BOARD # 355: EAGER GERMINATION: TRANSPIRE – Mentoring Postdocs via a transdisciplinary dialogic pedagogy for conceptualizing research questions with transformative potential

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Dr. Linda Vigdor is the Associate Director of Proposal Development at the Advanced Science Research Center of the Graduate Center, City University of New York. She is the PI on the NSF grant: EAGER GERMINATION: TRANSPIRE – A transdisciplinary dialogic pedagogy for conceptualizing research questions with transformative potential. Since 2015, Linda has created workshops and programs to help CUNY faculty better understand the expectations of funding agencies and write more competitive proposals. Her intensive NSF CAREER and Grants 101 bootcamps, which are open to CUNY faculty across all its colleges, have supported 21 NSF CAREER awards, and prepared over 150 faculty to submit and win awards. Linda was part of the planning committee and a presenter for NSF's Engineering CAREER workshops for 3 years and organized a CUNY-wide Convergence Workshop in 2018 as well as Broader Impacts presentations. Linda has a PhD in Educational Psychology from the University of Illinois at Urbana-Champaign; her postdoc, through the University of Arizona, focused on art and technoscience collaborations. She also earned two MFAs (fine art, School of Visual Arts, NYC) and theatrical design (Boston University).

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Rosemarie (Rose) Wesson serves as the Associate Vice Chancellor and University Vice Provost for Research at The City University of New York (CUNY), where her primary focus is advancing the University's research mission. Collaborating closely with the executive vice chancellor and university provost and the Chancellor, she leads strategic initiatives to foster and support research activities throughout CUNY.

Dr. Wesson's CUNY journey began as the associate dean for research at the Grove School of Engineering at the City College of New York (CCNY), where she achieved a remarkable 30% increase in research expenditures in less than five years. In 2020, she assumed the role of associate provost for research at CCNY, becoming the chief research officer and advocate for all research, scholarly, and creative endeavors. Her efforts centered on enhancing scholarly research across academic disciplines and establishing new institutional research programs through strategic partnerships within CCNY and CUNY's 24 other colleges and institutions.

With over 13 years of experience at the National Science Foundation (NSF), Dr. Wesson excelled as both a director and program director, securing over $100 million in funding. Her adept management of complex program demands earned her prestigious accolades, including the NSF Director's Award for Collaborative Integration and the NSF Director's Award for Superior Accomplishment.

Prior to her tenure at NSF, Dr. Wesson held influential leadership positions at Louisiana State University (LSU), Dow Chemical Company, and Battelle Memorial Institute. She has been elected as a fellow of the American Association for the Advancement of Science (AAAS) and the American Institute of Chemical Engineering (AIChE), recognizing her outstanding contributions to advancing science and its applications in the field of chemical engineering. Dr. Wesson served a three-year term on the board of directors for AIChE and recently held the position of AIChE treasurer.

With a solid technical foundation, Dr. Wesson holds an S.B. in chemical engineering from MIT and both an M.S. and Ph.D. in chemical engineering from the University of Michigan. She is also a licensed professional engineer.

JOSHUA Craig BRUMBERG

Joshua Brumberg became president of the CUNY Graduate Center in June 2024. An active neurobiology researcher, he has been a CUNY faculty member for more than two decades since his initial appointment

as assistant professor of psychology, in 2002. As dean of sciences at the Graduate Center from 2016 to 2023, he oversaw 11 STEM doctoral programs and five master of science programs, the latter created during his tenure. He also managed research operations, including the Office of Research and Sponsored Programs, at the Graduate Center and at CUNY ASRC. During his tenure as dean, he secured essential external funding for diversity programs in the laboratory sciences and gender equity in mathematics, and he co-chaired subcommittees for strategic plan development and Middle States accreditation. He also served twice as the acting executive director of the Advanced Science Research Center at the Graduate Center (CUNY ASRC).

EAGER GERMINATION: *TRANSPIRE – Mentoring Postdocs via a transdisciplinary dialogic pedagogy for conceptualizing research questions with transformative potential*

Linda Vigdor, PhD (PI), Rosemarie Wesson, PhD (co-PI), Joshua Brumberg, PhD (co-PI)*

In an episode of Freakonomics,[1] Brian Nosek spoke about one strategy for addressing academic research fraud – PIs would pre-register their research designs with a journal, to include the following:

> *The methodology that you're thinking about doing and why you're asking that question, and the background research supporting that question being important, and that methodology being an effective methodology. We'll review that. We don't know what the results are…**But we're going to review based on, do you have an important question?***[1] *(bold added).*

Being able to devise important – potentially transformative research questions (PTRQs) – is increasingly expected. Yet, PhD and postdoctoral research training often insufficiently prepares researchers to conceptualize the kinds of overarching research questions that foreground impactful, independent research careers. While emerging researchers become skilled in devising specific objectives, questions, or the tasks needed to guide specific research projects, they tend to have less experience with foregrounding the potential impacts (scientific &/or societal) of a research program or framing PTRQs.[2] Our **research questions** were:

1) What types of pedagogical approaches ground TRANSPIRE as a successful strategy for embedding students in the process of germinating PTRQs that have the potential to contribute to solving seemingly intractable scientific and societal challenges?
2) How and why does a transdisciplinary dialogic approach support change in helping students germinate more impactful research questions (even though their current projects are *not* expected to be transdisciplinary or team-driven)? What challenges remain?

To pilot the TRANSPIRE program, we focused on **two objectives**:

1) Design, deliver, and evaluate the TRANSPIRE program, with a focus on:
    a. How well does it enhance mentoring postdocs in germinating PTRQs?
    b. How do postdocs perceive the program's relevance and/or effectiveness?
    c. How do other stakeholders perceive the program's effectiveness in meeting personal professional goals and/or serving program or institutional needs?
2) Develop and test TRANSPIRE as a Theory of Change:
    a. How and why does this transdisciplinary dialogic approach support change and help postdocs germinate more impactful research questions?
    b. What aspects of the program are scalable?
    c. What challenges were identified in delivering or scaling the program?

Pedagogical approach & theoretical underpinnings

TRANSPIRE is based on the premise that a matrix of epistemologies, pragmatics, and values are needed to conceptualize and solve increasingly intractable problems.[3] Multiple factors coalesce when a researcher formulates a transformative research question. Such a question will contribute new knowledge to science, be methodologically sound, feasible, and, notably, lead to solving a

significant, previously intractable problem that has plagued science and society. It is this latter aspect that presents a significant challenge when educating emergent researchers.

TRANSPIRE is framed around several theories of learning. *Scaffolding* [4] posits that both peers and experts guide learners to progress beyond their current zones of comfort or expertise. *Design thinking* [5] emphasizes iteration and storytelling or visualization to illuminate or clarify how one thinks about a problem. *Mentoring* is critical, and both peer and senior mentors provide guidance and expand perspectives. *Transdisciplinarity* has recently entered the discourse around how people learn when siloed, discipline-based learning is no longer sufficient in a world facing increasingly complex problems [6]. *Reflective practice* [7][8], which involves questioning and understanding one's own and others' understandings, is not so much a learning theory but an orientation to being in the world, is central to adult learning [9] as well as to research and evaluation methodologies [10]. Each of these ideas were woven into our training and mentoring, albeit with varying degrees of success. One of the challenges seemed, upon reflection by the PI, due to many of these being well outside traditional STEM education approaches, particularly at the PhD and postdoc level.

The TRANSPIRE Program. We ran the program for 2 years; each year included two cohorts that would meet weekly, for 2 ½ hours/week. Sixteen postdocs in total participated; cohort groups included 4-6 postdocs (PDs), organized based on schedules and as much as possible some disciplinary diversity. Two faculty fellows (assistant or recent associate professors, 8 over the 2 years) and the PI attended and facilitated each meeting. The PI/facilitator presented concepts or strategies and guided discussions on topics such as what is meant by transformative research; what is an independent career path and what strategies are seen to be effective when preparing for such a path; what strategies have been taught for question germination and how useful have they been; and, what kinds of knowledge underlies types of research questions or goals? PDs were given writing assignments in the early weeks and then worked on two main projects, one each semester. Each PD developed a research statement for a job search (tenure track faculty or an industry research position); these were extensively discussed within the group and then presented to an advisory board of senior faculty for additional feedback. Each PD also developed a white paper for a grant proposal, with a similar presentation and discussion option. The facilitator and mentors prodded and guided the PDs to think more deeply about the critical problem(s) they posed and the scientific and the societal significance of their research questions. Discussions included how to effectively communicate their ideas to a broader audience as well as become more comfortable with incorporating perspectives from non-disciplinary experts. Along the way, this mentoring also included career development advice. This ability to interact with diverse scientific fields is a core aspect of team science or convergence research. Key is that scientists from different disciplines learn and work together to dissect a problem and challenge each other's thinking to re-conceptualize a research program. Such diverse standpoints and approaches open a space for new ideas to address globally significant scientific problems. One of the key aims of TRANSPIRE was to foster this type of cross-disciplinary dialogue to foster new ways of thinking about germinating research questions.

Data & analysis

The PI and/or the external evaluator gathered the following data types: pre and post surveys, recordings of meetings, PDs' work products, focus groups with PDs and faculty fellows,

interviews with some PD supervisors, and participant observations by the PI. The analysis was entirely qualitative, using conventional and directed content analyses.[11] Given the small number of participants, we note that our findings are limited and perhaps unique to our university. That said, many of the challenges we encountered are not unique to us but reflect the postdoc experience and perhaps highlight some gaps in PhD training more broadly.

A not-insignificant learning curve in thinking bigger about research questions:

For most of our postdocs, thinking about the intersection of a critical problem to solve, the societal and scientific potential impacts, any potential innovation, and articulating a coherent and compelling research question was a new way of thinking about their research. For example:

> *We started out with, "what's a research question?" And I was like, oh, my gosh, this is for kindergartners, we've all spent like 10 years learning what a research question is. But actually, it turned out to be a thing that I still struggle with the most: how to construct the question in a way that really works.* Postdoctoral Subject 3 interview, 1/19/23

For some postdocs, the program helped them to think through their career options and goals; for some a tenure track faculty position was the key goal. For others, a research position in industry was the aim and for others, there may not have been a clear motivation to advance beyond a postdoc or research associate position.

> My postdoc was *"torn between academia and industry…[They're] one of the best I've had. But it was this challenge of, should I work on fundamental questions in Academia versus go to industry?* Supervisor 3 interview (re Postdoctoral Subject 7), 7/2/24

However, many of the postdocs noted challenges due to their primary workload or to real or perceived resistance from their supervisors regarding their participation in TRANSPIRE.

> *I tried not to remind my supervisor I was in this program, because he might not think it was the best use of my time. "*Anton," post survey

> *At the end of the day, when you're a traditional postdoc, you're doing someone else's work [and] you're being expected to focus on that like a hundred percent. So, we need to have almost like a contract with your advisor to be like, hey, this is gonna be like twenty percent of my work.* Postdoctoral Subject 1 interview, 12/6/23

Successes, challenges & opportunities

Some of the challenges that emerged reflect a confluence of factors: the varied understandings of the postdoc role and how these intersect with faculty and institutional priorities. Ours is not the only institution facing a more limited pool of postdocs to recruit.[12] Thus, recruitment was an issue that shaped the experience and our planned approach. The small pool of postdocs, nearly all in a few disciplines (physics, biology, engineering) made the groups less transdisciplinary than anticipated. Additionally, PDs and faculty supervisors (and perhaps higher administration) hold varying expectations around the postdoc role. PDs intent on pursing a tenure track position came with different goals than did those aiming for an industry position; and a few were struggling to figure out what would come after their postdoc position.

Many Advisory Board members (which included social scientists) had quite limited availability even for the two events scheduled. The PDs also had varying degrees of engagement with the TRANSPIRE program. Supervisors may have discouraged or didn't allow participation during work hours – or the PD anticipated resistance and proceeded as if it was real. Most PDs faced work responsibilities such that there was limited time available for TRANSPIRE activities. And some PDs had personal commitments or challenges that interfered with their participation.

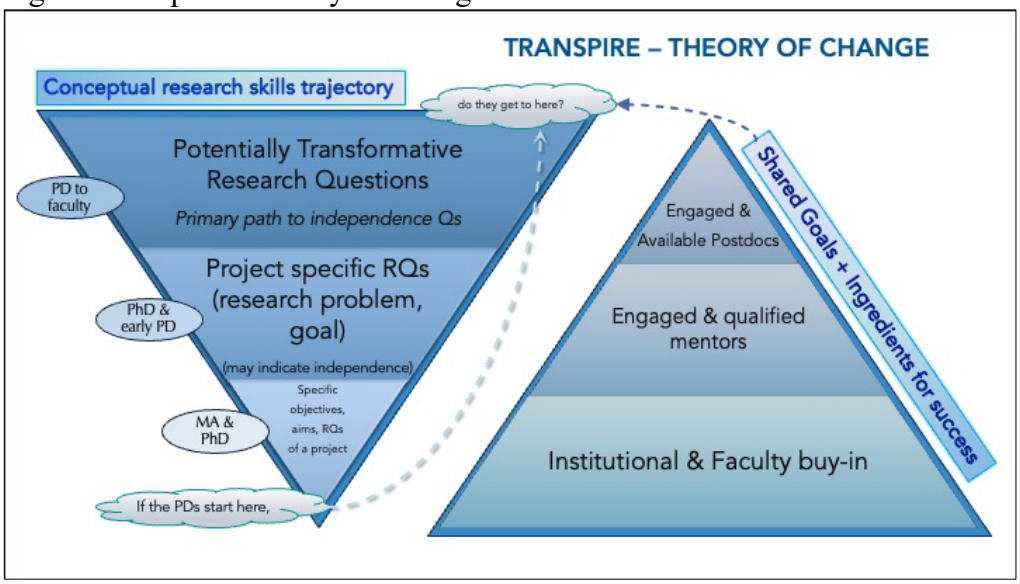
The faculty fellows were among the most committed and engaged participants. Each was invited by the PI based on prior relationships (most had previously participated in her NSF CAREER bootcamps) and their research areas. Interviews and focus groups conducted by the evaluator revealed that these fellows gained a great deal from their participation.

> *The program … also indirectly impacted the faculty mentors. Individuals in this position reported new knowledge and skills around transformative research and mentorship. The program purposely selected mentors who attended faculty bootcamps for grant writing and research development. The TRANSPIRE program complemented their original work and helped individuals to further develop their research concepts and mentoring plans.*

The program modeled effective approaches to mentoring, and indirectly supported participants and faculty in reflecting on–and in some cases, strengthening—how they supported students and staff. Postdoctoral researchers and faculty mentors reported new understandings of transformative research following participation Postdoctoral researchers felt that the program helped them to think about—and in some cases, directly supported—their career trajectories. Postdoctoral researchers and faculty mentors walked away with new perspectives on mentoring to take into their current or future roles.[13]

Based on our experience, observations, data, and analyses, we propose Figure 2 as a **Theory of Change**. This TOC is meant to highlight how even a successful training and mentoring program exists within a greater cultural context – in this case, a matrix of available and interested postdocs, mentors, and supports – wherein substantive buy-in from postdocs' supervisors/PIs and the institution is needed for such a program to be effectively implemented.

Figure 2: Proposed Theory of Change



One of the faculty fellows provided this perspective that summarizes both a need and the challenges of enacting a program like TRANSPIRE:

> *Maybe actually making [TRANSPIRE] a bigger scale and more formal – like, the formal nature of it would help faculty take it seriously and be like, okay, this is something that college system postdocs do. I don't know if you could ever make it a requirement; like, this is a part of the normal progression.* Faculty Mentor 3, 4/26/24

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