(Vacca et al. 2015)

Vacca, Raffaele, Christopher Mccarty, Michael Conlon, and David R. Nelson. 2015. “Designing a CTSA-Based Social Network Intervention to Foster Cross-Disciplinary Team Science.” *Clinical and Translational Science* 8 (4): 281–89. https://doi.org/10.1111/CTS.12267.

The need for transdisciplinary research prompted the “science of team science” (SciTS).

“In this paper, we propose a different approach to the problem of team assembly, by drawing on the notion of social network interventions and exploring its application to team science.” [This approach is the method that SNAP is using for the evaluation of the GCs investments]

“We report on a network intervention program designed at the University of Florida (UF) Clinical and Translational Science Institute (CTSI) in 2013 using VIVO, a semantic-web research networking system implemented at the university level.”  
“The program mapped the UF scientific collaboration network to identify and connect researchers in specific locations of it.” [SNAP is not yet connecting researcher-specific locations. In phase 1, we are simply examining the network]

“Querying VIVO, we constructed the network of all the scientific collaborations that resulted in a publication or an awarded grant at the university in 2012.” [SNAP has a co-authorship SNA branch [CATNIP] that is like the network these authors describe in this paper. However, this branch is not detailed in my thesis. I expect this paper will be useful to the branch examining historical grant proposal data.]

“We then applied a number of structural criteria to identify dyads and triads of unconnected researchers, whose collaboration would have enhanced certain structural properties of individuals or the whole network.”

“Finally, we implemented an online survey that introduced the unconnected potential collaborators to each other via their VIVO profiles.” [Perhaps I can examine the faculty that I interviewed in the grant network]

Lit Review Quotes:  
\*“A well-established finding in the field of social network analysis is that positions that span “structural holes” in network structure, bridging areas of a social network that are otherwise unconnected, are associated to creative ideas and innovation. One of the mechanisms that explain this result is that individuals who are in a network position that spans structural holes tend to have access to diversity, that is, to be connected to different social circles with different backgrounds, expertise, views, and opinions.” [It would be nice if I could identify holes in the grant proposal network. Perhaps I can use their method.]

“The basic intuition underlying the intervention program presented here is that, if certain structural positions or configurations of a social network are associated with creativity, innovation, or scientific success, we should try to intervene on the network to create those positions and configurations. This kind of network intervention has been called alteration in the social network literature.” [I notice that network interventions assume that the structure of the network causes the innovation but the innovation might cause the network structures.] “Edge alteration is not a typical network intervention, however, because there are normally strong reasons why people establish certain relations and avoid others.” “The project presented here did not actually implement the alteration program by creating the identified missing collaborations. We argue that CTSA institutes and hubs would be ideal frameworks for the effective implementation of this kind of programs. ”

“In general, a network intervention is a program that leverages social networks to promote behavioral change in a population or enhance individual or collective performance in an organization.” [I need to also define network intervention and this definition might be a useful source.]  
  
“four types of interventions: the programs based on the identification of specific individuals; the ones based on the segmentation of the network into groups or communities; induction programs that stimulate interaction among connected people and accelerate the diffusion of specific information or behaviors in an existing social network; and alteration programs that effectively change the underlying social network, for example, by adding or removing nodes or edges.” [I could describe these types of interventions in the discussion section of my thesis]

“Alteration identifies specific individuals whose collaboration is more likely to be successful and to improve the performance of the whole organization, by enhancing certain structural properties of single actors or the whole network.”\*

“The program aimed to add new edges between investigators in specific locations of the university network.”

“[Scientific collaboration network structures] are patterned in a clustered structure, with clusters being determined by institutional, spatial, or disciplinary proximity.”   
  
“A scientific network may respond in different ways when new conditions arise, for example, a new funding opportunity. Existing connections may be activated—scientists who are already collaborating or have collaborated in the past start a new project. Or new connections may arise—a new project is started by scientists who have never worked together before. In fact, the former is the usual outcome as individuals are typically more likely to pick collaborators with whom they are more familiar, possibly because of prior collaborations. As a consequence, the traditional way of funding academic research may have limitations, especially when it comes to stimulating cross-disciplinary research. In fact, in the framework of network interventions, the traditional way of funding research is a form of induction. It mostly uses the existing network as it is, and increases the volume of professional interactions along already established links. In the typical research funding process, agencies solicit applications for projects on specific topics from any investigator or team of investigators. Although there may be requirements about the team members, for example, collaborators may be required to have different college affiliations, funding is not targeted to specific areas of a scientific network—in fact, funding agencies have normally no exact knowledge of the scientific collaboration network that their announce is addressing.” [What I like about this quote is that the authors address solicitation for funding. Given that I need to write a lit review for the grant proposal network, this quote will be useful. The funding may be interdisciplinary, but for it to be effective, we need to know that the team is, in fact, extending across disciplinary boundaries in ways that will help connect the network at the institution. The facilitated formation of the team (edge alteration) needs to be a good fit for the individuals’ needs and a good fit for the network’s needs.]

“Furthermore, investigators may not realize that they have close indirect connections to potentially useful collaborators in other disciplines.” [Network intervention practitioners can help connect researchers.] [LOVE survey round two could rank their peers interdisciplinarity]

“Thus, scientists typically respond to funding opportunity announcements by finding close and familiar professional partners, replicating existing collaborative relationships, or establishing new collaborations still within their professional comfort zone.” [Need to help researchers find partners outside their well-established clusters.]

“Improving network cohesion means increasing mutual awareness, communication, and interaction between areas of the scientific network that were previously separate, distant, and unaware of each other. By improving the overall cohesion of a network, we specifically mean two things: ( i ) Connecting separate and distant areas of the network. ( ii ) Reducing the overall sum of distances among nodes in the network. The word “distance” refers here to the geodesic distance, the number of links in the shortest path that separates two nodes in the network. Higher cohesion enhances the overview and the understanding that single investigators have of the whole network available to them. In a more cohesive network, scientists are more aware of each other and each other's work; they are more knowledgeable of the skills, resources, and potential collaborators available in their institution, and they are more capable of locating the expertise they need.” [This quote will be useful for the literature review for CUPID because it describes traits that I should look for in the grant networks] “Unlike the traditional way of funding research, alteration targets specific pairs or teams of investigators, and creates specific collaborative links that may otherwise never occur, were the scientific network left to its natural evolution.”\*

“We picked dyads of researchers with the longest geodesic distance to each other.” [This might be useful if I were to identify specific nodes in the grant network]

“Nodes in distant communities: This strategy identifies and connects separate cohesive research communities in the network.” Using Girvan–Newman algorithm. “In each community we picked the most peripheral nodes, those with the lowest degree centrality (number of existing collaborations), to be brokers with the other community.” [This is very different from the way we assembled teams. In this study, it seems that they picked researchers who 1. Don’t have experience collaborating frequently. 2. May not have a lot of experience working as a researcher] They argue that the reason for this was because of an assumption that they didn’t have a strong commitment to their local community and would, therefore, be more likely to be willing to collaborate with outsiders. [They might not play well with others. They might be new to creating research. There are many reasons why researchers don’t want to collaborate, and I agree with that in my lit review, so I won't write it here.]

“Creating interdisciplinary teams This strategy aims to explore factors that facilitate or hinder the formation of cross-disciplinary research teams. The basic idea is to detect separate groups of actors who work in different disciplines or research areas, and to establish links between them. We used department affiliation as a proxy of discipline or research area, and we operationalized a group as the set of a central researcher A and all of A 's collaborators (in graph-theoretic terms, A 's first-order neighborhood). We identified completely homogeneous groups in which all collaborators belonged to the same department, and we connected the central researchers from two such groups with different department affiliation.” [Department affiliation is not discipline affiliation, as I write in my lit review. I wonder if a survey could help identify disciplinary distance as part of the treatment preparations.]  
  
“Spanning structural holes: This strategy consists in spanning holes in network structure 26 by putting certain actors in a brokering position between unconnected research communities. Brokering positions that span structural holes have been associated with innovation and “good ideas” in many settings: 25 criterion (3) tries to create such positions. We identified research communities using the Girvan–Newman algorithm, and analyzed department affiliation in each community. We selected the most homogenous communities, those where all or most researchers belonged to a single department. We finally picked peripheral actors from two communities with different department affiliation, and created a connection between them. We targeted peripheral actors as brokers for the same reasons discussed for criterion.” [This method could be used in future research]

“Counterbalancing preferential attachment: Preferential attachment is the process of network growth in which new nodes join the network and are more likely to do so by attaching to nodes with higher centrality than to peripheral nodes. In a network that grows by preferential attachment, popular, well-connected actors attract new collaborations more than peripheral ones. In scientific collaboration networks, preferential attachment implies that new, peripheral researchers tend to join the network by starting a collaboration with very central, well-established academic “stars” or “hubs”; more rarely are they aware of other peripheral researchers and inclined to work with them. This entails a process of cumulative advantage in science, whereby stars tend to attract more and more collaborators as they become more central, in a “rich-get-richer” dynamic that biases the distribution of collaborations, publications, and scientific rewards toward small scientific elites.” [This paragraph is very relevant to my research as I have written about this extensively in my literature review and identified it as a variable I consider in my thesis.]

“Preferential attachment essentially means that the way the collaboration network is structured, and the way it channels information and resources, biases the manner in which scientists become aware of new potential collaborators. Investigators are disproportionally more exposed to information about already popular scientific stars, and much less exposed to the work of more peripheral, younger colleagues. However, the most popular network actors are not necessarily the best collaborators for a given project. A particular marginal actor could be a better fit for a given collaboration, and would probably have more time and effort than a network star to spend on a new project. Yet in the natural evolution of scientific collaboration networks, junior investigators are disadvantaged in establishing new collaborations, and unlikely to find each other's expertise. This is especially true for cross-disciplinary collaborations: unlike people in the same field, researchers in different disciplines lack opportunities to hear about each other (common professional meetings, scientific journals, list servers, etc.), therefore a search for collaborators in a different discipline is probably even more biased toward the most popular network stars.” The researchers explore the consequences of counterbalancing preferential attachment. They counterbalance by connecting two peripheral researchers who are unlikely to link to each other naturally. [We could ask LOVE survey participants if a member of their team is someone they would not have thought to work with had they not been a member of this team. We could explore whether investigators’ reactions to the program they are a part of]

“All the alteration strategies described so far tend to add links between actors who are far apart in the network, belong to separate communities, and work within different disciplines. This creates connections that span structural holes in the network. While there is compelling evidence and a wide consensus on the value of bridging network positions and cross-disciplinary collaborations for creativity and innovation, we should not overlook the relevance of intra-disciplinary research. Supporting research and collaboration within well-established disciplines and fields is important for at least two reasons. First, for there to be structural holes to span, there must exist separate cohesive communities in the first place. There can be no cross-disciplinary bridge if there are not multiple solid, well-established, and constantly maintained disciplines to be bridged. Second, cohesion within disciplines is also a value in itself. Cohesive within-discipline research groups facilitate incremental innovation, the improvement, and refinement of existing theories and models within a consolidated scientific paradigm. At the same time, while structural holes foster individual creativity by increasing autonomy and access to diversity, well-established and close-knit teams benefit creativity and learning by supporting safer relationships, shared languages, and good personal relationships. If bridging across structural holes is good for radical innovation and creativity, density within cohesive subgroups is crucial to maintaining and updating “core” science, avoiding fragmentation and lack of agreed-upon directions in a discipline.” [This might be valuable in the main paper literature review. Make a 3 sentence summary.]  
  
Results:   
They found that “researchers who are 12 or 18 steps apart being less and less acquainted with each other's work: in other words, investigators’ familiarity with each other's research constantly decreases as a function of the geodesic distance that separates investigators. This means that the network data can be used to construct a meaningful science map of a university's research activities, with network distances approximating actual distances in the contents of individuals’ research; and cohesive communities in the networks approximating actual clusters of close research activities, similar for methods and substantive topics” [This result might be useful in CUPID]

“In the first place, the distance between scientists in the network should be taken into account, since it increases researchers’ skepticism toward a possible collaboration. This means, for example, that the incentives offered to start a collaboration should be higher as the targeted individuals are more distant in the network.” [Motivation]

“Researchers are clearly more reluctant to start a collaboration on a grant or a patent with someone with whom they have never worked. This probably points to a trust issue involved with patents and grants as opposed to publications.” [Lit Review Intro!]

Research Summary:   
The study by Vacca et al. (2015) addresses the challenge of fostering cross-disciplinary team science, particularly in the context of the University of Florida's Clinical and Translational Science Institute (CTSI). The research problem focuses on designing effective strategies for team assembly in scientific research, which is a critical aspect of the emerging "science of team science" (SciTS) discipline. The researchers propose a novel approach that leverages social network interventions to facilitate this process. They hypothesize that by identifying and connecting researchers based on specific structural criteria within a scientific collaboration network, it is possible to enhance the network's overall structure and foster productive, interdisciplinary collaborations. “The program aimed to add new edges between investigators in specific locations of the university network.”

To test this hypothesis, Vacca et al. (2015) employed a method that involved mapping the University of Florida's scientific collaboration network using data from VIVO, a semantic-web research networking system. They identified unconnected researcher dyads and triads whose collaboration would improve certain structural properties of the network. Various strategies were implemented, such as connecting researchers from distant communities, creating interdisciplinary teams, spanning structural holes, and counterbalancing preferential attachment. These strategies were aimed at addressing issues such as the natural bias towards collaboration with popular scientific figures and the challenges faced by peripheral researchers in establishing new collaborations, particularly across disciplines.

The researchers discovered that familiarity with each other's work decreases as researchers are further apart in the network, implying that network data can effectively map a university's research activities. Additionally, they observed that researchers are more skeptical about collaborating with individuals who are more distant in the network, suggesting that incentives for collaboration should be adjusted accordingly. This skepticism is particularly pronounced in the context of grants and patents, potentially due to trust issues.

In summary, the study by Vacca et al. (2015) contributes to the SciTS field by demonstrating the effectiveness of social network interventions in fostering cross-disciplinary team science. Their findings underscore the importance of considering network structure in assembling research teams and provide practical strategies for enhancing collaboration among researchers, especially those less-connected or from different disciplines.

My summary of this study’s Lit Review Section  
In their literature review, Vacca et al. (2015) delve into the principles of social network analysis and its application in fostering innovation and creativity in scientific research. They highlight a well-established finding in social network analysis: positions spanning "structural holes" in a network structure, which bridge unconnected areas of a social network, are linked to creative ideas and innovation. This phenomenon is attributed to the access such individuals have to diverse social circles, each with different backgrounds, expertise, views, and opinions. This diversity is a key driver of innovation, as it exposes individuals to a wide range of perspectives and ideas.

Building on this concept, Vacca et al. (2015) propose an intervention program based on the intuition that if certain structural positions or configurations in a social network are associated with creativity and scientific success, then deliberate interventions should be made to create these configurations. This approach, termed "alteration" in social network literature, involves changing the network's structure to foster desired outcomes. However, the authors acknowledge that edge alteration is not typical, as relationships in social networks are often formed and avoided for strong reasons.

The study also defines a network intervention as a program leveraging social networks to promote behavioral change or enhance performance in a population or organization. These interventions are categorized into four types: identification of specific individuals, segmentation into groups or communities, induction programs that accelerate the diffusion of specific information or behaviors, and alteration programs that change the underlying network structure.

Specifically, alteration interventions aim to identify individuals whose collaboration would enhance the performance of the whole organization by improving certain structural properties of the network. This is particularly relevant when new conditions arise, such as new funding opportunities. Traditional funding methods often induce existing connections, limiting cross-disciplinary research. In contrast, alteration interventions target specific pairs or teams, creating collaborative links that might not naturally occur.

Vacca et al. (2015) also discuss the limitations of traditional funding in academic research, noting that it typically replicates existing relationships or fosters collaborations within familiar professional networks. This approach often overlooks indirect connections to potential collaborators in other disciplines. By improving network cohesion, which means connecting separate areas of the network and reducing overall distances among nodes, scientists become more aware of each other's work and the available expertise within their institution. This increased cohesion can lead to a better understanding of the entire network and more effective collaboration.

In conclusion, the literature review by Vacca et al. (2015) emphasizes the potential of network alteration interventions in scientific research networks to foster innovation and creativity by connecting disparate groups and individuals, thereby enriching the diversity of ideas and expertise available for collaborative endeavors.