical modeling allowed for an estimate of main and interaction effects of the classification variables (e.g., narrow, and broad field of study). Each variable was added to the model sequentially; it was assumed that the climate scale was broken down into components that attribute to status, including broad field of study,

narrow field of study, and department or program (Wells et al., 2014). The interactions between status and the hierarchical variables broad and narrow field of study, and department/program were analyzed to account for possible differences in responses to the scales that may have attributed jointly to individual status and affiliated organizational subunits. Explanatory factors that were not statistically significant were omitted from the model.

Separate, nested models were fit, to include a random university and department-within-university effect. This was done to better partition errors, to reduce potential bias and type I error. The fixed factors included in this nested model were university status, age, and sex.

The interclass correlation coefficient (ICC) was calculated to identify how much of the variation was due to individual organizations (campuses) within the system to establish if individual organizations should be included in the final model. Based on the results, organizations were not needed in the model. All models excluded the university system administration (system), which has no departments, and those missing department responses. The mean scores for fields of study represented by fewer than three departments were redacted to maintain departmental and organizational confidentiality.

Data from the free-text comment field of the survey were categorized, looking for similar words or concepts. Grouped text were further categorized by status, sex, and university. Comment organization and analysis was performed using Microsoft Excel (2021).

The qualitative analysis of the research administrators' interview transcripts was done using a conventional content analysis approach, first by reading through each

transcript, followed by developing thematic categories based on the text, and finally grouping the categories thematically. Dedoose
8.0.35 a web application for managing, analyzing, and presenting qualitative and mixed method research data was used to organize and analyze interviews and open text responses.

Results

Respondents

A total of 4,653 responses were returned (response rate 35%) of those 2,183 (16%) had countable responses to scale questions. Respondents represented graduate students, postdoctoral fellows, faculty, and other research personnel (Table 5). Most respondents were from University B (*n*=1275, 53.9%). Faculty made up the majority of respondents (*n*=1045, 44.9%) and 34.5% (*n*=804) were graduate students. Of the respondents, the greatest percentage fell within the 25-34 age group (*n*=701,18.6%). There were 1,199 male respondents (51.1%) and 1,083 female (46.2%). Respondents came from a variety of departmental units across the four universities (*n*=245). For analysis, these departments were aggregated into 11 broad and 51 fine fields of study as defined by the Council of Graduate Schools/Graduate Record Exam (CGS /GRE) Survey of Graduate Enrollment and Degrees (Okahana & Zhou, 2018).

Perceived Research Climate Differences

The number of respondents, mean scores, standard deviations, and reliability for each of the seven integrity scales are shown in Table 6. The sample size for Regulatory Quality is slightly lower; this scale reflects interactions with regulatory committees such as the IRB and Institutional Biosafety Committee (IBC). Since not all researchers use these services, the sample size would be expected to be smaller, as also noted by Wells et al. (2014). Scales are scored from 1 to 5, higher scores indicate better climate. Mean scores ranged from 4.16 on integrity norms to 2.67 on integrity inhibitors, indicating that overall respondents in the organizational subunits reported that the climate reflected value for scholarly integrity yet, certain conditions produced negative effects in the organizational subunits.

The number of respondents, and percent distribution for respondent location and broad field of study for each scale are represented in Table 7. University representation by respondents ranged from approximately 15% from organization A, 54% from organization B, 15% organization C, 10% organization and 6% organization E. The largest responses among the broad fields of study were biological and agricultural sciences (approximately 19%), followed by health and medical sciences (18%) and engineering (17%).

The seven SOuRCe scales are also represented by location of respondent and broad field of study. Among locations, Organization E had the greatest mean scale scores on all scales except Integrity Inhibitors; second was University B, which also had the largest percentage of respondents.

Among broad fields of study, business had the highest mean score on three of the seven integrity scales: Advisor-Advisee Relations, Departmental Expectations, and

Integrity Socialization. Arts and Humanities had the lowest scores on three of the scales: Responsible Conduct of Research (RCR) Resources, Regulatory Quality, and Integrity Inhibitors. No single field of study scored consistently across all scales. The number of cases and percent distribution of field of study within broad field of study are represented in supplement 9. The mean score indicates that the field of study is a factor in explaining variance in the model.

The percent variance attributable to the each of the classification variables and their interactions are represented in Table 8. For each scale, an analysis of variance (ANOVA) model is used, the decomposition is hierarchical. The results are shown for each of the SOuRCe scales in the column labeled R^2 Increment. The Total at the bottom of the column is the total variance explained for each scale. These range from a high of 13.4% for Regulatory Quality to a low of 7.0% for Departmental Expectations. Not all effects were statistically significant, non-significant interactions were omitted by the model and are indicated by N/A. The variance explained by department/program is larger across all the SOuRCe scales ranging 52 % for RCR Resources to 73.9% for Advisor-Advisee Relations, accounting for more than half of the variance explained in each of the SOuRCe scales. While variance attributable to status ranged from a low of 5% for Advisor-Advisee Relations to a high of 24% for RCR Resources. The attributable percent explained by broad field of study ranged from 4.6% for Departmental Expectations to a high of 24.5% for Integrity Inhibitors. Fields of study ranged from 9% for Integrity Socialization to 16.7% for Regulatory Quality.

In the re-fitted model (Table 9) the Intraclass Correlation Coefficient (ICC) indicates that the University/Campus has minor impact across all the scales. None of the scales indicated difference by university but differed by status, age, sex, and department

within the university. Department continues to be significant, having significant impact on five of the seven SOuRCe scales. Status had significant impact on four of the seven scales, Integrity Socialization, $p < 0.0001$, Department Expectations, $p = 0.021$, RCR Resources, $p < 0.0001$, and Regulatory quality, $p < 0.0001$. Age and sex each had significant impact across three of the seven scales. Integrity Norms, $p = 0.0006$, Advisor/Advisee relations, $p = 0.026$, and RCR Resources, $p = 0.005$, were affected by age, while Integrity Socialization $p = 0.023$, Departmental Expectations, $p = 0.018$, and RCR Resources, $p = 0.007$ were affected by sex. RCR Resources scales were affected by status, $p < 0.001$, age, $p = 0.005$, sex, $p = 0.007$, and department within university, $p = 0.021$.

Free-text Results. Four hundred sixty-two (21%) chose to provide comments, of those, 391 (18%) had substantive, categorizable comments. The remaining accounted for responses of, yes, no, nothing more to say. Males represented 50% of respondents, 44% were female, 6% chose not to disclose. Graduate students represented the most comments (n=146, 32%) with tenured faculty representing 31% (n=145) of the comments. Figures 2-4 depicts the responses representative of sex, status, and campus.

Table 10 breaks down the comments into components and Figure 3 demonstrates the distribution of comments by status within the organization. Most comments fell into the resources (n=27), support (n=74), funding (n=35) components, depicting issues of both lack of support and funding to meet research productivity goals. Advising/mentoring

was also mentioned (n=39) primarily by graduate students (n=26), comments indicated a lack of mentors for junior faculty and variability in quality of mentors. Leadership (n=27) and communication (n=13) issues were also raised. Respondents identified that communication between levels of the organizations was inconsistent and there were perceptions that there were substantial gaps between messaging and practice in upper-level leadership at the school and campus level.

Interviews

From the interviews thematic categories were developed based on the text. Two overarching themes were identified: research integrity and the various pressures that are brought to bear in the current research climate. These themes were further broken down, revealing issues such as training, pressures to produce, workload, and pressures of the tenure process.

Research Integrity

Several interviewees mentioned that while training occurs with certain groups where it is required, earlier ethics training, especially at the undergraduate level would be a good idea. One commented that, "…it's much better now than it used to be, but it's still a long way from where we should be acting." (Interviewee E). Regarding research integrity, it was commented that, "research integrity is important, we must maintain our public trust." (Interviewee A).

Pressure in the Current Research Climate

Another interviewee commented, "Until ranking doesn't matter, and until ranking agencies change their criteria, we need to focus on that." (Interviewee C). Another commented that AAU status is a matter of excellence. Others addressed how scholarship is measured, "Science is becoming a lot more international; I know that

we're not really measuring that right now." (Interviewee C). The criteria (for

tenure) to me, have to be more, have to be broader than just papers or a single R01 equivalent grant." (Interviewee E).

It was acknowledged that significant pressures exist within the higher education research enterprise. "When you have people whose salary or their promotion is based on productivity and so in each of those circumstances, people will do things that they may not normally do based on what I would call external pressures" (interviewee B). Another interviewee pointed out that all pressure is not negative. "I see the pressure is the great pressure people work better under some kind of a pressure, to maintain our highest standard we are not only training students, but we are also training workforce for the next generation, so how to train them to really work." (Interviewee A).

Tenure and the pressures around criteria and timeframe to achieve tenure were raised as concerns. Research and scholarship are the primary measures for tenured faculty success and so obviously the pressure is there to produce." (Interviewee D). "…as I mix with other colleagues, especially in the social sciences, you can see the value to two different approaches to scholarship." (Interviewee D). "It's still difficult during the pre-tenured years, I really think our clock is too short." (Interviewee E). Given the depth and breadth of comments, representative quotes for each of the key elements are displayed in Table 11.

Discussion

Research misconduct has been a focus and topic of conversation for some time. In 1992, (National Academy of Sciences (US) et al., 2002 (National Research Council), and followed up in 2017 (National Academies of Sciences), extensive high-profile reports were produced outlining background, theory, and recommendations for the promotion of

research integrity. For example, a consensus study report published by the National Academies of Sciences, Engineering, and Medicine (2017) reported that the environment in which researchers are educated, socialized, and perform their work needs significant attention. This study addressed this call for research and assessed the organizational climate of research integrity across a diverse multi campus system.

This study established that research integrity is significantly influenced at the departmental (subunit) level. The variance explained by department/program was larger across all integrity scales, accounting for more than half the variance explained in each of the SOuRCe scales. This indicated that focus of initiatives aimed at improving research integrity should be targeted at the level of the department/program. This also provides an opportunity to examine more closely those departments with high scores to identify processes that may account for the differences. This would best be accomplished through a qualitative approach, which would offer insight, while better being able to explore the complexity and relationships at the department/program level. Understanding what components are more influential in departments with cultures embodying research integrity can provide insight into developing a framework for education, training, and process improvement. Across departments there was wide variability in integrity scores, the mean overall scores therefore can be inferred to provide only a part of the picture. A full picture necessitates drilling down to a departmental level. A high mean score on norms of integrity is reflective of value for scholarly integrity, acknowledging the work of others, and valuing honesty in the conduct of research. While the low score on integrity inhibitors indicates there are conditions within the organizational units producing negative effects. These include difficulties in conducting responsible research

due to lack of resources, pressure to obtain funding, pressure to publish, and competition among researchers. These difficulties were also reflected in the comments received, with 35% of comments falling into those categories of concern. Yet, identifying the root cause of the concerns requires looking beyond the broader organizational environment to the level of the department.

This study also reaffirmed findings from previous works that most of the variability to be explained in research integrity climates can be explained at the department/ program level (Wells et al., 2014). There was no consistency across fields of study or status within the organizations. Replication of these findings was important in confirming the applicability of this tool, SOuRCe, across multiple academic settings, and with a variety of statuses. This raises the confidence in how to develop future initiatives. Replication of these findings reaffirms the proposition that misbehavior in research, from questionable research practices to research misconduct, requires an acknowledgement that the local organizational context matters when setting upper-level administration expectation about behavior.

These findings support the need to develop interventions tailored at the departmental level aimed at improving research integrity. The 'one size fits all' mechanism of delivery of responsible research education and training needs to be reconsidered based on these results. The SOuRCe survey provides a tool that can be used to measure climate over time and the impact of interventional efforts. In addition to the opportunity for measures of quality improvement it also provides direct correlation to questionable research practices and research misconduct (Crain et al., 2013). This

feedback can be used to develop and target educational efforts for responsible research, targeted both for content and audience.

The study, by refitting the hierarchical model, identified age and sex to have significant impact on the climate scales. These findings require further exploration as to the effect of age and sex on pressure and increased risk for research misconduct. Studies have been inconclusive when looking at risk factors for research misconduct, such as age, sex, and pressure to publish (Fanelli et al., 2017; Fanelli et al., 2022; Fang et al., 2013; Kaatz et al., 2013). The pressure to perform is becoming more intense (Paruzel-Czachura et al., 2020; Tijdink et al., 2014) Further research is needed to determine the exact nature of the interrelationship of demographics such as sex, and age and modern academic pressures (Malisch JL et al., 2020).

As the research environment becomes increasingly global and competitive, there are subsequent increases in pace, scale, and focus on quantity over quality (Zwart & Ter Meulen, 2019). All of which call for additional mechanisms to address research integrity and the challenges inherent in today's research environment. Living in the era of rankings raises additional questions as to the pressures brought to bear on the research enterprise. Metrics, once a measure of performance, have become an end in their own right (Fischer J et al., 2012). Interviews substantiated the concerns around meeting research and scholarship expectations for researchers. Issues such as pressures to produce, relatively short tenure timelines, research productivity guidelines, and maintenance of federal extramural funding were identified as resulting in significant pressures for investigators. Discussion on the impact of competition on research integrity has begun, Anderson (2008) found that those researchers identifying their fields as highly competitive were

more likely to engage in questionable research practices, including misconduct as defined by federal regulation. Likewise, Tijdink et al. (2014) found that half the scientist in their study reported that the competitive environment led them to publish more articles, but that the publication pressure was detrimental to the validity of the scientific literature. Fang et al. (2015) suggests a more collaborative and cooperative scientific culture is needed. Future work needs to move from the singular focus on individuals to more global interventions strategy that involves the environments in which researchers work. To continuously improve the research integrity of the scientific enterprise will require more vertical solutions that cut across all levels of the organizations.

Free text comments revealed substantive issues of organizational climate that can provide a springboard for further study. Further evaluation of those comments may identify not only future areas of study but also opportunities to improve the system. These comments provide deep insight to guide future interventions to improve research integrity at the division and organization level. The interviews added further insight regarding factors within and external to the research organization that impact research integrity. The importance of training in research integrity and the pressures that come from funding, workload, and criteria for tenure were all highlighted as concerns.

Limitations

Several limitations are identified with this study. Certainly, timing within the academic calendar may have played a role in the response rate. The study collection period coincided with holidays and a holiday break. It also coincided with the COVID pandemic, which required that in person interviews be converted to zoom. This may have potentially affected the quality of dialogue. While zoom facilitated the interview process,

for safety and timeliness during COVID, they may have been more effective as in person conversations. The interviewees were selected because of their intimate knowledge of the research environment, this expertise lent to content that was able to add to the study in a substantive way. Another potential limitation is the generalizability of the study. The sample came from a single system within a state with geographical and socioeconomic diversity. The results for Organization E represent the organizations system administration, which has no departments. It is possible that some participants identified this as their department because of concerns over confidentiality even with assurances that responses would not be tied to individuals. This study also had unique strengths. The first is the ability to benchmark across other organizations utilizing data being collected from the SOuRCe survey at The National Center for Professional and Research Ethics (NCPRE) at the University of Illinois at Urbana-Champaign.

Conclusion

New strategies to support research integrity in academic research environments must be considered as we face major transformation in the way knowledge is produced and research is conducted. This study examined the perceived research climate differences within and across higher education organizations to assess the organizational climate of research integrity within and among those organizations to address what interventions are best utilized to improve research integrity and preserve the public's trust in the research enterprise. Understanding the complexities of the research enterprise through a systems lens that looks at how organizations shape individuals' behavior and identifying system changes to strengthen integrity may create a research culture that fosters and does not impede research integrity. For that to occur, we need to consistently

assess the research climate, identify gaps, and provide interventions that are meaningful and sustainable to the current research environment. Without continued attention to the actual problem and with proforma interventions without evaluation, we stand to reinforce this conversation for decades to come to the detriment of science and society.

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Table 4

SOuRCe Survey Scales

Scales	Subscales	#Items	Measure of Perception
Assessment of Global Perceptions (frame of reference)	Institutional environment	2	Global perception of respondent's organization
	Dept./program	2	Global perception of respondent's department/program.
Department or Graduate Program Level	The Integrity Norms scale	4	The extent to which scholarly integrity is valued in the department/program
	Integrity Socialization scale	4	The departmental commitment to effective socialization of junior researchers
	Advisor–Advisee Relations scale	3	Fairness, respect, and the availability of advisors
	Integrity Inhibitors scale	6	Extent to which conditions produce negative effects in a department/ program.
	Departmental Expectations scale	2	Impact of departmental expectations on publishing and obtaining external funding
Institutional Level Scale	The RCR Resources scale	6	Effectiveness and accessibility of RCR educational opportunities & resources.
	Regulatory Quality scale	3	The degree to which regulatory committees treat researchers fairly and with respect and understand the research they review.

Note. The four global items are not included in scale computations.

Table 5

Respondent Demographics

Age group	**Frequency**	**Percent**
18-24	208	5.53
25-34	701	18.63
35-44	499	13.26
45-54	437	11.61
Over 55	498	13.23
Total	2343	62.26
System	1420	37.74
Total	3763	100
Sex	**Frequency**	**Percent**
Male	1199	51.11
Female	1083	46.16
Prefer not to say	58	2.47
Other	6	0.26
Primary location	**Frequency**	**Percent**
Organization A	350	14.79
Organization B	1275	53.89
Organization C	350	14.79
Organization D	238	10.06
Organization E	153	6.47
Primary employee/student status.	**Frequency**	**Percent**
Graduate student	804	34.51
Postdoctoral Trainee/ Research assoc.	116	4.98
Faculty, not TT	332	14.25
TT Faculty, not Tenured	182	7.81
TT Faculty, Tenured	531	22.79
Research Personnel	365	15.67
Race	**Frequency**	**Percent**
White	2266	60.22
Black/ African American	133	3.53
Asian/Asian American	485	12.89
Hispanic or Latinx	104	4.47

Table 6

Number of Cases, Mean Scores, Standard Deviation, and Reliability by Integrity Scale

	Integrity Norms	Integrity Socialization	[Lack of] Integrity Inhibitors	Adviser Advisee Relations	Departmental Expectations	RCR Resources	Regulatory Quality
n of cases	2158	2108	2101	2118	2105	2213	1613
M	4.16	3.62	2.67	3.94	3.8	3.77	4.05
SD	0.8	0.99	0.72	0.89	0.97	0.91	0.82
Reliability (α)	0.872	0.884	0.519	0.886	0.818	0.903	0.865

Table 7 *Number of Cases, Percent, and Mean Integrity by University and Broad Field of Study*

	Integrity Norms			Integrity Socialization			Integrity Inhibitors		
	N	%	MEAN	N	%	MEAN	N	%	MEAN
Location									
Organization A	323	15%	4.13	317	15%	3.56	325	16%	2.67
Organization B	1160	54%	4.2	1122	53%	3.65	1114	53%	2.60
Organization C	320	15%	3.93	324	15%	3.51	321	15%	2.91
Organization D	214	10%	4.26	209	10%	3.56	206	10%	2.57
Organization E	136	6%	4.34	130	6%	3.92	129	6%	2.76
Total	2153	100%		2102	100%		2095	100%	
Broad Field									
ARTS & HUMANITIES	116	6	4.22	113	6%	3.57	120	6%	2.35
BIOLOGICAL & AGRICULTURAL SCIENCES	379	19	4.12	372	19%	3.63	369	19%	2.65
BUSINESS	59	3	4.36	56	3%	3.84	54	3%	2.49
EDUCATION	149	7	4.27	149	8%	3.64	143	7%	2.6
ENGINEERING	347	17	3.94	343	17%	3.53	336	17%	2.97
HEALTH & MEDICAL SCIENCES	349	17	4.26	334	17%	3.7	328	17%	2.57
MATHEMATICS & COMPUTER SCIENCE	89	4	4.04	91	5%	3.4	89	5%	2.76
PHYSICAL & EARTH SCIENCES	159	8	4.08	161	8%	3.67	166	8%	2.62
PUBLIC ADMIN. & SERVICES	20	1	4.04	21	1%	3.15	22	1%	2.72
SOCIAL & BEHAVIORAL SCIENCES	230	11	4.37	230	12%	3.71	225	11%	2.51
OTHER FIELDS	113	6	4.29	104	5%	3.56	108	6%	2.65
Total	2010	100		1974	100%		1960	100%	

	Advisor-Advisee Relations			Departmental Expectations			RCR Resources			Regulatory Quality		
Location	N	%	MEAN	N	%	MEAN	N	%	MEAN	N	%	MEAN
Organization A	322	15%	3.89	322	15%	3.68	331	15%	3.60	245	15%	3.9
Organization B	1138	54%	3.97	1122	53%	3.85	1190	54%	3.84	894	56%	4.13
Organization C	324	15%	3.79	320	15%	3.77	329	15%	3.52	194	12%	3.79
Organization D	198	9%	3.96	215	10%	3.73	220	10%	3.8	167	10%	3.98
Organization E	131	6%	4.15	120	6%	3.99	137	6%	4.10	109	7%	4.3
Total	2113	100%		2099	100%		2207	100%		1609	100%	
Broad Field												
ARTS & HUMANITIES	110	6%	3.85	127	6%	3.81	110	5%	3.47	49	3%	3.73
BIOLOGICAL & AGRICULTURAL SCIENCES	375	19%	3.99	358	18%	3.82	389	19%	3.79	280	19%	4.13
BUSINESS	52	3%	4.28	58	3%	3.95	62	3%	3.90	37	2%	4.09
EDUCATION	145	7%	3.99	137	7%	3.85	155	8%	3.92	135	9%	4.09
ENGINEERING	352	18%	3.80	343	18%	3.77	354	17%	3.65	230	15%	3.94
HEALTH & MEDICAL SCIENCES	336	17%	3.96	337	17%	3.78	361	18%	3.94	327	22%	4.22
MATHEMATICS & COMPUTER SCIENCE	88	4%	3.87	90	5%	3.68	94	5%	3.57	50	3%	3.88
PHYSICAL & EARTH SCIENCES	167	8%	3.88	159	8%	3.91	161	8%	3.61	81	5%	3.92
PUBLIC ADMIN. & SERVICES	20	1%	3.66	21	1%	3.38	22	1%	3.62	19	1%	3.92
SOCIAL & BEHAVIORAL SCIENCES	225	11%	4.03	222	11%	3.84	234	11%	3.81	192	13%	3.93
OTHER FIELDS	103	5%	3.97	106	5%	3.85	112	5%	3.74	87	6%	4.03
Total	1973	100%		1958	100%		2054	100%		1487	100%	

Table 8

Increment to R2 and Percent Variance Attributable to Classification Variables

	Integrity Norms		Integrity Socialization		[Lack of] Integrity Inhibitors		Advisor-Advisee Relations		Department Expectations		RCR Resources		Regulatory Quality	
Effects	R2 %	Attrib %	R2 %	Attrib %	R2 %	Attrib %	R2 %	Attrib %	R2 %	Attrib %	R2 %	Attrib %	R2 %	Attrib %
Status	0.6	6.4	2.2	23.7	1.0	10.1	0.4	5.1	0.7	9.9	2.5	24.1	2.5	18.9
Broad field of study	2.1	21.2	0.8	8.4	2.5	24.5	0.7	9.0	0.3	4.6	1.2	12.0	1.5	11.0
Field of study	1.1	11.0	0.8	9.0	1.0	10.0	0.9	12.0	0.9	12.4	1.2	11.9	2.2	16.7
Department/Program	6.1	61.5	5.4	58.8	5.6	55.3	5.6	73.9	5.1	73.1	5.3	52.1	7.2	53.4
Status x Broad Field	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Status x Field	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Status x Department/Program	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	9.9%	100.0%	9.2%	100.0%	10.2%	100.0%	7.6%	100.0%	7.0%	100.0%	10.2%	100.0%	13.4%	100.0%

Table 9

Re-fitted Models

Scale	ICC	Fixed Effects p-value			Random Effects p value	
	(Variability due to campus)	**University Status**	**Age**	**Gender**	**University**	**Department within University**
Integrity Norms	0.02	0.29	0.0006	0.12	0.14	0.004
Integrity Socialization	0.003	<0.0001	0.14	0.02	0.19	0.03
Integrity Inhibitors	0.03	0.17	0.44	0.27	0.14	0.0003
Advisor/Advisee relations	0.006	0.58	0.03	0.098	0.17	0.09
Departmental expectations	0.004	0.02	0.199	0.02	0.19	0.05
RCR Resources	0.02	<0.0001	0.005	0.007	0.11	0.02
Regulatory quality	0.03	<0.0001	0.19	0.07	0.12	0.08

Note. ICC = Interclass Correlation Coefficient

Table 10

Number of comments categorized

Components	N	(%)
Support	74	(25.3)
Advising/mentoring	39	(13.4)
Funding	35	(12)
Resources	27	(9.2)
Leadership	27	(9.2)
Climate/Environment	17	(5.8)
Communication	13	(4.5)
Value	13	(4.5)
Education/training	12	(4.1)

Table 11

Representative quotes by theme and subtheme

Theme	Subtheme	Representative Quotes	Interviewee
Research Integrity	Training	Implementation is always a challenge	A
		Certainly, seems to me it's never too early	D
		(should have) general requirement for ethics training	D
		It's much better now than it used to be, but it's still a long way from where we should be acting	E
	Public trust	Research integrity is important, we must maintain our public trust	A
		To maintain our highest standard, we are not only training students, we are training workforce for the next generation, so how to train them to really work	A
		The earlier we have them start asking questions the better it would be	E
Pressures	Ranking	Until ranking doesn't matter, and until ranking agencies change their criteria, we need to focus on that	C
		Science is becoming a lot more international. I know were not really measuring that right now	C
		(the AAU) it's a commitment to research excellence	B
	Salary based on performance	When you have people whose salary or their promotion is based on productivity and so, in each of those circumstances, people will do things that they may not normally do based on what I would call external pressure	B
		Pressure comes from new workload policies for example, and colleges, which now connect your teaching load with your research performance	C
	Acquisition and maintenance of federal extramural funds	I think the biggest pressure point is the acquisition and maintenance of federal extramural grant funding	B
	Tenure issues	Research and scholarship is one of the primary measures for tenured faculty success and so obviously the pressure is there to produce	D
		It's still difficult during the pre-tenured years I really think our clock is too short	E
		What is going to be the impact of COVID on tenure and promotion particularly of women	B
	Metrics	Yes, we do need to look at other aspects of a person's productivity beyond the very hard metrics of dollars and counting papers. It's so old and so traditional	D
		The criteria to me, have to be more, have to be broader than just papers or a single R01 equivalent grant	E
	Mentoring/Professional development	Mentoring and professional development is much more important than I ever thought it was when I first became a faculty member and you know the landscape is changing it's becoming more and more difficult, professional expectations are being influenced by global politics	E

Figure 1

Comments by category and organization

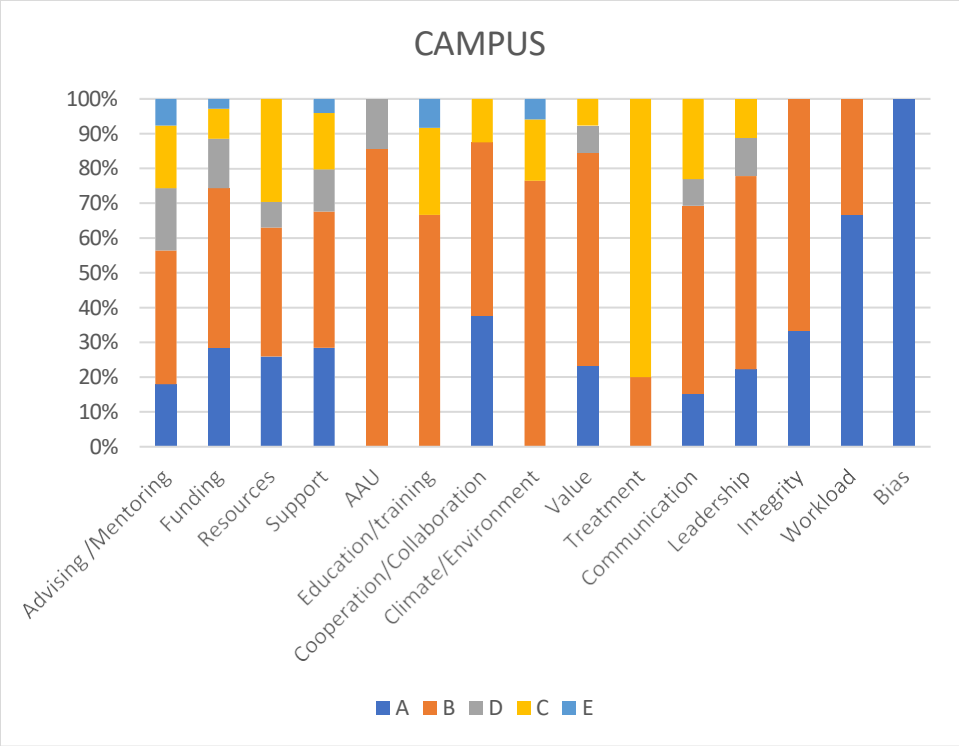


Figure 2
Comments by category and status

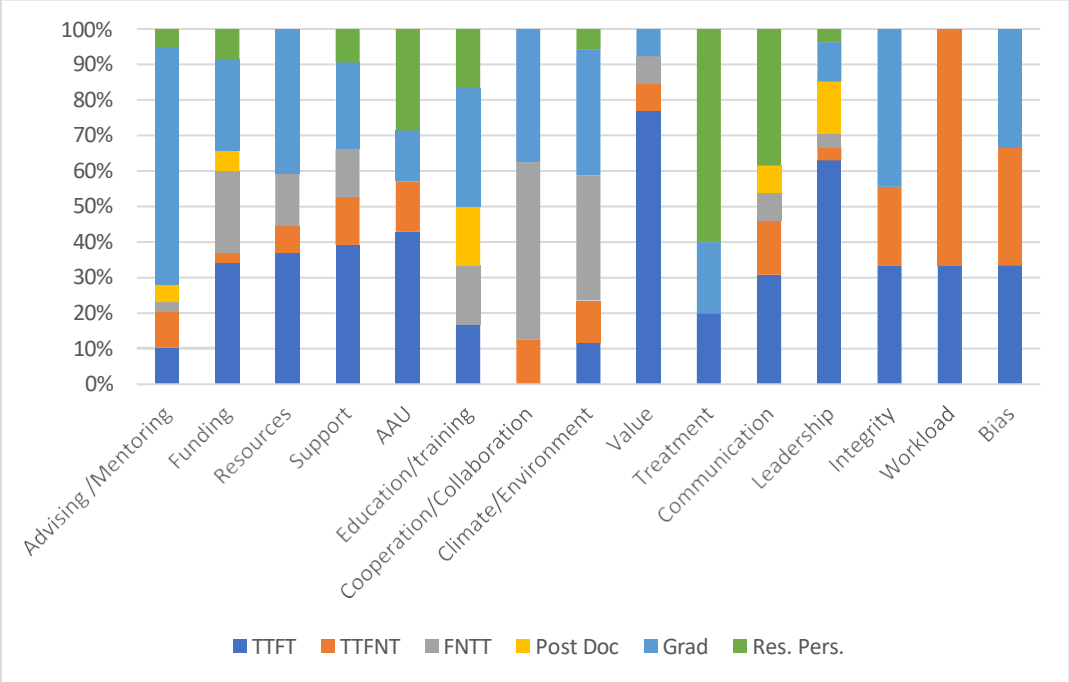
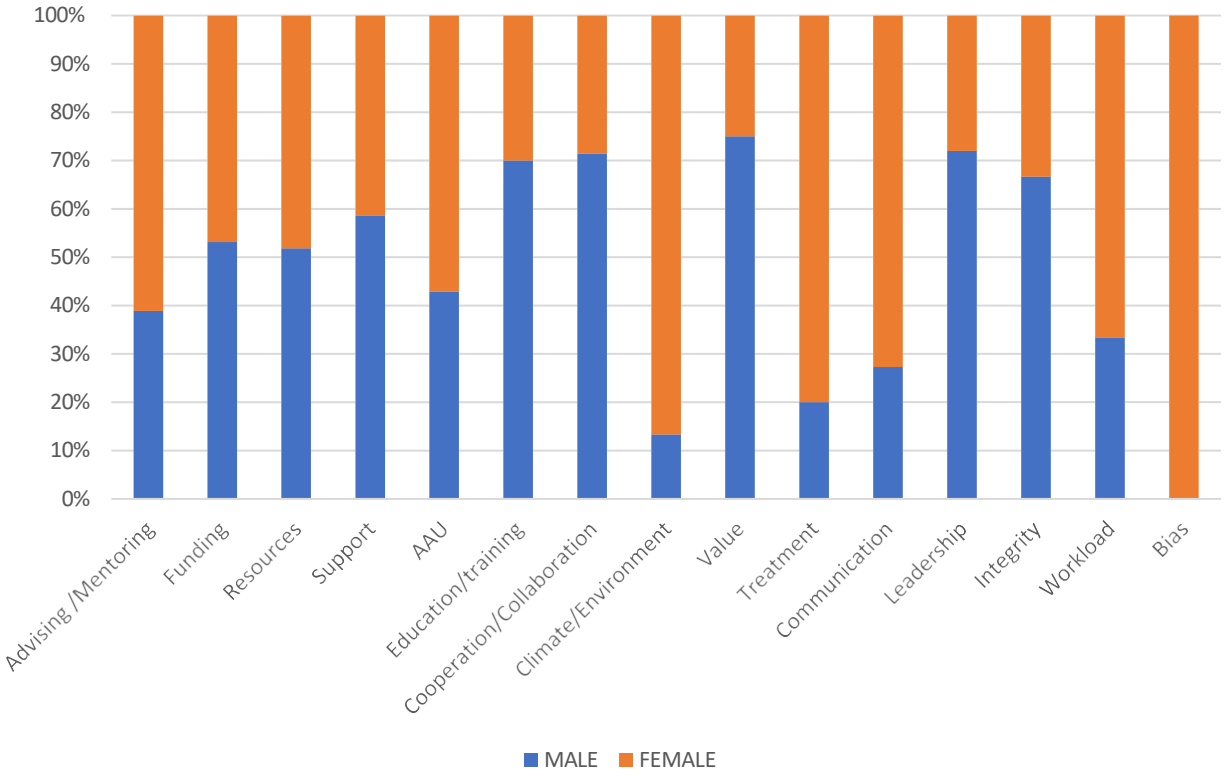


Figure 3 Comments by sex



Supplement 1

Number of cases, percent and mean integrity by field of study across all organizations

		Integrity Norms			Integrity Socialization			Integrity Inhibitors			Advisor-Advisee Relations			Departmental Expectations			RCR Resources			Regulatory Quality		
CGS broad field of study	CGS field of study	n of cases	% (of cases)	Mean Integrity	n of cases	% (of cases)	Mean Integrity	n of cases	% (of cases)	Mean Integrity	n of cases	% (of cases)	Mean Integrity	n of cases	% (of cases)	Mean Integrity	n of cases	% (of cases)	Mean Integrity	n of cases	% (of cases)	Mean Integrity
Arts & Humanities	ARTS - HISTORY, THEORY, & CRITICISM	13	1%	4.231	13	1%	3.744	14	1%	2.282	14	1%	4.036	17	1%	3.765	15	1%	3.588	7	0%	3.905
	ARTS - PERFORMANCE & STUDIO	24	1%	4.104	24	1%	3.378	23	1%	2.399	22	1%	3.818	25	1%	3.800	25	1%	3.706	16	1%	3.979
	ENGLISH LANG. & LITERATURE	30	1%	4.139	30	2%	3.606	32	2%	2.314	29	1%	3.695	32	2%	3.672	31	2%	3.303	13	1%	3.500
	FOREIGN LANG. & LITERATURE	7	0%	4.036	5	0%	3.500	8	0%	2.315	7	0%	3.524	10	1%	3.600	4	0%	2.771	2	0%	2.250
	HISTORY	18	1%	4.347	19	1%	3.474	21	1%	2.390	18	1%	3.713	20	1%	3.775	17	1%	3.337	3	0%	2.833
	PHILOSOPHY	13	1%	4.538	13	1%	3.936	12	1%	2.150	12	1%	4.181	12	1%	4.667	11	1%	3.652	3	0%	4.500
	ARTS & HUMANITIES, OTHER	11	1%	4.182	9	0%	3.454	10	1%	2.597	8	0%	4.292	11	1%	3.682	7	0%	3.629	5	0%	4.000
Biological & Agricultural Sciences	AGRICULTURE, NATURAL RESOURCES, & CONSERVATION	170	8%	4.174	162	8%	3.718	164	8%	2.607	170	9%	4.033	158	8%	3.968	173	8%	3.928	104	7%	4.220
	BIOLOGICAL & BIOMEDICAL SCIENCES	209	10%	4.083	210	11%	3.565	205	10%	2.677	205	10%	3.950	200	10%	3.705	216	11%	3.675	176	12%	4.080
Business	ACCOUNTING	21	1%	4.516	20	1%	3.921	21	1%	2.563	17	1%	4.235	21	1%	4.024	21	1%	4.149	14	1%	4.321
	BANKING & FINANCE	0	0%	0.000	0	0%		0	0%		0	0%		0	0%		0	0%		0	0%	
	BUSINESS ADMIN. &	26	1%	4.375	25	1%	3.783	23	1%	2.417	23	1%	4.370	26	1%	3.942	28	1%	3.798	15	1%	3.867

	MANAGEMENT																					
	BUSINESS, OTHER	12	1%	4.063	11	1%	3.803	10	1%	2.500	12	1%	4.194	11	1%	3.818	13	1%	3.728	8	1%	4.083
Education	EDUCATION ADMIN.	29	1%	4.460	31	2%	3.987	26	1%	2.546	30	2%	4.161	28	1%	3.964	32	2%	4.017	25	2%	4.240
	CURRICULUM & INSTRUCTION	8	0%	4.250	8	0%	3.490	8	0%	2.767	8	0%	3.875	8	0%	3.875	8	0%	3.833	8	1%	4.333
	EARLY CHILDHOOD EDUCATION	1	0%	4.000	1	0%	2.750	1	0%	2.167	1	0%	3.667	1	0%	4.000	1	0%	2.833	1	0%	3.667
	ELEMENTARY EDUCATION	5	0%	4.600	5	0%	3.917	5	0%	2.660	4	0%	4.125	4	0%	4.000	5	0%	4.293	4	0%	3.833
	EDUCATIONAL ASSESSMENT, EVALUATION, & RESEARCH	28	1%	4.190	26	1%	3.551	28	1%	2.655	27	1%	3.938	26	1%	3.962	29	1%	3.933	27	2%	4.253
		Integrity Norms			Integrity Socialization			Integrity Inhibitors			Advisor-Advisee Relations			Departmental Expectations			RCR Resources			Regulatory Quality		
	HIGHER EDUCATION	5	0%	4.600	5	0%	3.800	5	0%	2.600	5	0%	4.267	4	0%	4.375	5	0%	3.967	4	0%	4.417
	SECONDARY EDUCATION	5	0%	4.467	5	0%	4.000	5	0%	2.500	5	0%	4.133	5	0%	3.900	5	0%	4.100	5	0%	4.400
	SPECIAL EDUCATION	18	1%	4.028	18	1%	3.528	18	1%	2.519	17	1%	3.804	17	1%	3.794	17	1%	3.878	12	1%	3.861
	STUDENT COUNSELING & PERSONNEL SERVICES	4	0%	4.354	5	0%	3.217	5	0%	2.847	5	0%	3.867	4	0%	3.750	5	0%	3.020	5	0%	3.200
	EDUCATION, OTHER	46	2%	4.199	45	2%	3.491	42	2%	2.583	43	2%	3.961	40	2%	3.650	48	2%	3.934	44	3%	3.989
Engineering	CHEMICAL ENGINEERING	21	1%	3.901	21	1%	3.206	22	1%	3.044	23	1%	3.761	20	1%	3.475	22	1%	3.506	14	1%	3.810
	CIVIL ENGINEERING	42	2%	3.627	45	2%	3.357	41	2%	3.202	44	2%	3.470	43	2%	3.465	41	2%	3.489	34	2%	3.706
	COMPUTER, ELECTRICAL,	86	4%	3.929	82	4%	3.569	85	4%	3.036	84	4%	3.798	86	4%	3.715	87	4%	3.623	60	4%	4.022

	ELECTRONICS ENGINEERING																					
	INDUSTRIAL ENGINEERING	6	0%	3.500	6	0%	3.500	6	0%	2.756	6	0%	3.833	5	0%	3.900	7	0%	3.698	4	0%	4.042
	MATERIALS ENGINEERING	37	2%	4.070	35	2%	3.662	37	2%	2.609	37	2%	3.865	34	2%	4.147	38	2%	3.621	16	1%	3.844
	MECHANICAL ENGINEERING	62	3%	4.011	60	3%	3.646	58	3%	2.966	63	3%	3.786	60	3%	3.783	60	3%	3.792	40	3%	3.958
	ENGINEERING, OTHER	93	5%	4.045	94	5%	3.548	87	4%	2.938	95	5%	3.965	95	5%	3.858	99	5%	3.686	62	4%	4.043
Health & Medical Sciences	HEALTH & MEDICAL SCIENCES	349	17%	4.258	334	17%	3.698	328	17%	2.570	336	17%	3.962	337	17%	3.777	361	18%	3.939	327	22%	4.225
Mathmatetics & Computer Science	MATHEMATICAL SCIENCES	30	1%	3.925	31	2%	3.013	29	1%	2.596	27	1%	3.889	32	2%	3.609	32	2%	3.355	11	1%	3.788
	COMPUTER & INFORMATION SCIENCES	59	3%	4.105	60	3%	3.590	60	3%	2.845	61	3%	3.858	58	3%	3.716	62	3%	3.685	39	3%	3.902
Physical & Earth Sciences	CHEMISTRY	76	4%	4.013	79	4%	3.594	80	4%	2.614	81	4%	3.809	76	4%	3.829	80	4%	3.672	48	3%	3.875
	EARTH, ATMOSPHERE, & MARINE SCIENCES	32	2%	4.130	32	2%	3.945	32	2%	2.643	32	2%	3.979	31	2%	3.968	32	2%	3.712	15	1%	3.956
		Integrity Norms			Integrity Socialization			Integrity Inhibitors			Advisor-Advisee Relations			Departmental Expectations			RCR Resources			Regulatory Quality		
	PHYSICS & ASTRONOMY	48	2%	4.182	47	2%	3.672	51	3%	2.604	51	3%	3.935	50	3%	3.990	46	2%	3.460	17	1%	3.961

	NATURAL SCIENCES, OTHER	3	0%	3.583	3	0%	2.917	3	0%	3.000	3	0%	3.667	2	0%	4.250	3	0%	3.139	1	0%	5.000
Public Administration & Services	PUBLIC ADMINISTRATION	5	0%	4.217	6	0%	3.250	6	0%	2.614	6	0%	4.111	6	0%	3.667	6	0%	3.553	4	0%	3.917
	SOCIAL WORK	15	1%	3.983	15	1%	3.117	16	1%	2.763	14	1%	3.464	15	1%	3.267	16	1%	3.650	15	1%	3.922
Social & Behavioral Sciences	ANTROPOLOGY & ARCHEOLOGY	14	1%	4.446	15	1%	3.672	13	1%	2.803	15	1%	4.178	15	1%	4.033	14	1%	3.724	7	0%	4.000
	ECONOMICS	26	1%	4.157	26	1%	3.596	27	1%	2.521	25	1%	4.047	26	1%	3.981	25	1%	3.484	18	1%	3.370
	POLITICAL SCIENCE	31	2%	4.427	32	2%	3.831	30	2%	2.613	30	2%	4.239	32	2%	3.828	31	2%	3.847	24	2%	3.764
	PSYCHOLOGY	116	6%	4.348	116	6%	3.678	114	6%	2.472	114	6%	3.914	106	5%	3.807	120	6%	3.836	105	7%	4.046
	SOCIOLOGY	20	1%	4.458	18	1%	3.694	17	1%	2.480	18	1%	4.037	19	1%	3.658	20	1%	3.864	17	1%	4.010
	SOCIAL SCIENCES, OTHER	23	1%	4.489	23	1%	3.819	24	1%	2.382	23	1%	4.196	24	1%	3.833	24	1%	4.004	21	1%	3.921
Other Fields	ARCHITECTURE & ENVIRONMENTAL DESIGN	5	0%	4.150	4	0%	3.938	4	0%	2.583	4	0%	3.833	5	0%	4.200	5	0%	3.967	4	0%	3.833
	COMMUNICATIONS & JOURNALISM	40	2%	4.406	39	2%	3.748	40	2%	2.470	36	2%	4.120	38	2%	3.895	40	2%	3.970	39	3%	4.218
	FAMILY & CONSUMER SCIENCES	25	1%	4.393	24	1%	3.684	23	1%	2.877	24	1%	3.778	22	1%	3.841	23	1%	3.955	19	1%	4.070
	LIBRARY & ARCHIVAL SCIENCES	19	1%	4.118	15	1%	3.178	18	1%	2.562	16	1%	3.938	17	1%	3.647	19	1%	3.386	12	1%	3.736
	RELIGION & THEOLOGY	3	0%	5.000	4	0%	3.042	4	0%	3.083	4	0%	4.417	4	0%	4.000	4	0%	2.804	1	0%	2.000
	OTHER FIELDS	21	1%	4.036	18	1%	3.329	19	1%	2.746	19	1%	3.912	20	1%	3.850	21	1%	3.513	12	1%	3.875
Total	TOTAL	2010	100%		1974	100%		1960	100%		1973	100%		1958	100%		2054	100%		1487	100%	

CHAPTER 5

CONCLUSION

The Committee on Science, Engineering, Medicine, and Public Policy (2017), in a consensus report, suggests that the environment in which researchers are educated, socialized, and perform their work requires significant attention. Previous reports set the stage for the role organizations have in creating an environment that embodies the structures, processes, policies, and procedure that support a culture of integrity (National Research Council, 2002; *Preserving Public Trust: Accreditation and Human Research Participant Protection Programs*, 2001).

Historically descriptions of scientific misconduct have been predominantly based on assumptions of individual causes, acts carried out deliberately by individuals acting in their own self-interest. These individual acts of misconduct tend to be framed at the organizational level as deviations of behavior conducted by autonomous individuals (Zwart & Ter Meulen, 2019). Today's practice of research occurs with interdisciplinary teams, globally, and with large networks of researchers frequently processing large amounts of information in a competitive environment (Zwart, 2008). An organizational perspective on research integrity and correspondingly improving the quality of science might better address the challenges of a global research enterprise, which has become highly competitive. These changes in today's research environment create challenges; environments where the focus is on quantity over quality and where quantifiable indicators for funding and assessing research are in play. One dimension of

an organizational perspective on misconduct is an emphasis on collective (or organized) misbehavior, which may involve behavior by organizations (by groups of people acting in a coordinated manner) or individual behavior on behalf of an organization's activities that are sanctioned or rewarded by the organization (Breit & Forsberg, 2016). This is closely linked to the notion of organizational culture as described by Schien (2017) as a set of shared meanings, assumptions, and values defining appropriate behavior for situations within an organization (Breit & Forsberg, 2016). A strong ethical climate is premised on the organization creating a set of structures, i.e., an ethical infrastructure, to ensure that organizational values are integrated into the daily operations and decision-making at all levels of the organization.

It is time then to shift from a focus on individual behavior to one including social and organizational structures that influence how researchers conduct their research. Internal and external factors influencing those structures include types of research conducted, pressure to publish, increased collaborations, and heightened competition. Misconduct is a way individuals under pressure may react to organizational demands and impositions (Faria, 2015). Misconduct then becomes an adaptive tactic to respond to increasing internal and external performance pressure. In this way researcher actions, perceptions, and interpretations shape and are shaped by organizational constraints, organizations' culture and goals, which goes beyond the individual researcher. One framework in which to view organizational ethical accomplishments and failures is systems thinking. By using the lens of systems thinking the complexity that results from the interactions involving multiple individuals and processes is embraced and can be used towards redesigning systems that improve the quality and reliability of all

research (Silverman, 2000). The emphasis on the organization does not disregard or diminish individual responsibility. Instead, these concepts are complementary, only suggesting a next generation approach to research integrity. This acknowledges researchers as organizational actors influenced by the organizational context.

Dissertation Overview and Findings

This dissertation study informs strategies to address research integrity at the organizational level. As noted in Chapter 2, research reviews directly related to organizational ethics and research integrity are limited resulting in a knowledge gap about what is known about the organization's influence on research integrity. Specifically, there was a lack of empirical research dealing with the influence of academic research organization's ethical climate on organizational integrity. Chapter 3 is the research proposal that that explored the following aims: 1) quantify differences in perceived climate between academic units to measure heterogeneity or homogeneity of research integrity across subunits in a multi university academic system, including a healthcare system; and 2) to determine whether the additional pressure of maintaining rankings affect research integrity between universities of a multi-university system that do and do not have AAU status.

Approach

A cross-sectional study was conducted using a 32-item validated survey instrument, SOuRCe, designed to assess the organizational climate of research integrity in academic settings. Members of the research community of a multi campus academic system were asked to participate. Demographic and classifying questions were added to aid in analysis and reporting. One qualitative question was included to allow participants

to further expand on their perceptions of the organizational climate. Data were analyzed using SPSS, Dedoose, and Excel software.

Major Findings

Quantitative analysis demonstrated that variance explained by department/program was larger across all the SOuRCe scales from 52.1 % for RCR Resources to 73.9% for Advisor-Advisee Relations, accounting for more than half of the variance explained in each of the SOuRCe scales. The variance attributable to status ranged from a low of 5.1% for Advisor-Advisee Relations to a high of 24.1% for RCR Resources. The attributable percent explained by broad field of study ranged from 4.6% for Departmental Expectations to a high of 24.5% for Integrity Inhibitors. Fields of study ranged from 9.0% for Integrity Socialization to 16.7% for Regulatory Quality. This study replicated findings in a prior study, which identified that most of the variability to be explained in research integrity environments was explained at the departmental level, finding that in all bit one instance the department accounted for more than half the variance explained in each of the SOuRCe scales (52.6% to 80.3%) (Wells et al., 2014). We used hierarchical linear modeling to further explore the influence of organizational site and department within the university. The new model included a random university and department-within-university effect. The fixed factors included university status, age, and sex. Campus was not included in that model because after calculating the Intraclass Correlation Coefficient (ICC) it was determined that based on the results, campus did not explain any additional variance and was removed from the model. No effects were seen for race/ethnicity, so it was also excluded from the analysis. The findings under this analysis indicated difference by status, age, sex, and department within the university.

Status had significant impact on four of the seven scales, Integrity Socialization, Department Expectations, RCR Resources, and Regulatory quality. Age had significant effect on three of the seven scales. Integrity Norms, Advisor/Advisee relations, and RCR Resources. Sex had a significant effect on Integrity Socialization, Departmental Expectations, and RCR Resources. RCR Resources scales were affected by status, age, sex, and department within university. In addition, race/ethnicity was shown to have no impact in the analysis.

Discussion

This study facilitates the building of a body of literature that provide evidence needed to build our understanding about the dimensions of the research integrity climate to address risks to research integrity. It provides direction for educational initiatives to be focused at the department level and findings from this study will be used to inform future interventions and research.

This study was able to identify those overall mean scores reflected a climate where conditions were present with the potential to produce negative effects within departments. This was supported by comments expressing concerns over issues such as funding pressures, mentoring, and support within departments. Further analysis allowed a closer look at the departmental level to focus on specific areas of concern that ranged from lack of educational opportunities for RCR, committee review of proposals, value of research conducted, communication, mentoring, or other negative effects such as challenges to obtaining funding, pressure to publish and competition among researchers. This assessment will provide data needed to begin to identify systems level tensions that predispose individuals to engage in scientific misconduct. This deeper understanding of

the root causes of scientific misconduct allows for the development of target strategies within the organization where it is most needed as opposed to broad educational strokes.

Traditionally, RCR education has targeted individuals to influence the way they understand the research enterprise and how they make individual decisions (National Academies of Sciences, 2017). It is suggested by those authors that by targeting individuals, it is hoped that RCR education will affect attitudes and behaviors influencing the overall environment. It is noted by these same authors that institutional leadership is also importantly viewed to either be a support or a barrier to an effective RCR program. The Council of Graduate Schools' program on scholarly integrity has recommended that leadership of organizations are critical to a sustainable and effective RCR program. An individual's view of the organization experience as the climate and believe is the culture determines whether sustainable change is accomplished. Leadership is responsible for climate and culture and the degree to which change is implemented and supported (*Organizational Climate and Culture*, 1990). This has not been explored in the research, thus, opening another area of inquiry when exploring the research integrity dynamics at the departmental level. The importance of departmental leadership in creating climates fostering research integrity must be addressed.

Similarly, another area of inquiry is mentorship, mentors have a unique opportunity to influence novice researchers. This happens in countless ways, developing ethical behavior, modeling behavior, and conveying the importance of responsible research. Keyser et al. (2008) discuss mentorship as essential, providing skills to advance careers, enhancing institutional environments where researchers work, and fostering high

levels of research integrity. Failure to have successful mentorship within a department then may have significant impact on research integrity.

Several limitations are identified with this study. Certainly, timing within the academic calendar may have played a role in the response rate. The study collection period coincided with holidays and a holiday break. It also coincided with the COVID pandemic, which required that in person interviews be converted to zoom. This may have potentially affected the quality of dialogue. Interviews with administrators while zoom facilitated safety and timeliness during COVID but may have been more effective as in person conversations. The interviewees were selected because of their intimate knowledge of the research environment, this expertise lent to content that was able to add to the study in a substantive way.

Another potential limitation is the generalizability of the study. The sample came from a single system within a state with particular geographical and socioeconomic diversity. The results for Organization E represent the organizations system administration, which has no departments. It is possible that some participants identified this as their department because of concerns over confidentiality even with assurances that responses would not be tied to individuals.

This study also had unique strengths. The first is the ability to benchmark across other organizations utilizing data being collected from the SOuRCe survey at The National Center for Professional and Research Ethics (NCPRE) at the University of Illinois at Urbana-Champaign.

Future Research

This dissertation study (Chapter 4) and the systematic review used to develop the study (Chapter 2) provide knowledge and insight that allow us to begin to unpack the

complexities of how research misconduct and detrimental research practices occur within

research organizations. The study helps us understand the impacts, and how to better understand how organizational initiatives can be tailored to promote research integrity.

The systematic review provides a synthesis of the empirical data surrounding the role of organizational culture in promoting research ethics and integrity, while the study more clearly defined the research climate. It also highlights a variety of gaps in our knowledge of systems that foster responsible research. While the dissertation study (Chapter 4) identified areas where the research climate needs improvement, certain correlations between scores on integrity scales and departments, sex, and age provided potential insight to further elucidate where change needs to occur.

What is not clear is what is it about those areas evidencing lower integrity scores that is different from those who have higher scores. Further studies are needed to grasp the environment and its complexities more fully to better establish organizational change mechanisms that foster a strong climate for research integrity. Those studies may lend themselves to qualitative methodologies, collecting data from interviews and focus groups, to provide insights that incorporate the experiences of those within the system. Qualitative methodologies allow for looking at things that are more complex and not reducible to closed answers. System thinking, as an organizational framework for such research, is a possible lens to uncover nuances. Donella Meadows, systems analyst, author, and scientist says,

> You can see some things through the lens of the human eye, other things through the lens of a microscope, other through the lens of a telescope, and still others through the lens of system theory. Everything seen through each kind of lens is actually there. Each way of seeing allows our knowledge of the wonderous world in which we live to become a little more complete. At a time when the world is

> more messy, more crowded, more interconnected, more interdependent, and more rapidly changing than ever before, the more ways of seeing, the better (Meadows, 2008, p. #).

As has been discussed, organizational culture plays an important role either in fostering or undermining research integrity. There is a need for organizations to move away from individual blame to a climate of organizational research integrity. Leadership commitment is needed to promote an ethical climate based on formal compliance standards that incorporates a value based cultural approach. Ethical leadership sets an organizational tone and is key to promoting professional interactions. Institutional (Gunsalus C.K. & Robinson A.D., 2018). Further research is needed on the impact of leadership at the departmental level and interventions to improve the research integrity climate from the role of leadership.

While climate at the departmental level has been identified as critical, the environment researchers work in may also provide an opportunity for further research. Solomon et al. (2022) aimed at developing a measure of climate explicitly focused on the research lab. They found that the new measure is reliable and valid. An advantage is that it can be used in conjunction with other surveys or on its own and is short to ease administration.

Simons A. et al. (2020) have also adapted the SOuRCe survey to assess translational research practices to improve those practices in organizations. This new survey requires further study and has yet to be validated but may be another important contributory tool focused on research climate within the translational research environment.

The move to maturation of the research integrity climate will be evidenced by a shift from solely blaming individuals for misconduct to continuous improvement efforts aimed at improving organizational climate to foster best practices. Transition to this more mature culture will be difficult, historically individuals and organizations have focused on their own reputations and not with a focus on mutual investment in the research enterprise. The move from focus on individuals to organizational integrity needs to look to the next generation of thinking about policies and education about research integrity.

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Appendix 3

Pre-Notification E-Mail

From: Vice Chancellor for Research
Dean of the Graduate School
Date: <today>
Re: University of Missouri Survey of Organizational Research Climate

You are invited to participate in the University of Missouri's Survey of Organizational Research Climate. The purpose of the survey is to measure the climate of research integrity in our organization. Additionally, this information will allow us to assess the impact of initiatives to sustain and improve the organizational environment for research integrity and monitor the organizational climate for research integrity over time.

In two or three days, you will receive an invitation to complete the survey online via RedCap. This invitation and all future reminders will come from Michele Kennett, JD, MSN, LLM, who is the principal investigator of this study funded by the Department of Health and Human Services Office of Research Integrity. This project is part of the dissertation requirements for doctoral candidate, Michele Kennett.

This research will provide an assessment of the University of Missouri's climate for scholarly and research integrity. The findings from this research will be used to make recommendations about how to improve the research climate and provide a direction to develop policies or target interventions to make the organization a better place to conduct research and other scholarly work.

I am asking you to help The University of Missouri assess the university's current climate for scholarly and research integrity by completing an online survey that will take approximately 15 minutes. Your participation is voluntary but is important to the success of this effort. Your personal information is confidential, and only aggregate statistics will be reported.

All tenure-track and tenured faculty, scientists, researchers, technicians, postdoctoral scholars, graduate students, and other research personnel across the organization have the opportunity to participate.

I hope you will join me in participating in this survey.

Sincerely,

Vice Chancellor for Research Dean of the Graduate School

Appendix 4
Support Letter

Dear

I am conducting a cross-sectional study of the four universities in the University of Missouri system to compare perceived differences in research climate across institutions and subunits within institutions. The survey used is the Survey of Organizational Research Climate (SOuRCe), a validated tool designed to assess the organizational climate for research integrity in academic institutions for which I have received permission to use from the developers. This study is funded by the Department of Health and Human Services Office of Research Integrity and is part of my dissertation study. The population to be surveyed from each university includes all graduate students, tenured/tenure-track faculty, post- doctoral fellows, and all research personnel. These data will provide valuable information about employees' perceptions of the research climate. By better understanding subunit similarities and differences, targeted educational interventions and organizational change initiatives can be developed within an institution. I am asking your support in putting your name along with the name of your Graduate School/Office of Graduate Studies dean on a pre-survey notification (attached) to be distributed prior to circulating the survey solicitation.

If you have questions, please do not hesitate to contact me.

Michele Kennett, PhD (c), JD, MSN, LLM
Doctoral Candidate
University of Missouri

Appendix 5
Survey Invitation

This is the Survey Invitation to be sent 3 business days after the Survey prenotification -
to all potential survey respondents
From: Michele Kennett <principal _investigator _email>
Date: <today>
Re: University of Missouri Survey of Organizational Research Climate

A few days ago, Drs. Mark McIntosh & Jeni Hart wrote on my behalf to invite you to participate in a research project: The University of Missouri's Survey of Organizational Research Climate. This will assist me in the completion of my doctoral program and provide information to improve the organizational climate for research integrity here at the University.
Your personal link to the survey is <survey_link>. Your personal identification number (PIN) is <PIN>.
Please use Microsoft Internet Explorer 5. x or higher or Mozilla Firefox 1.x or higher. JavaScript and cookies must also be enabled. If you have questions about the web-based form or experience any trouble logging on to the survey, you may contact <survey_organization> at <survey_organization_email>.
If you have any questions or concerns, you can reach me at <principal _investigator_phone> or
<principal_investigator_email> or visit our Website at <survey_website>.
I remind you that your participation is voluntary, but important to the success of this effort. Your personal information will be kept confidential and only aggregate statistics will be reported.
Please help us to make the University of Missouri a better place to conduct research and other scholarly work by participating in this survey. The survey will take about 15 minutes to complete.

Sincerely,

Michele Kennett, JD, MSN, LLM

Principal Investigator, University of Missouri Survey of Organizational Research Climate

Appendix 6
Survey Reminder

[This is Survey Reminder #1, 2, 3 to be sent to nonrespondents weekly for 3 weeks after the Survey Invitation]
From: Michele Kennett <principal _investigator_email>
Date: <today>
Re: Survey Request
A few days ago, I sent you an invitation to participate in the University of Missouri Survey of Organizational Research Climate. I am writing simply to ask you to participate in this important initiative of the University of Missouri. Your participation is important to providing information that will be used to contribute to a positive organizational climate and help to evaluate and develop policies or target interventions to make the organization a better place to conduct research.
If you have any questions or concerns, you can reach me at <principal_investigator_email> or visit our Website at <survey_website>.
I remind you that your participation is voluntary, but important to the success of this effort. Your personal information will be kept confidential and only aggregate statistics will be reported.
I hope you will join me in participating in this survey. The survey will take about 15 minutes to complete.
Your personal link to the survey is <survey_link>. Your personal identification number (PIN) is <PIN>.
Please use Microsoft Internet Explorer 5.x or higher or Mozilla Firefox 1.x or higher. JavaScript and cookies must also be enabled. If you have questions about the web-based form or experience any trouble logging on to the survey, you may contact <survey_organization> at <survey_organization_email>.

Sincerely,
Michele Kennett, JD, MSN, LLM

Principal Investigator, University of Missouri Survey of Organizational Research Climate

Appendix 7
Cover consent for Interviews

To:
Date: March 17, 2021
Re: Survey of Organizational Research Climate
I am the principal investigator of this study funded by the Department of Health and Human Services Office of Research Integrity. This project is part of my dissertation requirements as a doctoral candidate.
The purpose of the survey was to measure the climate of research integrity in our organization. Additionally, this information will allow us to assess the impact of initiatives to sustain and improve the organizational environment for research integrity and monitor the organizational climate for research integrity over time. The survey went out to all tenure-track and tenured faculty, scientists, researchers, technicians, postdoctoral scholars, graduate students, and other research personnel across the organization.
I have completed the collection of data from the survey and would like to interview you, if you consent. The interview will take place by zoom and will be recorded. The interview will focus on issues regarding pressures of meeting research/scholarly expectations, areas that are perceived influences of research integrity, and training in the responsible conduct of research. It will take no more than an hour. The analysis will be per accepted qualitative methodology. Manuscripts will contain aggregate reflection of comments, use of quotes will not be attributable to a person or institution.
This research will provide an assessment of the University of Missouri's climate for scholarly and research integrity. The findings from this research will be used to make recommendations about how to improve the research climate and provide a direction to develop policies or target interventions to make the organization a better place to conduct research and other scholarly work.

If you want to talk privately about your rights or any issues related to your participation in this study, you can contact University of Missouri Research Participant Advocacy by calling 888-280-5002 (a free call), or emailing MUResearchRPA@missouri.edu.

You can also contact the Investigator, kennettmr@missouri.edu or MU Human Subjects Research Protections Program/IRB: 482 McReynolds Hall, Phone: 573-882-3181, irb@missouri.edu.

Thank you for your contributions,

Michele Kennett

Michele R. Kennett, JD, MSN, LLM, PhD(c)

Appendix 8

Interview Guide

Interview Guide

Background:

Brief description of the project- define or be prepared to define – research integrity, organizational climate/culture,

Lapses in research integrity erode trust in the scientific process and have serious consequences such as potentially reducing funding sources, research subject willingness to participate, and research quality

Thrush et al. provided basis for the development of the first validated survey, Survey of Organizational Research Climate (SOuRCe) designed to assess the organizational climate for research integrity in academic health centers. The SOuRCe provides valuable information for academic administrators (i.e., deans, department chairs, division heads) about their employees' perceptions of the research climate.

Focus on the structures and processes that influence ethical behaviors. Applying systems theory, the focus is not on individuals as objects of improvement, but on the interrelationships, communications, ongoing processes, and underlying causes of behavior in order to change interactions and/or redesign systems to produce different behaviors.

1. What does research integrity mean to you, especially in relation to the role you have in the organization?
2. What do you see as the pressures of meeting research/scholarship expectations on the system?
    a. On individuals within the system?
    b. How do you see this influencing research integrity?
3. How do you think this is or might be different for:
    a. Graduate students
    b. Non tenured faculty
    c. Tenured faculty
4. How do University policies support responsible research?
    a. To what extent is there systematic understanding of research policy supporting the responsible conduct of research?
    b. On your campus what is the mechanism for undergraduate and graduate students to receive training on responsible conduct of research?
    c. What more can or should be done?
5. What do you see as the metrics for scholarship/research productivity?
    a. Describe other ways of measuring scholarship/research productivity in lieu of # of publications and citations.

6. How have you perceived COVID influence research integrity?
7. How do you perceive that the additional pressure of maintaining AAU status (at the MU campus) affects researchers/departments?
    a. What are the additional pressures?
    b. How do these influence research integrity?

VITA

Michele R. Kennett is a master's prepared nurse with 12 years of adult ICU experience before attending law school. She received her JD from the University of Missouri and her LLM in Health Law from St. Louis University in 2001. She joined the University of Missouri Office of Research in 2003. She has been a site visitor, team leader and council member for the Association of Accreditation of Human Research Protection Programs. She has had the opportunity not only to broaden her knowledge and critical thinking but also to have amazing experiences, an internship with the Midwest Bioethics Center, experiences in research coordination, work in a nursing home, and with home healthcare. During her doctoral program she had her dissertation proposal successfully funded through the Department of Health and Senior Service, Office of Research Integrity, Research on Research Integrity Program, an ORI/NIH collaboration. Michele works as an Associate Vice Chancellor for Research at the University of Missouri Columbia, Office of Research, overseeing research compliance efforts.