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Nurse Scientists Overcoming Challenges to Lead Transdisciplinary Research Teams

Shawn M. Kneipp, Ph.D., RN, ANP-BC, APHN-BC[1] **[Associate Professor]**, **Donna Gilleskie, Ph.D.**[2] **[Professor]**, **Amanda Sheely, Ph.D., MSW, MPH**[3] **[Assistant Professor]**, **Todd Schwartz, DrPH**[4] **[Research Associate Professor]**, **Robert M. Gilmore**[5], and **Daryl Atkinson, JD**[6]

[1]School of Nursing, The University of North Carolina at Chapel Hill

[2]Department of Economics, The University of North Carolina at Chapel Hill

[3]School of Social Policy, The London School of Economics

[4]School of Nursing & The Gillings Global School of Public Health, The University of North Carolina at Chapel Hill

[5]Work First Program Manager, Department of Social Services, Orange County, North Carolina

[6]The Southern Coalition for Social Justice, Durham, North Carolina

Abstract

Increasingly, scientific funding agencies are requiring that researchers move toward an integrated, transdisciplinary team science paradigm. While the barriers to and rewards of conducting this type of research have been discussed in the literature, examples of how nurse investigators have led these teams to reconcile the differences in theoretical, methodological, and/or analytic perspectives that inevitably exist are lacking. In this article, we describe these developmental trajectory challenges through a case study of one transdisciplinary team, focusing on team member characteristics and the leadership tasks associated with successful transdisciplinary science teams in the literature. Specifically, we describe how overcoming these challenges has been essential to examining the complex, and potentially cumulative effects that key intersections between legal, social welfare, and labor market systems may have on the health of disadvantaged women. Finally, we discuss this difficult, but rewarding work within the context of lessons learned and transdisciplinary team research in relation to the future of nursing science.

"The difficulty lies not in the new ideas, but in escaping the old ones."

— John Maynard Keynes (1936)

Noted over 75 years ago, this statement remains highly relevant for scientists today. Federal initiatives within agencies such as the National Institutes of Health (NIH) and the National Science Foundation (2011) are urging scientists to rethink the phenomenon they seek to understand from different disciplinary perspectives (NIH, 2011, p. 5; NSF, 2011). These initiatives are, at least in part, based on the premise that viewing the same phenomenon or problem from multiple perspectives will facilitate not only scientific discovery, but also more rapid translation of findings into the settings where they will have the greatest utility. In response, and often with significant effort to overcome existing challenges, scientists have

undertaken many different forms of what is generally referred to in the literature as interdisciplinary research (Stokols, Misra, Moser, Hall, & Taylor, 2008).

In a landmark paper that predates recent interdisciplinary initiatives, Rosenfield (1992) made a number of key observations from her study of research teams that included investigators from the social sciences and from medicine working on common public health problems. Among them, two of the most important were: (1) that the models of scientific collaboration differ by the level of theoretical and methodological integration that occurs within teams, and (2) that the academic, career, and societal/health outcomes from the research vary based on the level of integration. Given these findings, she recommended a taxonomy be applied to characterize these differences, with *multidisciplinary*, *interdisciplinary*, and *transdisciplinary* research representing distinct forms of collaborative research. From this taxonomy, *multidisciplinary* research represents the most basic level, is characterized by members working independently and sequentially, and by members maintaining the theoretical and methodological perspectives of their own disciplines. *Interdisciplinary* research is considered a more advanced form of collaboration, occurring when team members work jointly to add — but not integrate — independent theoretical and methodological perspectives where needed. Finally, *transdisciplinary* research is considered the most progressive form, and is conducted when team members integrate — or fully synthesize — concepts, theories, and/or methods across disciplinary perspective. Although clearly differentiated by Rosenfield as early as 1992, multi-, inter-, and transdisciplinary research have often continue to be used synonymously. The most frequently used of these terms – *interdisciplinary research* – has been cited as taking on such an array of meanings that it cannot be said to characterize any unique form of scientific collaboration based on its use in the literature (Klein, 2008). Even with the robust team science agenda originating from NIH, and the “transdisciplinary” initiatives within the *Roadmap* – NIH has not clearly defined how the composition and/or functioning of transdisciplinary research teams differ from those operating within a multidisciplinary or interdisciplinary framework.(National Institutes of Health, 1998, 2012; Stokols, Misra, et al., 2008) Although there is some agreement that research benefits when perspectives from multiple disciplines come together at *any* level, transdisciplinary research is considered most likely to result in the theoretical and methodological paradigm shifts that Kuhn (1996) posited are essential for scientific progress to occur (Stokols, Hall, Taylor, & Moser, 2008).

Despite funding incentives and the genuine desires of researchers to engage in transdisciplinary research, few teams are able to overcome the inherent challenges of generating collaborative projects, and even fewer are able to achieve long-term success. Scholars from diverse fields have chronicled these challenges, attributing many transdisciplinary team failures to the negotiation required to genuinely integrate perspectives (Angelstam et al., 2013; Gray, 2008; Kessel & Rosenfield, 2008; Klein, 2008; Rosenfield, 1992; Stokols, Hall, et al., 2008; Stokols, Harvey, Gress, Fuqua, & Phillips, 2005; Stokols, Misra, et al., 2008). As such, this form of collaborative research is highly labor-intensive, and almost inevitably leads to some degree of conflict within the team (Gray, 2008; Kessel & Rosenfield, 2008; Stokols, Misra, et al., 2008). Given these inherent difficulties, there has been a growing interest in understanding what contextual factors and leadership qualities can best facilitate successfully launching and sustaining transdisciplinary research teams.

Transdisciplinary Science Representation in Nursing Research

In the nursing literature, scholars have tended to characterize most team science as "interdisciplinary." Much of the writing in this area has focused on the greater inclusion of nurse scientists on interdisciplinary teams (Broome, 2007; McCloskey & Maas, 1998). Some scholars have pointed to the contributions nurse scientists can make as either members of or leading interdisciplinary teams given the skills they acquire related to interpersonal communication, crossing cultural boundaries, and coordinating the efforts of diverse groups when providing care to individuals and/or communities (McBride, 2010; McCloskey & Maas, 1998; Woods & Magyary, 2010). Grey & Connolly (2008) trace the lineage of interdisciplinary collaboration in nursing, noting that it has been historically robust among public health nurses. They attribute this in part due to the fact that public health practice is less physician-centered and highly dependent on collaboration across a wide array of health and social science disciplines. Despite more recent calls within the discipline for nurse scientists to more astutely attend to the differences between the different forms of team science, and embrace the challenges and opportunities that accompany *trans*disciplinary research, its representation in terms of funding by NIH generally, and the National Institute of Nursing Research (NINR), more specifically, has remained negligible (Grey & Connolly, 2008; Mitchell, 2005).

While it is difficult to come to any definitive conclusion about why transdisciplinary research lags behind other forms of team science in nursing, the challenges of transdisciplinary work likely plays a key role. Other than having the opportunity to participate directly on transdisciplinary teams as a student, postdoctoral fellow, or junior faculty member, detailed descriptions of the experiences nurse investigators have had working on transdisciplinary science teams are lacking in the literature. Although we found one case study of a transdisciplinary team led by a nurse and physician that focused on ethical perspectives (Austin, Park, & Goble, 2008), we found no examples of how nurse-led transdisciplinary teams have overcome obstacles that arise when integrating theory and methods perspectives. To that end, the case study presented here details the developmental trajectory of a nurse-led transdisciplinary team and how the team overcame language, theory integration, and analytic modeling barriers across different disciplines. Moreover, it describes the team's experience within the context of characteristics associated with successful transdisciplinary team science outcomes in the literature.

Pilot Findings Raise New Questions

During a pilot study using a community-based participatory research (CBPR) approach with women in *Work First* (North Carolina's 'welfare-to-work' program), one-third of study participants prioritized a prior criminal record as *the* primary problem to improving their quality of life and health. Their rationale for this as a priority related to the fact that it precluded their ability to secure employment and/or relevant educational opportunities in order to become more economically self-sufficient and provide even the most basic economic support for themselves and their families. The criminal offenses committed by women in the pilot study were non-violent misdemeanors in which no jail sentence was served, and were often committed years ago. Despite this, study participants articulated the

pathways through which the lingering effects of these criminal convictions were major barriers to improving their socioeconomic conditions, quality of life, and health. In particular, the women described their high level of psychosocial distress as a consequence of the prior minor prior criminal record. Put differently, women situated their criminal record-related barrier to employment as a key social determinant of their health.

Early Collaborative Efforts

These findings were discussed with community partners in the *Work First* program that the principal investigator (PI) had collaborated with over the prior three years – who reaffirmed the potential health-related implications of these barriers – particularly given the high prevalence of psychosocial distress and depression in this population (Kneipp et al., 2011). Additional discussions were held with women who have been in the *Work First* program and who are research advisors to the first author, and a research colleague from the School of Social Work with expertise in TANF policy and public health. Their insights shed further light on the mechanistic pathways through which the criminal justice system, TANF program policies, and labor market dynamics might intersect to influence both mental and physical dimensions of health.

Based on these findings, the PI and a co-investigator (co-I) colleague in social work conducted a comprehensive literature synthesis to determine how health disparities researchers have empirically examined whether a criminal record influences health via employment, and whether the job search services provided through TANF modified employment and health outcomes for women with a criminal conviction. From the 47 reports of empirical findings that were synthesized, none of the studies had been designed to examine the causal mechanisms operating *at the intersections of* the criminal justice, welfare, and labor market systems that disproportionately affect socioeconomically disadvantaged groups. To move a research agenda forward, this initial group needed to bring others onto the team with expertise in criminal justice / law, and the statistical expertise required to analytically model the complexity of the problem at hand. Additional collaborators that would ultimately be brought onto the research team included: (1) two prior public criminal defense attorneys with experience serving disadvantaged populations – one academically-oriented from the School of Government, and the other from a local non-profit community-based agency; (2) an applied econometrician from an academic Department of Economics with expertise in modeling complex systems data; and (3) a biostatistician who had previously collaborated on research projects with the PI, and who is skilled in fostering the understanding of difficult statistical concepts to more applied research audiences across health-related disciplines.

Scholars have noted that the involvement of both community stakeholders and scientists in the research who are bound together by a commitment to solve a complex, real-world problem is essential to a transdisciplinary team's success (Walter, Helgenberger, Wiek, & Scholz, 2007; Wickson, Carew, & Russell, 2006). Team success has been more likely when the research questions originate from real-world, rather than theoretical problems, and when the end contributions of the research have transformative potential through direct applicability to communities. Nurse investigators conducting community engaged research

will readily recognize these key features of transdisciplinary research success given they are also requisites of a community-based participatory research (CBPR) approach, and are well-suited to lead these scientific efforts (Minkler, 2005).

Overcoming Challenges on the Developmental Trajectory

Stokols and colleagues have led the field in this area by both synthesizing relevant literature to delineate the 'ecology' of team science and advancing the 'science' of team science (Stokols, Hall, et al., 2008; Stokols et al., 2005; Stokols, Misra, et al., 2008). They found a team's ability to achieve a level of functioning commensurate with the high level of integration that characterizes transdisciplinary research is dependent on six factors, which reflect intrapersonal, interpersonal, organizational/ institutional, physical/environmental, technologic, and sociopolitical contexts. Nash (2008) identified the challenges confronted in transdisciplinary team science as generally cultural in nature, citing the need to learn different disciplinary languages as "one of the most time-consuming, confusing, frustrating experiences" (p.S134). Others have focused on what is required of individual team members generally, and the investigator leading the team, more specifically, to conduct transdisciplinary research. In addition to a shared commitment to solving a problem, Kessel & Rosenfield (2008) cite the following as traits essential for team members conducting transdisciplinary work: "*rigor* in argument, taking into account all existing data … *openness* [to accept] the unknown, the unexpected and the unforeseeable, [and] *tolerance* [of] ideas and truths opposed to our own" (p.S226).

Gray (2008) delineates the cognitive, structural, and process tasks that investigators leading teams must carry out to successfully overcome the challenges of transdisciplinary work. She describes the *cognitive tasks* required as largely relating to the "management of meaning", where they: (1) envision and convey how diverse disciplinary perspectives can intersect in constructive ways when applied to a specific problem, (2) motivate members to align their respective scientific interests with a larger goal, and (3) facilitate members to "break out of past mindsets and open up the content of new agendas" (p.3). *Structural tasks* address coordination needs, and are attended to when team leaders act as brokers within the system by "building linkages among previously unrelated parties … [ameliorating] power and status differences among diverse groups … [and] serve as translators to facilitate alliances across cultural boundaries" (p.5). Finally, attending to *process tasks* ensures team member interactions are "instructive and productive", and that emotional responses from funding or publication disappointments are acknowledged but then redirected to "reorient the team's efforts toward their long-term goals" (p.6).

Our team members quickly confronted these inherent challenges as we set out to respond to two Requests for Applications (RFAs) from the National Institutes of Health (NIH) and the National Science Foundation (NSF). With the problem at hand well-defined and understood across team members, the background and significance section of the research proposal was written with relative ease. Conceptual agreement around theoretical perspectives and the analytic methods in the team's initial discussion of the research was strained, however, as we struggled to find common language when writing the proposals. The language-related barriers that surfaced are described in the next section, with examples of theory integration

and analytic modeling discussed in relation to team members' traits and the tasks that investigators leading transdisciplinary teams must take on to overcome the conflicts that arise.

Theory Integration Challenges—Within the confines of what often feel like insufficient page limits to write a coherent research proposal, we were confronted with integrating theoretical perspectives related to the social determinants of health and behavioral economics. With roots in public health, the language of a social determinant of health (SDOH) perspective takes on qualities that may be best described as non-judgmental in nature. From this perspective, the lifestyle and health-related choices of individuals are understood as being heavily shaped by the environmental conditions in which they live, work, and play (Braveman, Egerter, & Williams, 2011), rather than from an individualistic, predominantly autonomous decision-making framework. When articulating the theory underlying the research, the PI and co-I from social work had conceptualized and discussed the problem of interest with other team members based on a SDOH model. Given the general agreement from others regarding the logical fit of the problem with this perspective, these investigators made assumptions around this framework serving as “the” theoretical framework for the proposed research.

Many – if not, arguably, most – scientists in public health, nursing, or other health or social science fields are taught to (in stepwise fashion) employ a theory or framework to study the relationships of interest, select variables and measures, and then move on to select an appropriate analytic approach based on the study design and other factors. Notably, under this sequential approach, the decision to adopt a SDOH framework to guide the empirical work does not assume that any particular analytic or statistical approach must be used. In contrast, the empirical or analytic modeling employed in the field of economics is driven by and embedded within economic theory – most notably, Rational Choice Theory (RCT). As such, for the econometrician on the team, the idea of proposing an analytic model guided solely by a SDOH framework was completely incongruent with the scientific practices of her discipline. With these differences in perspectives, we came to the realization that both conceptualizing the problem, and deriving a theoretically-grounded, and rigorous econometric approach to understand this highly complex problem was dependent on synthesizing these theoretical positions.

Historically, a commonly held assumption of what constitutes ‘rationality’ within RCT has been defined by behavioral norms or expectations, whereby individuals act on preferences that are based solely in economic self-interest – originally assumed (by the non-economists on the team) to be in direct conflict with a SDOH perspective (Quackenbush, 2004). This juxtaposition brought the first major challenge to the team, and required members operate with tolerance and openness (traits cited as critical by Kessel & Rosenfield (2008)) to better understand the bases of these theories if there was any hope of reconciliation. It also required the PI to assume the cognitive task of “meaning management” described by Gray (2008) – so that points of potential intersection in the concepts and relational statements within each of these theories could be negotiated for novel, constructive purposes, if possible. Further examination of RCT found that in recent decades, scholars have applied critical sociological and psychological analyses to redefine the traditional boundaries of

'rationality' in the theory. In a modern account of the concept of 'rationality', preferences reflect more than personal economic gain, and the constraints in the social and environmental context are increasingly recognized as limiting the options available to individuals to act on any set of preferences – economically-driven or not (Hausman, 2011; Quackenbush, 2004). This expanded view of RCT facilitated shared meaning, or common ground, to be found between a SDOH model from public health and RCT from economics, thus allowing the team to integrate these perspectives and capitalize on the empirical modeling strengths that RCT could offer. As one example of how the conceptual and empirical/analytical basis of the research was dependent on theory integration, the conceptual model from the proposed work is depicted in Figure 1.

Analytic Modeling Language Challenges—Without question, the language challenges around discipline-specific analytic modeling approach differences were the most difficult to overcome. There were several reasons that approaching data analysis using an econometric, dynamic modeling approach was appealing to the PI. These included the complexity of the problem, the recursive feedback loops that needed to be accounted for in the longitudinal data set, the causal inference strengths of dynamic modeling, the pragmatic benefits of the simulation (or 'forecasting') capability of dynamic modeling, and RFA incentives to apply this modeling in order to more fully understand the mechanisms underlying complex health phenomenon.

Initial conversations with the economist on the team highlighted that she: (1) was very committed to the problem of interest and goals of the research, (2) was highly regarded in her field and had made significant contributions using dynamic modeling, and (3) "spoke" largely in mathematical equations – while the investigators from nursing and social work "spoke" predominantly in conceptually-grounded analytic terms. The significance of the language difference became apparent, and to no small extent – increasingly frustrating – when the PI and co-I from social work would ask a question to clarify unfamiliar modeling terminology that was used by the econometrician, expect a conceptual answer that could be described in relation to the terms used in our disciplines, and have the question answered largely in statistical symbols and equation format. To provide a clear example of such an encounter, we describe in detail here a conversation around the use of the term 'unobserved heterogeneity.'

In one of our earliest, formative conversations (and prior to having the biostatistician on the team), the econometrician stated that most of the analytic modeling methods in the health sciences do not account for 'unobserved heterogeneity', which can adversely affect the precision of the estimates we derive from the analyses. Being unfamiliar with this term, when ask to clarify, the econometrician briefly explained the term reflected correlated error terms between the variables of interest in the model and the 'unobservables.' When asked to clarify 'unobservables,' she explained these included all of the variables that were not going to be in the model – that were not measured, and that were not in the longitudinal data set we would be using – but that must be accounted for in the dynamic model to recover causal effects of variables of interest. The method she proposed involved parametrizing the potential correlation (across both time and outcomes of interest) and estimating the distribution of these unobservables. Based on conceptions of modeling from the nursing and

social work disciplines – typically through regression approaches – whether and how it was possible to "control" for variables that were unobserved, and that we had no access to in the dataset seemed farfetched to us. Our attempts to bridge the language differences using analytic terms common to us – for example, "controlling for confounding", and the use of "covariates" in a model to accomplish this, did not resonate with the econometrician, and failed to bring us any closer to mutual understanding. In a subsequent meeting, the econometrician presented a set of variable definitions and equations (see Figure 2) in an attempt to better explain the dynamic, discrete choice optimization problem of the individual, which would help motivate the empirical model of jointly estimated individual demand and health production functions. While this did help to visualize where and how the variables of interest were being represented empirically, the chasm between disciplines in analytic terminology, the 'forms' of language used (i.e., conceptually-clarifying narratives versus mathematical formulas), and ultimately, the ability to achieve mutual understanding, remained daunting. Eager to submit funding proposals, the PI and co-I from social work debated abandoning the dynamic econometric approach altogether and applying more familiar analytic methods.

This represented a critical decision-making juncture in the team's formation and development of the research, requiring the PI to step back and reassess the goals of the work altogether. During this reflective period, it became clear that the primary goal of the PI was *not* to maintain a highly diverse interdisciplinary team for the sake of doing so. Rather, the PI's motivations for pursuing an analytic approach (and, by extension, the disciplinary composition of the team) were driven by the need to forge new ways of understanding a highly complex problem, and the degree of scientific rigor, pragmatic utility – and therefore transformative potential – the findings could have for ameliorating health inequities.

While academic partners on the team were seeking analytic comprehensiveness and accuracy, community partners on the team found the simulation potential of the dynamic modeling approach most compelling. For the *Work First* administrator and the lawyer/community advocate on the team, the ability to report findings that could be cited in terms of "if X% more women with a criminal conviction of Y became employed within 1 year of Y, depression rates at 1, 5, and 9 years in this disadvantaged population of women would decrease by Z1, Z2, and Z3%, respectively" would be highly persuasive to the policy-making audiences they must report to, interact with, and try to negotiate changes in program implementation, state statutes, or city ordinances with on a continual basis. Although not without reservation, the PI remained committed to maximizing the social change potential a dynamic modeling approach could bring. As such, the PI added a biostatistician to the team who had been following the proposal ideas and development, and who has the unique ability to translate highly technical, statistical concepts into narratives that can be readily understood by more applied research audiences.

In terms of leadership tasks relevant to transdisciplinary team-building, the PI's energies then went to conducting the *cognitive tasks* of motivating other team members to align their respective scientific interests with the larger goal, and to "break out of past mindsets and open up the content of new agendas" as described by Gray (2008). Ultimately, this resulted in the economist spending many hours reading about mediation and moderation testing

approaches used in the social sciences (which would be required to meet one of the specific aims), and the other academic partners spending many hours learning about principles of econometric analyses and dynamic modeling. Over a 3-month period of further face-to-face, phone, and email team conversation, the academic partners had sufficient shared understanding to negotiate writing the methods section of the proposal. Two research proposals were submitted, with the dynamic modeling description / analysis section written predominantly in the language econometricians would be familiar with (and who were to be represented on study sections), but also embedding terms to indicate how mediation and moderated-mediation analyses would be conducted using the dynamic model.

Scientific Review Feedback and Transdisciplinary Team Maturation—Although "scored" and considered competitive on several fronts, neither proposal received funding consideration on the first submission. Across reviewers from both NIH and NSF, the diversity of the research team in terms of academic and community partnerships, the range of disciplines represented, the significance of the problem, clarity of the aims, and the integration of SDOH and RCT theory were reviewed very favorably. One reviewer, in particular, commented:

> "It is not typical for teams as disciplinarily diverse (disparate) as this team is to find common ground either theoretically or methodologically. Each individual researcher could have pursued a piece of the puzzle, focusing, for example, on a policy analysis of poverty interventions, a small-scale analysis of health disparities within a particular community, or a statistical analysis left uninformed by criminal justice processes in practice. *Surprisingly, they have forged a workable research collaboration* [emphasis added]" (NSF Reviewer, personal communication, June 13, 2013).

Despite these more favorable comments, reviewers across agencies raised concerns about the ability of the analytic approach to deliver findings that could establish causal relationships among the variables of interest. Although the breadth and depth of reviewer feedback from NIH has waned in recent years – making interpretation increasingly difficult – these causal relationship critiques were often made in tandem with comments that also reflected uncertainty around which pathways in the model were being tested (as depicted in Figure 1), and what specific advantages a dynamic modeling approach would bring that other analytic approaches could not. These comments indicated we had to (1) better communicate the modeling approach by conveying econometric concepts and terms within the analytic language more common to investigators in the health and social sciences, and (2) show the pathways being tested in a diagram that may be more familiar to investigators in the health and social sciences, rather than those with predominantly econometric backgrounds.

With the team in a nascent stage of development at the time these review comments and funding rejections were received, the PI focused on the *process tasks* of dealing with the team's emotional responses, reorienting the group to the long-term research goals, and ensuring that discussions around reviewer comments were instructive, productive, and focused on how to mount a response as opposed to "which discipline or team members' contributions" were most responsible for the failed funding attempt (Gray, 2008). The fact

that the team received praise in several areas of the proposal, and appeared to have gotten much of the science “right” provided the motivation to work diligently toward revisions. This entailed the academic team members work to further understand, and more clearly explain the roles of “endogeneity,” “exogenous variables,” “permanent and time-varying unobserved heterogeneity,” and “structural dependence” in relation to common modeling approaches used in the health and social sciences, and the causal inferences that can be made from the findings. It also required that the econometrician reframe how a dynamic modeling approach can be used to sequentially test the individual pathways many in the health and social sciences visualize when thinking about mediation and moderated-mediation. The result was an introduction to the analysis section explaining these terms using analogies based on terms readily understood in the health and social sciences (i.e., “confounding”, “correlated error terms”, etc.) and a description of the advantages a dynamic modeling approach can bring to better address them. It also resulted in the addition of a figure that more clearly depicted the specific mediated (β_{c3}, β_{c5}, β_{c2}, α_{c4} and β_{c5}) and moderated-mediated (α_{cr4}, γ, and δ) pathways being tested (see Figure 3) than what could be ascertained from solely the original model (Figure 1).

As of this writing, the revised NIH proposal is under scientific review. Although we remain hopeful, we must wait to hear the outcome of our attempt to better synthesize, or integrate, the analytic methods by using a language that is accessible across disciplinary boundaries, and in a way that reflects transdisciplinary research. In the interim, the team has made contingency plans to pursue – and have pursued – different avenues to support completing the research, given that all members of the team fundamentally believe in the importance of the questions being asked, and the societal need for answers.

Discussion

Returning to the lesson of the opening quote by Keynes, much of what has taken place in the developmental trajectory of this research team includes the deliberate effort of escaping old (and at times tenaciously entrenched) ideas so that new ideas can take shape. A noted scholar who has written on the topic of scientific progress, Kuhn (1996) characterizes this redistribution of old and new ideas as moving away from operating in a “normal science” mode of inquiry toward one that represents a “paradigm shift.” Other scholars would describe the statement by Keynes in terms of intellectual humility – that is, avoiding the fundamentalist tendency of believing a single perspective or approach (i.e., the one you, as an individual scientist holds) is the only one that is “right” (Rauch, 1993). Still others would relate to Keynes' statement on sociopolitical or cultural fronts, whereby clinging to “old” ideas represents a culturally hegemonic practice to maintain status, power, or control by marginalizing or minimizing the potential of new ideas (Coutinho, 2013; Lears, 1985). In practical and scientific proposal-writing terms, this means remaining open to the possibility that the community perspectives and needs, and the theories and methods embraced by each of the academic team members have the potential to advance the understanding of the phenomenon of interest in new and progressive ways.

It is clear from the literature, however, that accepting, adopting, and synthesizing different perspectives is not easily achieved, given the challenges that members of transdisciplinary

teams confront. Although discussed throughout this article in primarily individualistic perspective terms – that is, how team members needed to overcome the limits of their own ways of thinking – there are constraints to transdisciplinary research at the institutional level, as well. Such constraints have been discussed in relation to scholarly and research funding threshold expectations for promotion and tenure, and the equitable distribution of funding resources across academic departments and community-based agencies, among others (Rosenfield, 1992; Stokols, Hall, et al., 2008; Stokols et al., 2005). Several authors have described the labor-intensiveness of achieving the level of synthesis that characterizes transdisciplinary research. The time investment required to pursue this type of work often acts as a significant disincentive when weighed against how such time could be spent generating scholarly and research products that align with “normal science” pursuits. Constructing a novel or paradigm-shifting argument takes far more time than constructing one under a normal science paradigm, given that, by definition, in the latter scenario some nominal level of acceptance of the argument will have already been achieved within one's discipline. Put another way, scientists willing to engage in transdisciplinary research have to be willing to take on a different formulation of “calculated career-development risk.” That is, while the payoff in breaking new ground or making paradigm-shifting discoveries may be great, the path to get there may not only be fraught with obstacles, but also rather steep and full of uncertainty.

The individual traits that members must hold, and the tasks lead investigators of transdisciplinary research teams must take on to improve the odds of the team's success have been well described in the literature. Openness, tolerance, and rigor are recognized as essential traits for conducting transdisciplinary work across disciplinary and international boundaries, and were critical to sustaining a developmental trajectory within our team (Rosenfield, 1992). Each of the cognitive, structural, and process tasks required of the PI were essential in unique ways and relevant to overcoming different sets of challenges at different points along the developmental trajectory (Gray, 2008). Interestingly, the CBPR basis of the research eased the structural leadership tasks the PI needed to attend to, such as brokering relationships across disciplinary boundaries and managing power and status differentials. Many of these negotiations had already been underway given the early community-engaged nature of the research, and may be one reason that successful transdisciplinary outcomes have been associated with community engagement (Wickson et al., 2006). Although speculative, it may be the case that investigators are likely to be more successful in leading ‘team science’ teams when some of the anticipated problems have already been addressed in prior community partnership experiences (i.e., establishing trust, addressing expertise and power differentials, etc.).

For a number of reasons that align with the leadership tasks proposed by Gray (2008) and have been described elsewhere (Grey & Connolly, 2008; Grey & Mitchell, 2008; McBride, 2010; Woods & Magyary, 2010) nurse scientists who conduct community-engaged research are well-suited to lead transdisciplinary science teams. The case study described here adds to the existing literature related to nursing's role with regard to transdisciplinary research. Specifically, we have provided an account of how theoretical and analytic challenges were addressed within the team, the team characteristics that facilitated overcoming the barriers that were confronted, and the roles assumed by the nurse PI leading the team with a level of

detail and through concrete examples that may be useful to nurse investigators embarking on this type of work.

On a final note, some nurse scholars have cited concerns around the loss of distinctively nursing knowledge that could result from nurse scientists focusing on transdisciplinary research (McCloskey & Maas, 1998). While this potential exists, it seems far less likely from a public health nursing perspective. In this case study, a public health nursing perspective remains central given that the problem identification originated in the context of a nurse-patient/population/community relationship, and that questioned the health outcomes that the combination of the criminal justice, welfare, and labor market system interactions could have on the health of disadvantaged women. From a practice perspective, this resulted from the nurse assuming an *etic* perspective (i.e., being embedded within the patient's/population's/community's social and environmental context, as is the case with public health nursing), as opposed to an *emic* one (i.e., the nurse embedded in an individual-focused clinical setting looking outward at the population/community). As transdisciplinary research evolves in the years to come, what should be guiding nursing's role in it is a focus on solving the contemporary health problems that we confront as a society, embracing the inherent complexity at the core of these problems, being clear about the contributions that a nursing perspective can bring, and approaching our science in a manner that allows us to take full advantage of new ideas – by escaping some of the old.

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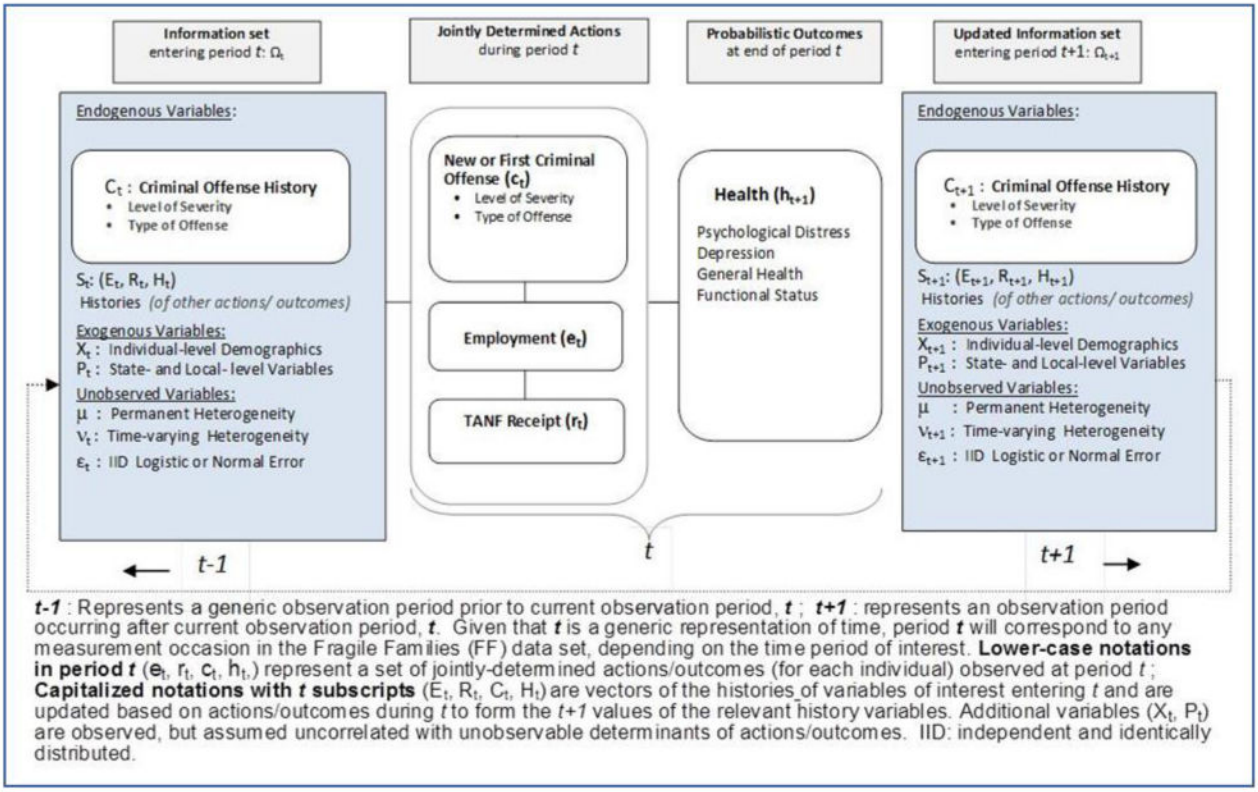

Figure 1. Model of Criminal Offense-Related Social Determinants of Health over Time

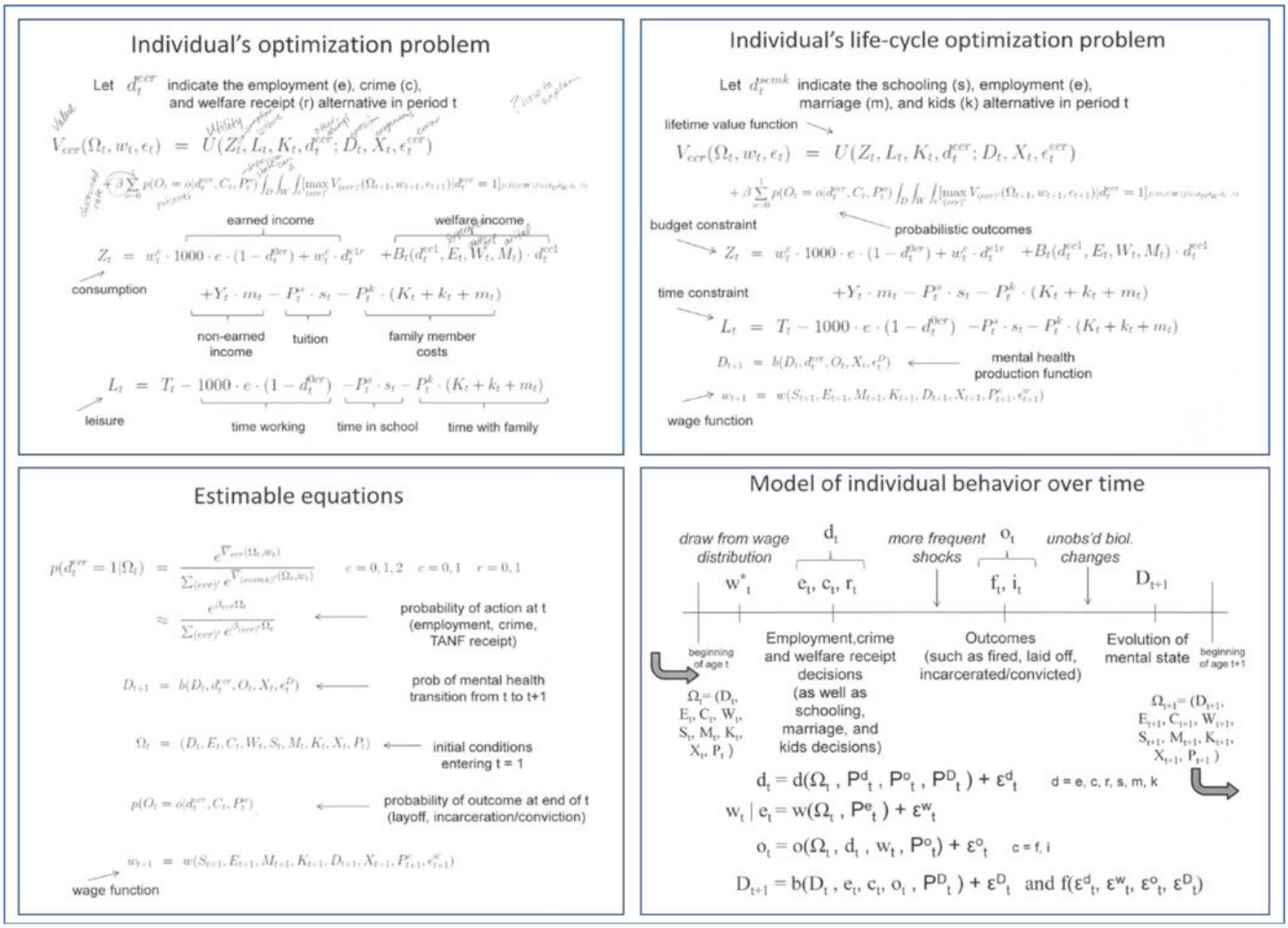

Figure 2. Econometric Explanation of Dynamic Modeling Approach*

*Preserved copies from the original meeting, with hand-written notes by the PI incorporated on the first page.

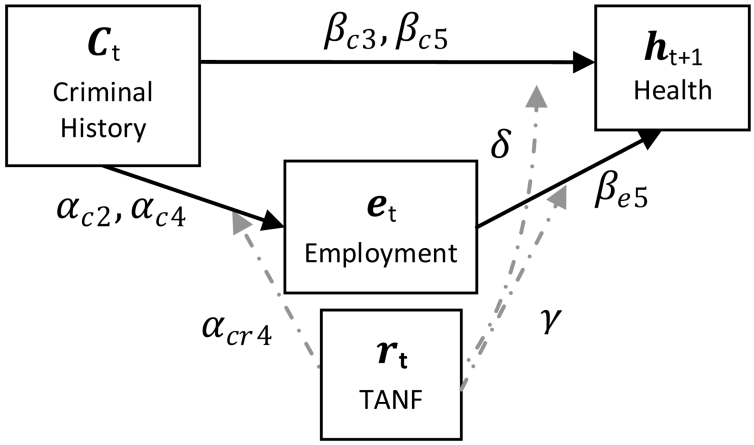

Figure 3. Mediation, Moderated-Mediation Model