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Causal Factors Implicated in Research Misconduct: Evidence from ORI Case Files

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Abstract There has been relatively little empirical research into the causes of research misconduct. To begin to address this void, the authors collected data from closed case files of the Office of Research Integrity (ORI). These data were in the form of statements extracted from ORI file documents including transcripts, investigative reports, witness statements, and correspondence. Researchers assigned these statements to 44 different concepts. These concepts were then analyzed using multidimensional scaling and cluster analysis. The authors chose a solution consisting of seven clusters: (1) personal and professional stressors, (2) organizational climate, (3) job insecurities, (4) rationalizations A, (5) personal inhibitions, (6) rationalizations B and, (7) personality factors. The authors discuss the implications of their findings for policy and for future research.

Keywords Research integrity · Research misconduct · Responsible conduct of research

There has been a groundswell of scholarly interest in research integrity over the past two decades. Part of this is undoubtedly due to well-publicized cases of misconduct involving some of the most prominent research institutions in the world. More recently, some of the interest may also stem from the extramural research program

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of the Office of Research Integrity (ORI), which is supported by several branches of the National Institutes of Health (NIH), and which annually funds a number of studies on various aspects of research integrity. The body of empirical research in this area covers a broad array of perspectives and is growing at an impressive rate.

Despite the increase in research on research misconduct, relatively few studies have addressed its causes. This is curious inasmuch as substantial resources are being devoted to the development of conferences and curricula designed to train individuals in the responsible conduct of research (RCR). The available anecdotal evidence on the contours of research misconduct, as weak as it may be, does indeed inform policy [1]. But it stands to reason that policies intended to prevent and control research misconduct would be more effective if informed by a more thorough understanding of the problem's etiology.

In defense of those charged with formulating and carrying out policies on the responsible conduct of research, they cannot wait for definitive answers about the causes of research misconduct any more than a physician would hesitate to treat the symptoms of a patient's unidentified disease. Legions of new scientists are continually being trained, and it is reasonable to acquaint them with research norms and the consequences of their violation early in their training programs, regardless of whether ignorance of such norms actually underlies instances of research misconduct.

What are the Purported Causes of Research Misconduct?

There has been a great deal of speculation about the causes of research misconduct. One way to organize the discussion of the literature regarding the alleged causes is to use the categories offered by Mark Davis [2]: individual, situational, organizational, structural and cultural factors.

Individual Factors

According to Rebecca Dresser, "Researchers who deviate from fundamental scientific norms with awareness that they are doing so are deemed most responsible for their behavior and thus most deserving of condemnation." [3, p. 5] Regardless of any other factors said to be wholly or partially responsible for research misconduct, it is the individual who stands accused in actual cases. The individual's research activities are put under scrutiny by the institution in which the alleged misconduct occurred, as well as by federal agencies if the research in question has federal sponsorship. Upon a finding of scientific misconduct, the respondent (as the individual accused of research misconduct is referred to by the ORI) is subject to a variety of consequences including debarment. So it is appropriate, although perhaps to some unduly reductionistic, for analyses of etiology to include the individual level of analysis. John Long, who testified about his own misconduct before a Congressional subcommittee in the 1980s, stated:

> I do not believe that the environment in which I work was responsible for what I have done. Competition for limited research funds among research investigators is a necessary part of federally funded scientific work. Neither this, nor competition for major awards in science, can be implicated as an important factor in my particular instance. An honest investigator should be able to deal effectively with the traditional 'publish or perish' pressures… The loss of my ability to be an objective scientist…cannot…be linked to defects in the system under which I worked (quoted in [4]).

A number of analysts attribute research misconduct at least in part to the mental or emotional state of the accused [5–9]. Those who would fabricate data, plagiarize the work of another, or engage in similar practices, as the reasoning goes, cannot be in their right minds. One physician-scientist in the United Kingdom, who was investigated by the General Medical Council for research misconduct, was said in a psychiatrist's report to be suffering from depression at the time of the incident [10]. 'If it was not for the mental state I was in,' the respondent stated, 'I would never have done something like this.' Douglas Weed, however, has suggested that this type of excuse may simply be used to avoid taking responsibility [9]. This pattern of accused scientists pointing to poor mental state is believed to be a recurring one [11].

William James flatly asserts that '[s]ome scientists are psychopaths...' [6]. This opinion seems to coincide with that of Efraim Racker who observes that research misconduct '…springs from an unbalanced mind. Perhaps as with most professional criminals they are emotionally and mentally ill, often seeking self-destruction.' [12, p. 91]

Closely related to mental state is the personality of the accused. According to the Diagnostic and Statistical Manual of Mental Disorders—Fourth Edition (DSM-IV), mental health professionals' primary source of wisdom about personalities:

> Personality traits are enduring patterns of perceiving, relating to, and thinking about the environment and oneself that are exhibited in a wide range of social and personal contexts. Only when personality traits are inflexible and maladaptive and cause significant functional impairment or subjective distress do they constitute personality disorders [13].

The personality traits of ego, vanity and self-aggrandizement mentioned by a number of observers [8, 9, 14–18] bring to mind narcissism, particularly its more socially maladaptive forms. In their comprehensive review of factors related to professional integrity, including those at the individual-level, Michael Mumford and Whitney Helton found evidence that narcissism is related to a lack of personal integrity [19]. One particular aspect of narcissistic personalities, a sense of entitlement, was found by Mark Davis, Kelly Wester and Bridgett King to be significantly related to doctoral students' likelihood of engaging in various questionable research practices [20]. So the professional impressions that certain narcissistic personality traits underlie research misconduct have at least some empirical support.

It has been argued that some cases of research misconduct arise out of a 'messianic complex,' that is, an individual's belief in a particular theory or line of inquiry [7]. Why should researchers who firmly believe they are right go to the trouble of actually conducting the research [21]? There is some evidence that this syndrome may be responsible for at least some instances of research misconduct. In his testimony before Congress, John Long told the committee that '…part of the problem was that I had tremendous faith in the cell lines. I had worked so hard on them that I believed they were the real thing (quoted in [22]).' Cyril Burt, the famous British psychologist who many believe faked most of the data upon which he based his conclusions about the inheritability of intelligence, is said to have suffered from this syndrome. 'If a real scientist is one who wants to discover the truth,' write William Broad and Nicholas Wade, 'Burt was no scientist, because he already knew the truth.' [11].

In one of the earlier surveys designed to assess the contours of research misconduct, June Tangney asked her subjects to speculate about possible contributing factors [18]. Thirty-one percent of her sample felt that a firm belief or desire to promote a theory might underlie research misconduct. Another factor cited by her respondents was the belief that one's theory or data are right, as ill-founded as it might be.

Situational Factors

Like members of the general population, even fundamentally honest researchers can find themselves in trying circumstances that can test one's ability to deal with pressure/capacity to cope. The loss of loved ones, relationship problems including separation and divorce, and financial pressures all have the potential of contributing to the compromising of quality research. Although these factors have received less attention in the literature as possible causal factors, a few commentators (e.g., Marion Broome [14] and Ruby Morrison [23]) have mentioned them.

Mark Davis and Michelle Riske note that some of those who had been found guilty of scientific misconduct expressed that they had been experiencing family and other personal difficulties at the time of their involvement [24]. These difficulties included, but were not limited to:

- Loss of family members
- New baby
- Emotional difficulties due to a relationship breakup
- Wife's complicated pregnancy
- Son diagnosed with Attention Deficit Disorder and Conduct Disorder
- Parents' disappointment over respondent not getting into medical school
- After purchasing a new home, respondent's salary was cut

There is evidence, then, that situational factors belong on the list of potential etiological factors underlying research misconduct. One has to wonder, though, whether these situational factors, much like mental and emotional problems, might

be used by those who are caught as a means of avoiding responsibility for their own actions.

Organizational Factors

The environments in which scientists conduct their work are said to be conducive to research misconduct [14]. While this influence is distinct from what inheres in the individual [25], the two levels can interact [19]. It has been argued that institutions have an obligation to create an atmosphere that promotes the responsible conduct of research [26].

The nature of interpersonal relationships within an organization has been pointed to as one pertinent element of the organizational culture. Morrison suggests that the closeness of the relationship between supervisor and subordinate is important with regard to research misconduct [23]. Problems in such a relationship, however, may take the form of inadequate supervision and mentoring of inexperienced researchers [4], including graduate students [27].

In a comprehensive review of the literature dealing with various correlates of integrity, Mumford and Helton set forth a number of propositions grounded in the empirical literature on organizations [19]. While these propositions derive from the literature on integrity in general, they provide a rich set of testable statements for those interested in research on research misconduct.

Structural Factors

Those speculating about the causes of research misconduct place a great deal of the burden on the way modern science works. Certain characteristics of the scientific enterprise within the academic setting are said to lend themselves to departures from the norms of science as practiced in the U. S. Most notable among these is the dreaded 'publish-or-perish' pressure under which faculty researchers must operate [4, 7, 8, 23, 28–32]. Tenure-track faculty in research institutions are commonly judged by the quantity and quality of published articles and abstracts. Those who fall short of this expectation often lose their prospects of a permanent position. Failing to publish can also affect their chances of securing funding for their research. This places a substantial amount of pressure on researchers, especially young, untenured investigators, to get their research findings into print.

The publish-or-perish pressure can be considered structural because it pervades academic science. It may not, however, be an immutable pressure. Tom Jefferson contends that academic institutions need only consider a small number of the candidate's papers, thereby eliminating the incentive to engage in misconduct in order to generate large numbers of publications [29].

The publish-or-perish pressure, while admittedly important, cannot be disentangled from the tenure and promotion process. Tenure, which represents academic job security, and promotion, which translates into advancement and greater financial rewards, are both embedded in the structure of academic science. These two facets

of professional life within research institutions are considered by many to be responsible for research misconduct [5, 14, 15, 17, 18, 23, 27, 33, 34].

Publish-or-perish pressure, which is closely related to the desire to achieve tenure and promotion, leads to intense competition. This competition is also thought to account for at least some instances of research misconduct [4, 9, 14, 23, 35–38]. Academic scientists, according to David Goodstein, '…are more like players in an intense, winner-take-all competition for scientific prestige and the resources that follow from that prestige.' [21]. R. Illingworth, like other commentators, suggests that this competition is capable of distorting one's perception of what is ethically acceptable [39].

Cultural Factors

Although very little work has been undertaken on the role of culture in research misconduct, it has been observed that some researchers from abroad might be susceptible to unique pressures to deviate from science's norms [2]. Further, individuals moving from one culture to another necessarily bring with them the norms of the specific culture in which they were socialized. Thus culture is yet another factor which potentially could increase the probability that an instance of research misconduct will occur.

In their review of 16 allegations of questionable research practices, Walter Meyer, III and George Bernier, Jr. found that foreign personnel were overrepresented among the accused [40]. It should be noted that their sample, derived from only one research institution, does not permit any valid inferences. Nevertheless, future research examining the relationship between culture and the understanding and perception of scientific norms would be a worthwhile addition to the field.

Questionable authorship practices, which do not constitute research misconduct *per se*, may be uniquely vulnerable to departures from accepted standards by those from abroad. According to Anne Hudson Jones, some young scientists-in-training may operate with the understanding that their mentors from their countries of origin expect to be included as co-authors on publications generated in the U.S. [41]. While this clearly represents gift authorship, which has been disapproved by virtually all organizations addressing the responsible conduct of research, it is understandable that researchers from abroad could find themselves in an untenable situation. Whether or not this is actually a widespread expectation, such a dilemma would seem especially problematic for young scientists-in-training who intend to return to their respective countries of origin.

Although there has been a great deal of speculation about the causes of research misconduct, few of these observations are empirically grounded. The purpose of this study is to help fill that void. Specifically, this study is an attempt to identify the causes of research misconduct as perceived by those against whom a finding of scientific misconduct was made. In particular, this paper presents the results of a study using data extracted from ORI case files to identify the factors implicated in research misconduct, and includes a discussion of the implications of these findings for both future research and policy on the responsible conduct of research.

Research Design

Subjects

The subjects for the current study are individuals against whom a finding of scientific misconduct was made by the Office of Research Integrity (ORI) as of December 2000. The criterion for the sample was only those cases classified as 'closed' by the ORI. Cases that were processed and closed by the ORI's predecessor agency, the Office of Scientific Integrity (OSI), were not used in the analysis. Demographic data including gender, age and ethnicity were not collected from the case files and therefore were not available for analysis. The sample is purposive and does not permit inferences to any population other than those against whom a finding of scientific misconduct was made by the ORI for the period in question.

Each respondent's file constituted a case study in and of itself which offered insights distinct from the others. This differs from purely quantitative research which aims for large numbers of subjects, and where selection is devoid of context and statistical significance is sought [42, 43]. Although small by quantitative research standards, this group of cases is 'information rich' in that the respondents were selected because they exemplify characteristics of interest [44], in this case, those found of scientific misconduct. Accordingly, this sampling strategy provided a wealth of detailed information that offers the potential of contributing to understanding of research misconduct, despite its limitations in generalizability [45]. Cases were excluded from the analyses if they failed to yield information relating to etiology.

Data Collection

An instrument was developed for the systematic collection of information through the review of case files. It included information about the type of misconduct, who made the allegation, the formal investigation and findings by the institution, the respondent's response to the allegation, or other circumstances surrounding the incident, as well as the formal administrative action by the ORI.

A pilot study of respondents who had cases closed by the OSI was performed to test the utility of the data collection instrument to be used for the case file reviews. Although the OSI differed substantially from the ORI, the research team considered the case file materials similar enough to use the OSI cases for the pretest. For the pretest 15 case files were reviewed. The instrument was deemed adequate for collecting the data required for this project.

Information included in the case files was drawn primarily from investigation reports submitted by the universities, as well as information contained in ORI reports, correspondence, transcripts from the hearings, and other evidence submitted by the parties pertaining to the charge of scientific misconduct.[1]

[1] This information included fact-finding procedures, hearings, testimony, counter-allegations, evidence, the authority and manner of decision making, and appeal procedures.

The first step in the data analysis process employed a strategy adopted from phenomenological research wherein the textual material is scanned for statements or phrases which could explain why the misconduct occurred or possible consequences as a result of the misconduct. Rather than searching for evidence of specific theories or propositions, the investigator examines the data more for explication than explanation [46].

Once the data were collected from the files at the ORI, two different coders extracted phrases that conveyed causal factors implicated in research misconduct. As a check against possible bias created by prior knowledge or other factors, the analyst extracted verbatim phrases rather than interpreted or paraphrased concepts. The second analyst approached the data in the same manner, identifying exact wording thought to convey possible causes of research misconduct. The statements or phrases pulled from the instrument were recorded on index cards. The two analysts then compared and reconciled their lists. Any discrepancies were resolved by the research team so that items were coded in a consistent fashion.

Because most of the information gleaned from the case file review is akin to hearsay in the legal sense, except for information contained in transcripts or correspondence from the respondent, the data were interpreted with caution. Hearsay, for these purposes, is defined as statements based upon the reports of others [47]. Thus statements only suggest possible factors implicated in research misconduct and should not be considered as the official cause of the misconduct.

The researchers did not record the names of the respondents nor did they capture demographic or other data which would permit identification of individuals. The project was reviewed and approved by Justice Research and Advocacy's Institutional Review Board.

Methods of Analysis

After all of the statements were extracted from the case file reviews, the research team then grouped the statements which were similar and assigned a label or 'concept' in order to better classify the statements, such as 'pressure to produce.' A total of 44 concepts were generated in this manner. Statements identified with each concept were also separated into (A) those statements that were attributed to the subject, and (B) statements made by others about the respondent.

To explain patterns in the data, multidimensional scaling and cluster analysis was employed. The combined use of these techniques is borrowed from the Concept Mapping/Pattern Matching (CMPM) methodology. Concept mapping is a type of structured conceptualization which can be used by groups to develop a conceptual framework which can guide evaluation or planning [48].

Although reliability for CMPM has been well-established, its calculation departs from conventional test theory in which there are either correct or incorrect answers. Because these do not exist for CMPM, reliability focuses on the consistency of the maps produced as opposed to the individual items [49]. Overall, research on the reliability of CMPM has focused on two primary efforts: (1) providing an accurate representation of what people were thinking, and; (2) integrating the concept maps into scientific theory building and experimentation [50]. Pattern matching itself is used as a

methodology for establishing reliability and validity [51, 52], and has been used to help clarify phenomena as varied as feminism [53], model transfer in psychiatric rehabilitation [54], and social technologies related to in-home health services [55].

William Trochim's CMPM methodology involves six steps: (1) Preparation; (2) Generation of Statements; (3) Structuring of Statements; (4) Representation of Statements; (5) Interpretation of Maps, and; (6) Utilization of Maps [48]. These steps are described below, in turn, as they are used in a modified fashion for this particular study.

Step 1: Preparation

In other more traditional uses of CMPM, the investigator chooses who will participate in the process, and then works with them to decide on a particular focus for the conceptualization. This study was an attempt to create a conceptualization that helps clarify the causal patterns inherent in instances of research misconduct. In this study, the investigators chose participants indirectly by focusing on closed ORI case files.

Step 2: Generation of Statements

A more conventional use of the CMPM methodology would involve preparing a research or evaluation question, and then gathering a group of stakeholders to identify individual items that address that question. For example, if this study were conducted in a fashion consistent with most CMPM studies, the investigators would have convened a group of stakeholders who are experts on research misconduct, and then asked these individuals, 'What are the factors or causes that lead to research misconduct?' This study deviates from that conventional approach, a deviation we believe enhances the objectivity of the CMPM process. Rather than asking experts to identify via a focus group those factors associated with research misconduct [56], evidence from the ORI case files was used to identify codes that help explain research misconduct.

Step 3: Structuring of Statements

In the more conventional approach alluded to above, stakeholders would be asked to individually sort the items (i.e., codes) identified into meaningful piles, and then multidimensional scaling would be used to find the aggregate sort. In this study, the meaningful piles are created by examining actual instances of research misconduct in the ORI case files, and identifying the codes inherent in each. As mentioned previously, these codes help identify possible explanations for research misconduct in a particular case file. For example, a particular case file might hypothetically contain three of the 44 codes: (1) pressure to produce; (2) personal problems, and; (3) insufficient supervision. Therefore, rather than asking stakeholders to speculate on which codes belong with one another, the ORI case files of real world examples

of research misconduct provide data for the relative association among the 44 identified concepts (i.e., codes).

Multidimensional scaling was used to generate a two-dimensional plot that illustrates the conceptual proximities among the 44 codes, based on the frequencies with which they occurred together within individual case files. Cluster analysis was then used to spatially clarify these relationships.

Steps 4 and 5: Representation of Statements and Interpretation of Maps

In this study, 'statements' are synonymous with the codes identified in the ORI case files. The two-dimensional concept map produced via multidimensional scaling and the subsequent cluster analyses are then interpreted to help guide future theory development on the topic of research misconduct.

Step 6: Utilization of Maps

The concept map developed in this study can be utilized by scholars and practitioners to develop more grounded and evidence-based approaches to investigating the phenomenon of research misconduct. Although this study does not attempt to provide a definitive explanation of how research misconduct occurs in all cases, the concept map developed serves as a tool to help guide future investigations into this phenomenon.

Results

A total of 104 individual case files were reviewed, 12 of which contained no information on etiology and were therefore excluded from the analysis. A plurality of respondents held the position of research assistant/associate or technician (24%), 13% were associate professors, 13% were postdoctoral fellows, 12% were assistant professors, 12% were graduate students, 9% were professors or head of department and the remaining 17% were categorized as 'other.' A plurality of the respondents had also earned a Ph.D. (38%), 16% had earned an M.D, 7% had combined degrees of Ph.D. and M.D., 22% were categorized as 'other,' and for 17% of the respondents, the information on educational level was not available.

The forms of misconduct committed by the respondents included plagiarism, falsification, fabrication, and combinations of the three with falsification/fabrication being the most common. The majority of the cases were for either falsification (39%) or a combination of fabrication and falsification (37%).

From the 92 individual case files, concepts were attributed either to the respondents or to others who made comments about the respondents. The number of concepts per respondent varied. Some respondents had as few as one concept, while others had up to 15 concepts. Based on this review, 44 concepts were identified in the case files and labeled sequentially from 1 to 44. Each particular case file, then,

was labeled with one or more of these concepts that identify possible explanations for the research misconduct that took place. Hereafter, these concepts will be referred to as 'factors implicated in research misconduct.'

The average number of explanations for research misconduct identified in a particular case file was approximately 4 (mean = 3.8, s.d. = 3.0, range 1–15). The frequency with which individual explanations for research misconduct were identified among all case files ranged from 1 to 47 times (mean = 11.8, s.d. = 10.8).

Multidimensional scaling was used to generate a two-dimensional proximity matrix which illustrates the perceived aggregate relationships among the 44 factors implicated in research misconduct. A dissimilarity matrix identifying the frequency with which explanations for research misconduct coexisted within case files was used to enter the data. Multidimensional scaling using SPSS 13.0 [57] yielded coordinates for each of the 44 factors implicated in research misconduct as shown in Figs. 1, 2.

The factors implicated in research misconduct, each labeled with their respective identifiers ranging from 1 to 44, are contained in this plot. The distance between any two points illustrates the relative relationship of coincidence between these two points. For example, at the top center of the plot, explanations for research misconduct #16 (competition for position) and #3 (inappropriate responsibility) lie close together. Their proximity suggests that throughout the individual case files, these two factors implicated in research misconduct coexisted with relatively high frequency. On the other hand, factor #16 lies relatively far from factor #35 (avoid degradation) located at the bottom center of the plot. This greater distance suggests that throughout the case files these two factors implicated in research misconduct coexisted with relatively low frequency.

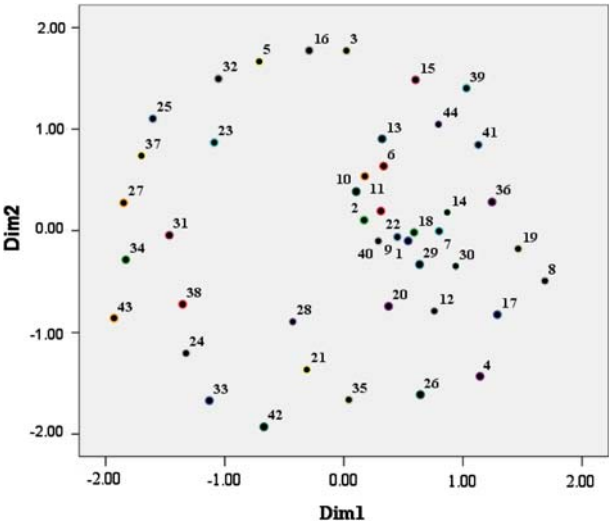

Fig. 1 Two-dimensional plot of the 44 concepts

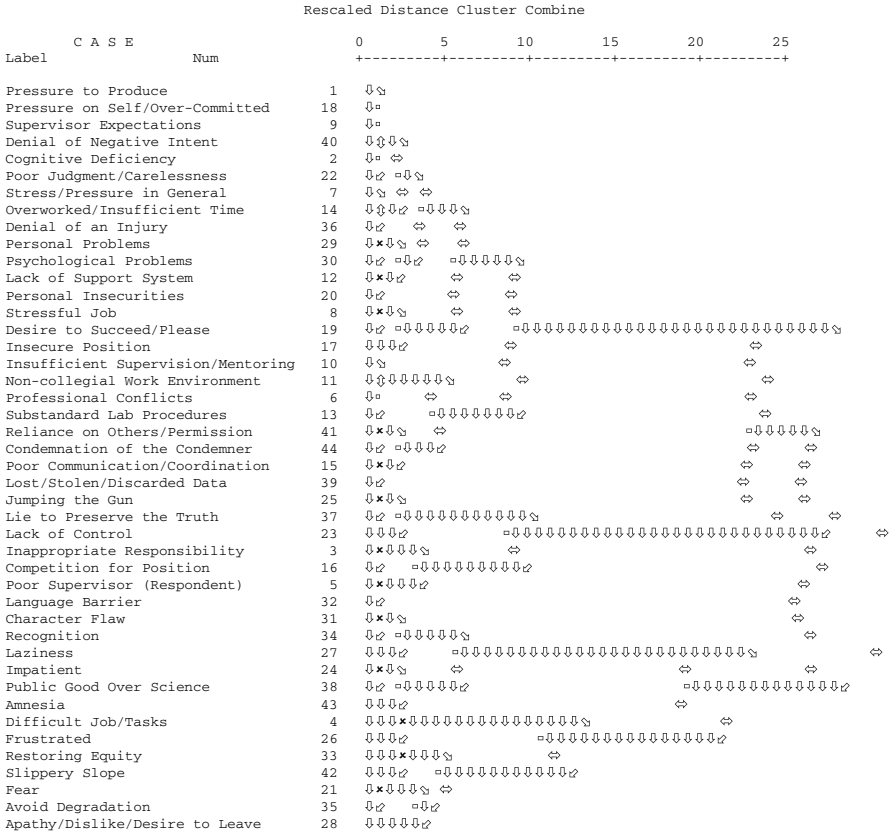

Fig. 2 Dendogram of the 44 concepts

The significance of these distances illustrated in Fig. 1 is based on an assumption that when different factors implicated in research misconduct coexist repeatedly among individual case files, they collectively represent a larger construct that might help investigators explore the phenomenon of interest, research misconduct in this case. To examine these constructs further, cluster analysis was used to determine which subsets of the 44 factors implicated in research misconduct might be combined to create new categories of research misconduct causes.

Cluster analysis, again using SPSS 13.0 [57], yielded the following dendrogram based on the Euclidian distances among the 44 factors implicated in research misconduct.

This dendrogram, when read from right to left, illustrates how the 44 factors implicated in research misconduct can be broken up into smaller clusters, ranging from two clusters up to 44 clusters. Choosing the number of clusters that is most representative and meaningful is somewhat subjective. However, the horizontal distance between successive cluster solutions is one criterion available to researchers for informing this subjective choice. A greater horizontal distance suggests a more definitive cut-off.

The 44 factors identified can be grouped into the 7-clusters illustrated in Table 1 by alternating italics. The utility of the 7-cluster solution can be further enhanced by labeling each of the clusters.

Cluster 1—Personal and Professional Stressors

The 13 items (8, 9, 12, 14, 17, 18, 19, 20, 22, 29, 30, 36, & 40) comprising this particular cluster seem to relate to stressors in the respondents' work environment and in their personal lives. Items such as Pressure to Produce, Overworked/Insufficient Time, and Stressful Job point to stressors that are more work-related. Some items point to stressors that are much more personal in nature (e.g., Personal Problems, Psychological Problems). Other items, however, seem to bridge both personal and professional issues (e.g., Pressure on Self/Overcommitted, Lack of Support System, Stress/Pressure in General). Together, these items seem to point to more micro-level stressors that might contribute to research misconduct.

Cluster 2—Organizational Climate Factors

Eight items (6, 10, 11, 13, 15, 39, 41, & 44) comprise the second cluster, which seems to be related to issues of organizational climate. Professional Conflicts, Insufficient Supervision/Mentoring, Poor Communication/Coordination, & Non-collegial Work Environment all seem to relate to factors inherent in an individual's particular place of work. Other items such as Substandard Lab Procedures and Lost/Stolen/Discarded Data might be related to either characteristics of individual employees, characteristics of the particular work place, or both. In general, these items seem to point to aspects of the particular organizational climate in which research misconduct took place.

Cluster 3—Job Insecurities

Four items (3, 5, 16, & 32) comprise a cluster related to job insecurities. Inappropriate Responsibility, Poor Supervisor, and Competition for Position are items that seem to point to work situations in which the researcher might be hesitant to ask for guidance given their perception of tenuous job security. Another item in this cluster, Language Barrier, might include situations wherein a researcher fails to ask for assistance for fear of being perceived as inadequate due to low proficiency in spoken or written English. Together, these items point to factors due to a perception of job insecurity on the part of the researcher/employee.

Cluster 4—Rationalizations A

Three items (23, 25, & 37) comprise this cluster which seems to be related to rationalizations that might be offered by the individual who was accused of

Table 1 Final clusters and concepts

1:Pressure to Produce
2:Cognitive Deficiency
7:Stress/Pressure in General
9:Supervisor Expectations
12:Lack of Support System
14:Overworked/Insufficient Time
18:Pressure on Self/Over-committed
20:Personal Insecurities
22:Poor Judgment/Carelessness
29:Personal Problems
30:Psychological Problems
36:Denial of an Injury
40:Denial of Negative Intent
8:Stressful Job
17:Insecure Position
19:Desire to Succeed/Please
6:Professional Conflicts
10:Insufficient Supervision/Mentoring
11:Non-collegial Work Environment
13:Substandard Lab Procedures
15:Poor Communication/Coordination
39:Lost/Stolen/Discarded Data
41:Reliance on Others/Permission
44:Condemnation of the Condemnors
3:Inappropriate Responsibility
5:Poor Supervisor (Respondent)
16:Competition for Position
32:Language Barrier
23:Lack of Control
25:Jumping the Gun
37:Lie to Preserve the Truth
4:Difficult Job/Tasks
26:Frustrated
21:Fear
28:Apathy/Dislike/Desire to Leave
33:Restoring Equity
35:Avoid Degradation
42:Slippery Slope
24:Impatient
38:Public Good Over Science
43:Amnesia
27:Laziness
31:Character Flaw
34:Recognition

engaging in the particular misconduct. Lack of Control Over One's Environment, Jumping the Gun to Disseminate Findings, and Lying in Order to Preserve the Truth seem to point to factors where a person guilty of misconduct might try to justify his or her actions through rationalizations.

Cluster 5—Personal Inhibitions

This cluster is the smallest of all clusters, containing only two items (4, & 26). Difficult Job/Task and Frustrations are factors which seem to be work-related frustrations due less to the work environment and more to limitations of the individual.

Cluster 6—Rationalizations B

Cluster 4 dealt with three particular factors related to rationalizations. Although the items in Cluster 6 yielded a separate factor in the cluster analysis, these items (21, 28, 33, 35, & 42), much like those in Cluster 4, seem to relate to rationalizations offered by individuals responsible for research misconduct. These factors included: Fear, Apathy/Dislike, Restoring Equity, Avoiding Degradation by Others, and Slippery Slope.

Cluster 7—Personality Factors

This cluster is comprised of six items (24, 27, 31, 34, 38, & 43) related to particular personality factors that generally may be perceived as weaknesses in character. Impatience, Amnesia, Laziness, Character Flaw, and Personal Need for Recognition all point to personality factors that, in general, are viewed negatively. Choosing Public Good over Science can also be viewed as a personality factor since it seems indicative of dogma that can compromise the integrity of the scientific process, thus resulting in research misconduct.

Cluster analysis, then, is useful in helping to define the structure of the causal factors implicated in research misconduct. To further help visualize the structures inherent in the data, the results of the cluster analysis may be combined with the results of the multidimensional scaling to produce a concept map of the 7-cluster solution.

The schematic in Fig. 3 illustrates some characteristics of the 7-cluster solution chosen for this study. For example, the 13 items comprising Cluster 1—Personal and Professional Stressors are clustered relatively close to one another as compared to other clusters. In contrast, Cluster 7—Personality Factors, is comprised of less than half the number of items ($n = 7$) and yet occupies approximately the same amount of space on the two-dimensional map. Obviously, then, researchers attempting to find patterns or structures in the data that might help define new phenomena in the study of research misconduct might place more confidence in

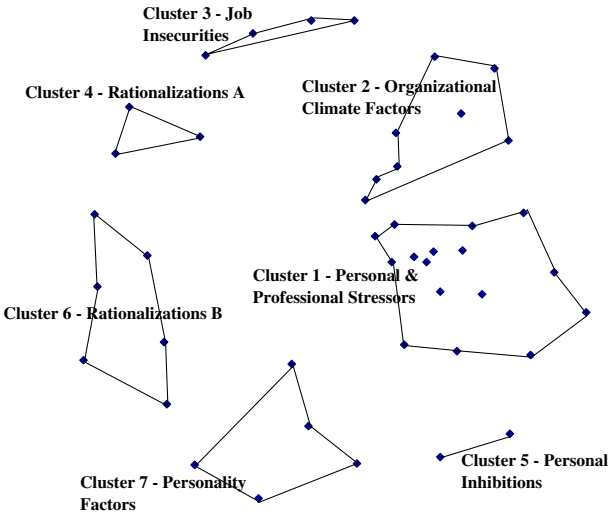

Fig. 3 Final 7 clusters in two-dimensional space

those 'tighter' clusters more easily defined by numerous explanations, and therefore have less confidence in those clusters composed of more dispersed data.

Another characteristic revealed by the schematic concerns the relative positions of each of the clusters in the two-dimensional plot. The individual items in Cluster 2—Organizational Climate Factors, therefore, appear to be much more closely related to Clusters 1 and 3 than they are to Cluster 6, given the relative Euclidian distances between clusters. As investigators study the geometric proximities of these clusters, they may choose to subjectively combine clusters that lie very close to one another.

Discussion and Conclusions

The results of data reduction techniques make it possible to identify seven groups of causal factors implicated in research misconduct. The first group, Personal and Professional Stressors, includes not only structural factors such as publish-or-perish pressure, but also a variety of situational stressors that may attenuate researchers' abilities to conduct research with integrity.

A second group, Organizational Climate Factors, concerns not only the larger organization, but also what has been referred to as group-level factors [19], those which characterize the environment of the laboratory. These factors reinforce the argument that institutions such as universities and smaller units within those institutions may play an indirect role by creating an atmosphere that facilitates misconduct through various forms of alienation.

Next are Job Insecurity Factors that inhere more in the individual than in his or her work environment. These could be interpreted as weaknesses in the respondent's

ability to withstand what may well be ordinary work pressures which other researchers learn to handle effectively.

Two factors, both of which address a variety of rationalizations offered by ORI respondents, are labeled Rationalization A and B, respectively. It seems that once offending researchers are caught, they tend to offer reasons for their behavior, many of which externalize the blame to others. These are similar to what Gresham Sykes and David Matza termed techniques of neutralization, which are formulated in advance of engaging in the deviant behavior [58]. There was evidence of denial of an injury, denial of responsibility and condemnation of the condemners. Due to the limitations of the data, it is not possible to know whether respondents formulated these rationalizations before they engaged in research misconduct or only after they were caught.

One unique contribution of this study is that it made use of attributions found in actual case files of research misconduct. Data from cases in which individuals were found to have committed scientific misconduct offer insights different from other methodologies such as surveys that call for subjects' opinions on why research misconduct occurs. This research was limited in that it only examined information contained within the case files for individuals who have had a finding of research misconduct by ORI. Nevertheless, these data help to further understanding of research misconduct, especially why those involved in it believe it occurs. Future research might explore causal factors implicated in cases in which research misconduct was alleged but not found by ORI. Also of interest would be instances of research misconduct investigated by administrative bodies other than the ORI.

Another contribution of this study is the application of the CMPM methodology. Previously, there were few systematic efforts to make empirical sense of causal factors implicated in research misconduct. The CMPM methodology makes it possible to spatially and graphically link explanations that coexist in real cases. This in turn not only allows refinement of theoretical explanations based on actual cases, but it also may help policy makers use these imputed causes as they propose changes in practices and procedures.

The results of this study may also be of interest to those charged with training and education in the responsible conduct of research (RCR). Courses designed to train research staff in the responsible conduct of research typically address the ORI's nine core areas [59]. Few would argue that such training is important, but what is lacking is sufficient attention to the causal factors that underlie irresponsible conduct. Consequently, web-based instructional modules might include segments addressing the structural realities of scientific research and how they indeed create pressures on the individual researcher to deviate from the responsible conduct of research. Accompanying this might be a list of proven, accepted strategies for managing these pressures.

Closely related to RCR education and training is the need to take steps to increase the awareness about employee assistance programs for all research staff, but particularly for researchers whose lives are known to include multiple stressors. Mid-level research managers could easily be trained to be aware of various stressors their subordinates face, as well as the implications that poorly managed stress can have for the individual researcher and the research environment.

This study also points to areas for future research. One possibility would be to employ more fully Trochim's CMPM methodology to determine the explanations for research misconduct by convening a group of stakeholders who would identify potential explanations for research misconduct. Each stakeholder would then individually structure the items, and rate them on relative importance. It would be interesting to compare and contrast how these stakeholders collectively structure possible explanations for research misconduct as compared to the results of this study.

Research on factors related to the irresponsible conduct of research can and eventually will have an impact on policy and practice. Evidence-based practice in such areas as health, child welfare and delinquency prevention have proven the value of linking etiological studies to preventive strategies.

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