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A social science: Using psychoneuroimmunology principles to promote career longevity, productivity, and meaning

Annelise A. Madison^{a,b,*}^a The Ohio State University, United States^b VA Boston Healthcare System, United States

A B S T R A C T

Over the past several decades, psychoneuroimmunologists have uncovered key principles (e.g., social support and stress management) that can inform future research content *and* conduct. That is, psychoneuroimmunology (PNI) can inform how scientists from all disciplines engage in the scientific method in a more sustainable manner. Dr. Janice Kiecolt-Glaser, a PNI pioneer, recently ended her long and celebrated career. Her unique engagement in the scientific method, including her mentorship style, is worthy of closer examination. As her final graduate student, I observed Dr. Kiecolt-Glaser's science and mentorship style at their full maturity. Her scientific content, remarkable in its own right, is the subject of commentaries and accolades; yet, her scientific conduct – the foundation of her success and innovation – deserves further consideration. This article outlines ten research conduct principles that Dr. Kiecolt-Glaser explicitly and implicitly taught: (1) applying the literature to one's own health behaviors; (2) knowing and remembering “the why” behind the science; (3) developing and adhering to a vision; (4) creating a streamlined workflow; (5) embracing team science; (6) pursuing depth and breadth; (7) communicating ideas clearly; (8) engaging in a daily rhythm of science; (9) treating trainees like future primary investigators; and (10) working toward clinical meaningfulness. These principles correspond to PNI findings and account for her health and longevity as a scientist.

1. Introduction

One tacit trope in academia is that a principal investigator's final trainees can struggle to garner adequate mentorship, negatively affecting their productivity. As Dr. Jan Kiecolt-Glaser's final graduate student, I had the opposite experience: She continued to innovate, ideate, and mentor even after her retirement, just recently advising me throughout my tenure-track job search – from crafting my job talk to accepting the University of Michigan's offer. Duty has never been her driving force; She was passionate about helping to create new knowledge – and even frameworks for knowledge (i.e., psychoneuroimmunology; PNI) – as well as mentoring the next generation of knowledge-creators. “The best predictor of future behavior is past behavior,” she often told me, which explains why she continued to explore new frontiers even as she approached retirement (e.g., the gut microbiome's connection with human behavior; [1–3]). Her innerworkings, as a paradigm shifter and pacesetter, meant that her lab was an efficient, productive foundry for high impact ideas until the day she retired. Moreover, she ensured that her science would endure by carefully recording methodological details in her scientific articles to ensure replicability, as well as training her students how to sustainably engage in the scientific method to advance the field. She modeled her scientific

method itself on principles that emerged from her science – building quality relationships (e.g., with participants, collaborators, and trainees), as well as maintaining a balanced, low-stress approach that fostered creativity.

She was a pioneer in what she studied and in how she studied it – her workstyle as a principal investigator mirroring her groundbreaking science. Moreover, her innovations have primed the field to address some of the most pressing issues plaguing mental health and medicine today, including autoimmune disease, long COVID, and treatment-resistant depression. This article explores ten principles of scientific engagement that Dr. Kiecolt-Glaser embodied, which likely contributed to her career impact and longevity. These conduct principles are rooted in her research content, and vice versa – a fully integrated science.

2. Scientific conduct principles

Dr. Kiecolt-Glaser demonstrated the following scientific conduct principles:

2.1. Apply the literature: the health behaviors of a health psychologist

It was 2016, and I had been reading Dr. Kiecolt-Glaser's work for

* The Ohio State University, Department of Psychology, 1835 Neil Avenue, Columbus, OH, 43210, United States

E-mail address: madison.119@osu.edu.

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years because it accessibly bridged several disciplines. As my introduction to PNI, her work was the primary reason I had spent years specializing from history and political science to biology and psychology. I was self-conscious of this non-traditional route in my first face-to-face meeting with her during my graduate school interview at The Ohio State University; later, she would tell me that my circuitous academic path conveyed passion and independent thinking. Upon first meeting her, I observed that she was using an under-desk peddler and had a yoga mat in her office. Through her health behaviors, she applied the literature and tried cutting-edge interventions on herself first.

Perhaps more notably, Dr. Kiecolt-Glaser adeptly integrated work and life, so that she had enough margin for creative ideas to spontaneously emerge. She understood that a stressful, last-minute workstyle yielded neither high-quality science nor career longevity, so she encouraged her trainees to manage their stress. Given her first major findings on the connection between academic stress and immune function [4], perhaps it is unsurprising that keeping my own autoimmune disease at bay during graduate school was a constant challenge. After I took a leave of absence due to a prolonged flare-up, Dr. Kiecolt-Glaser checked in with me regularly to ensure that I was following her lead by applying the literature to myself – managing stress and engaging in the health behaviors that blunt stress’s physiological impact. As I approached every major graduate school milestone, she reminded me to engage in a mindfulness practice or go for a run – two of my go-to stress management strategies.

2.2. Know the why

My physical ailment provided many necessary intangibles for my work – passion, a sense of urgency, and fodder for research questions. I hesitate to disclose this personal anecdote in a scientific outlet, but perhaps it belongs here. Dr. Kiecolt-Glaser, who had studied dementia caregiving for decades, demonstrated the power of intentional self-disclosure, or discussing “the why”: In her recent memoir, she detailed her heartbreaking experience of caring for her late husband, distinguished immunologist Dr. Ron Glaser, as he suffered from Alzheimer’s disease in the final years of his life [5]. She drew on her caregiving findings, relying on support from her loved ones and good friends during Dr. Glaser’s progressive decline. Then, with renewed vigor for this line of work, in one of her final longitudinal studies (R01AG069138; data collection ongoing and now led by Dr. Kiecolt-Glaser’s former trainee Dr. Lisa Christian), she sought to provide clarity on prior mixed findings on whether spousal dementia caregiving predicts improved or worsened health; she hypothesized that the answer could lie in molecular aging biomarkers, so she proposed to examine them longitudinally. By reengaging with this work after her own personal experience as a spousal dementia caregiver, Dr. Kiecolt-Glaser demonstrated that personal experiences fuel, rather than bias, this work, spurring on the quest for scientific truth.

2.3. Develop and adhere to your vision

I became a doctoral candidate the week the world shut down during the COVID-19 pandemic. In the months leading up to candidacy, I studied daily from 6am to 10am, and during the pandemic, there was no need to alter this routine. Dr. Kiecolt-Glaser encouraged me to develop a vision for my own work, with the goal of being focused rather than overextended. Following her advice, I scheduled time away from email and other demands to daily engage in research, reading, and writing. Although we were unable to collect data, it was a highly productive, ideation-rich time in which I developed my current and future research program. The irony was not lost on me: In this time of high social stress (i.e., isolation, loneliness) and immune challenge, my own PNI research program took shape. Even a global pandemic did not thwart Dr. Kiecolt-Glaser’s vision; she understood the direction of her work and modeled saying ‘no’ to seemingly good opportunities that fell outside of her clear

vision. Her foresight ensured that her science was methodical rather than stressful and haphazard.

2.4. Streamline the workflow

Dr. Kiecolt-Glaser explicitly and implicitly taught her trainees how to sustainably engage in science. She believed that space and time were integral to creative research ideas. Rather than overloading her schedule with meetings, she preferred to let ideas percolate even outside of the lab and meet only when necessary. She endorsed email dictation; audio-taped, rather than written feedback; efficient journal reviews; and dedicated daily writing time. Her lab functioned smoothly over the years because she hired and retained qualified, friendly people; provided them with scaled opportunities to thrive; delegated tasks to the appropriate level; had written systems for every task; and wrote grants that funded intriguing projects. Because her science existed at the nexus of several disciplines, she understood her role and value-added as a clinical psychologist, and she relied on expert collaborators from other disciplines. Her straightforward vision streamlined the workflow, generating sophisticated science in a manner that was sustainable throughout her long career.

2.5. Embrace team science: scientists need social support too

Dr. Kiecolt-Glaser modeled team science. Both the content and conduct of her research hinged on the strong connection between social ties and physical health. She sought meaningful collaborations – not simply for the sake of productivity, but also for mutual support. Effective study designs arose from her collaborations. For example, alongside Dr. Martha Belury, a fatty acid expert, she designed a within-subjects, randomized to sequence high-fat meal challenge, with subsequent behavioral, cognitive, and psychological tasks [6,7]. The two meals were identical in form, such that participants did not know whether they were eating the high oleic fat or the high saturated fat meal. Her collaborators’ expertise ran the gamut of microbiology, immunology, molecular biology, nutrition, oncology, and endocrinology. Like the immune system itself, Dr. Kiecolt-Glaser’s work boldly attacked multiple targets – thanks in large part to these collaborations. This innovative approach required a team, and this team further innovated; this baked-in social support carried Dr. Kiecolt-Glaser through her busy day, as well as through her illustrious career, creating meaning even in the slog of deadlines.

2.6. Pursue depth and breadth

With these collaborators, Dr. Kiecolt-Glaser branched out to different populations – medical students [4,8–10], dementia caregivers [11–13], cancer survivors [14,15], married couples [3,7,16,17]– using various stress paradigms to demonstrate for whom and to what extent stress affects immunological processes. Her research portfolio is wide-ranging, reflecting her insatiable curiosity and ability to develop oblique expertise through daily, focused reading. She modeled that a principal investigator is a life-long learner. During my graduate school interview, she conveyed her plan to study the gastrointestinal tract as a stress- and immune-relevant mechanism; she was especially interested in connecting the gut microbiota to human mood and behavior – previously uncharted territory. Recognizing that distinctions between physiological systems are arbitrary, Dr. Kiecolt-Glaser probed beyond the immune system (e.g., to the cardiovascular and gastrointestinal systems). She was interested in stress-relevant physiological mechanisms and processes first and foremost, above specific diseases or populations; therefore, she could never be pigeonholed or labelled anything other than a very general “stress researcher.” Her ability to flexibly shift from one population, paradigm, or disease to another was not at the expense of depth. A voracious reader, she understood the amount of reading required to be a cutting-edge expert in any area, and therefore,

confidently asserted that targeted expertise is valuable. She encouraged her students to pursue depth by developing two to three areas of expertise, as she had done with psychosocial stress, close relationships, and the immune system. These were the consistent throughlines of her expansive and varied research portfolio.

2.7. Communicate ideas clearly

Although Dr. Kiecolt-Glaser's science itself is often a source of awe, her clear communication is responsible for its impact and recognition across disciplines. She believed that an inter-disciplinary field like PNI could only flourish with accessible writing, devoid of jargon. Not only did she push the field of PNI forward with her elegant study designs, translational research questions, and novel empirical findings, she had a talent for synthesizing the literature in a concise and clarifying way; her reviews are a compass orienting the field to proceed in a unified direction. My first major obstacle in graduate school was learning to write (and in effect – think) scientifically via Dr. Kiecolt-Glaser's guidance. At first, she eliminated whole paragraphs, and I listened to multiple hour-long audio recordings explaining why these sections were problematic. In these audio tapes, I learned about her unparalleled scientific mind; details and concision mattered. Unclear thinking produced unclear writing. Hiding behind prepositional phrases indicated that I needed to achieve greater clarity in my thinking. Even so, writing was part of the process to achieve clarity; although Dr. Kiecolt-Glaser's final drafts were polished and concise, she often explored biological pathways, theoretical ideas, and synthesis in her initial drafts prior to editing.

Dr. Kiecolt-Glaser's communication was not only clear; it was confident. She walked the line of neither downplaying nor exaggerating her findings' importance. She instructed all trainees to speak confidently and excitedly about their findings when warranted. With concern, she circulated a study that found that male scientists convey their research findings more positively than female scientists – a practice associated with more citations [18]. She wanted good ideas and findings to have traction regardless of their source, and she wanted her trainees to excel, regardless of their sex. I noted that she began incorporating additional specific positive feedback into her audio recordings likely to uplift her trainees; it had its intended effect.

2.8. Develop a daily rhythm of scientific engagement

Dr. Kiecolt-Glaser's consistent, daily engagement in the scientific method is worth comment. She started each morning sipping mushroom coffee, peddling on her under-desk peddler, and reading the latest findings – not only from the top psychology and psychiatry journals, but also from nutrition, gastroenterology, and immunology. Her broad reading inspired her originality. She did not shy away from basic science findings, as she gravitated toward designing first-in-human, translational – and whenever possible longitudinal and experimental – studies. She then bookmarked, saved, and forwarded relevant articles to trainees and collaborators. With that accomplished, she embarked on her morning writing block, which she considered “a meeting with myself” – a mindset that barred her later-career administrative duties from encroaching on her passion. As she detailed in her memoir [5], she was an adherent and proponent of Robert Boice's writing method, which favors short, daily spurts of writing to longer and less frequent “binge” writing sessions [19]. She made effective use of this time; when I worked with her, these sessions incorporated mindfulness principles. A little laminated moniker near her elbow featured the words ‘mindful’ and ‘distracted’ on opposite sides, which she could turn to acknowledge when her mind had wandered. Her daily mindfulness practice, and even week-long silent meditation retreats, cultivated a vibrant, organized mental landscape that formed the backdrop of her creative research ideas.

2.9. Treat trainees as future principal investigators

Dr. Kiecolt-Glaser's trainees published secondary analyses from prior studies while helping to collect R01-funded longitudinal data. My secondary analyses tended to explore “immune-neuro-psychology” relationships; my psychological outcomes had been predictors in prior eras of her lab. She welcomed this approach. In fact, she included mood, behavioral, and cognitive measures after inflammatory stimuli as a critical part of study designs, even though they were not always part of the primary aims. When I met her, she had recently published an insightful review in *American Journal of Psychiatry* about the bidirectional relationship between inflammation and depression, which helped to explain the prevalence of “treatment-resistant” depression, as well as high rates of comorbidity with inflammatory diseases [20]. She was also beginning to consider the gut's role in human mood and behavior, paralleling her keen interest in nutrition and her understanding that gut health (i.e., bacteria, viruses, gut barrier function) partially dictates immune function [21]. Together, we began collecting data and publishing empirical articles and reviews on this topic [1,2,22–25].

She encouraged trainees' independent thinking with the expectation that we would generate and develop ideas and analyses prior to our meetings. She took these ideas seriously, as if her trainees themselves were principal investigators; she even allocated lab resources to support trainees' good ideas. She had a knack for identifying how a project fit into the larger body of evidence; her understanding of the literature was so deep yet easily accessible that she knew whether a project – even in its nascence – should move forward or whether it would be an unnecessary replication or – at worst – a step backward or red herring. She emphasized that although there are many possible questions to explore with the data, we should focus on developing and testing novel hypotheses that help to advance the field. She provided direct, no-nonsense feedback, which was refreshing and saved time that we might otherwise have wasted on dead-end projects. The upside: When a project was good, she conveyed that as well. The first time I received audio-taped feedback that was only 15 min long and relatively positive, it was particularly meaningful due to her objectivity.

Dr. Kiecolt-Glaser uplifted her trainees and promoted their work and ideas. She regularly advertised her up-and-coming doctoral students and post-doctoral scientists during her conference presentations. If the media contacted her about a trainee-led project, she directed them to the first author and then coached the trainee to interact with the media in a thoughtful and concise, yet accurate, manner. She frequently delegated her numerous writing and speaking invitations to her trainees. She was more than happy to share the spotlight, and she encouraged her trainees to step into it, voicing confidence in them as they did so.

I realize now that Dr. Kiecolt-Glaser's approach with trainees required a degree of humility. She respected trainees to such an extent that she even asked first-year graduate students for feedback on her manuscripts and grants prior to submission. She conveyed gratitude for their time. Dr. Kiecolt-Glaser had already achieved preeminence in her field and had little need for trainee feedback; yet, this practice displayed her true character, in that she treated people with the utmost respect, regardless of their position or title.

2.10. Work toward clinical meaningfulness

Despite the translational nature of her work, Dr. Kiecolt-Glaser kept clinical implications in the forefront of her mind. Her introductions, discussion sections, and reviews focus on clinical meaningfulness. She pushed her trainees to translate their statistical findings for a clinical audience. She also remained connected to participants' stories – inspiration for future research questions – and expressed appreciation for their time and effort – sending them thank-you notes, updates, and study results. She held stories from breast cancer survivors, dementia caregivers, and distressed spouses, and she encouraged her trainees to consider the clinical presentations or populations that first stirred our

interests.

In designing my own research program, I thought of two similar but distinct patient presentations that had disturbingly poor outcomes: Those with chronic depression or other immune-relevant disorder (e.g., autoimmune disease) failing standard-of-care treatment [26,27]. In fact, autoimmune disease and depression often present together [28,29] – an even more intractable combination, e.g., [41]. In both cases, psychosocial stress and inflammation may contribute to symptom severity and chronicity, and therefore they are ripe areas for PNI exploration and innovation. Neurons release and respond to proinflammatory cytokines, and immune cells release and receive neurotransmitters [31]; these basic pathways have yet to be fully exploited in autoimmune disease and depression. For example, rheumatoid arthritis (RA) patients with comorbid depression have 20–40 % reduced odds of achieving a good RA treatment response after one year on biologics compared to their non-depressed peers [41]. In a subset of these patients, RA-related inflammation may be driving depressive symptoms, and biologics like the TNF- α blocker etanercept may improve depressive symptoms alongside inflammatory levels and RA symptoms [33]; in other patients, the depression may have a different etiology, so an evidence-based psychotherapy for depression at biologic treatment initiation may improve the biologic's efficacy [34,35]. As another example of PNI's clinical relevance, it may be possible to classically condition the immune system, such that immunomodulating treatments, which themselves carry risks, can eventually be discontinued [36,37].

Following Dr. Kiecolt-Glaser's recent retirement, it is apt to consider the current clinical relevance of the field she helped to create – PNI. With loneliness as a pressing global health concern [38], it is no wonder that the prevalence of immune disorders and depression is rising [39,40]. Their “treatment-resistant” nature points to the need for PNI-informed interventions. Rather than viewing psychology as an adjunctive or supportive treatment, it can be a first-line tool of medicine – directly impacting disease onset, symptom severity, remission, and treatment efficacy. Dr. Kiecolt-Glaser's research conduct and content – truly a “social” science – can promote career sustainability, while also providing much-needed clinical innovation.

3. Conclusion

Dr. Kiecolt-Glaser's compendium of work is so impressive that her research conduct – legendary in and of itself – has not received the attention it deserves. Her science's success and sustainability hinged on her practice of incorporating PNI principles, including health behaviors, stress management, and team science's inherent social support, into her scientific endeavors. She also prioritized mentorship in such a way as to make the scientific method accessible and sustainable for her trainees – thus ensuring that her scientific content and conduct would continue into the next generation. Dr. Kiecolt-Glaser's model for scientific conduct is replicable across fields and could yield a more novel and engaging science.

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