1-1-2017

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Marie Kennedy
Loyola Marymount University, marie.kennedy@lmu.edu

David P. Kennedy
RAND Corporation, davidk@rand.org

Kristine R. Brancolini
Loyola Marymount University

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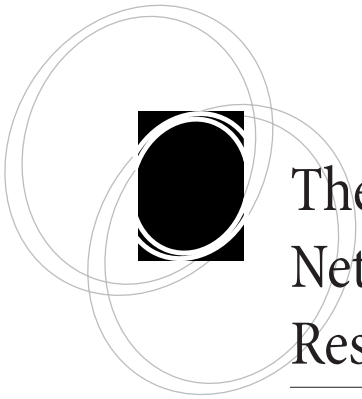
portal: Libraries and the Academy, Volume 17, Number 1, January 2017, pp. 71-89 (Article)

Published by Johns Hopkins University Press
DOI: *https://doi.org/10.1353/pla.2017.0005*



The Evolution of the Personal Networks of Novice Librarian Researchers

Marie R. Kennedy, David P. Kennedy, and Kristine R. Brancolini

abstract: This article describes for the first time the composition and structure of the personal networks of novice librarian researchers. We used social network analysis to observe if participating in the Institute for Research Design in Librarianship (IRDL) affected the development of the librarians' personal networks and how the networks changed over the course of one year. Four times during the year, we used EgoWeb 2.0, open-source software for social network analysis, to gather the data used in the study. We found that the size of the research networks of the participants dramatically increased after the IRDL summer workshop and continued to evolve over the yearlong program.

Introduction

This article reports the results of an analysis of personal network data gathered from the novice librarian researchers who participated in the Institute for Research Design in Librarianship (IRDL), a program designed for academic and research librarians to provide instruction in how to conduct a research project and how to establish a peer network of like-minded library professionals to support one another throughout the research process. We studied the research networks of the IRDL participants to begin to understand a novice librarian researcher's community of practice, the group of fellow professionals who share a concern for librarianship and help one another learn to do it better. We also hoped to learn how participating in an institute like IRDL might influence a librarian researcher's community of practice and how becoming connected to other IRDL participants might expand a novice librarian's personal research network.

Highlighted in the article is a description of EgoWeb 2.0 software, developed by a member of the research team, specifically designed to collect the personal network data used in this work. We used this open source and freely available Web-based software to

portal: Libraries and the Academy, Vol. 17, No. 1 (2017), pp. 71–89.

program a customized survey designed to identify key people in the IRDL participants' networks, characterize these network contacts in different ways, and measure the interactions among the network members. We present findings that describe the networks of the IRDL participants over the course of one year, including how much and under what circumstances they interact with their network contacts, the role their networks play in giving or requesting advice about research, and how interconnected these network members are with one another. We present results of the statistical analysis of these networks generated from the software, such as how densely connected the networks are over four waves of data collection. We also present an example of the software's customized visualization features to illustrate general trends in the network data. The images accompanying this article show the evolution of one IRDL participant's network over the course of one year.

Problem Statement

How does the personal research network of a novice librarian researcher evolve on the novice's path to becoming a more advanced researcher? In addition to mastery experiences, such as exhibiting competence or confidence in completing the steps in a research project, we suspected that a successful librarian researcher continually builds his or her own personal network of like-minded researchers to call on for assistance or to offer support over time. We had a unique opportunity to examine this in the relatively short term of a three-year, grant-funded project, the Institute for Research Design in Librarianship (IRDL), a continuing education opportunity designed specifically for novice librarian researchers. We conducted an exploratory research project to observe the following: does participating in an institute like IRDL have an effect on the personal research networks of novice librarian researchers, and if so, to what extent do those networks change during the course of the yearlong program?

The Institute for Research Design in Librarianship

The institute was created as the result of an expressed need of academic and research librarians in a 2010 national survey conducted by Marie Kennedy and Kristine Brancolini about librarian preparation for, and experiences in, conducting research.[1] As a result of their findings, Kennedy and Brancolini developed a continuing education program that was funded in 2013 by a grant from the Laura Bush 21st Century Librarian program of the Institute of Museum and Library Services (IMLS). The centerpiece of the program is a nine-day research workshop held at Loyola Marymount University in Los Angeles. The three-year project is designed to assist academic and research librarians to develop the skills necessary to complete a research project of their own design, as well as to aid participants in constructing a personal network of like-minded librarian researchers. It is devised from two components of the psychologist Albert Bandura's model of self-efficacy—that is, a person's belief in his or her ability to succeed in specific situations or to accomplish a task—mastery experiences and social persuasion.[2] Mastery experiences build confidence through success and provide an individual with the ability to persevere in the face of obstacles, which is especially important in performing a difficult task such

as answering a research question. Social persuasion consists of structuring situations in which an individual receives encouragement in working through challenges.

Using the procedure outlined at http://irdlonline.org, applicants to the IRDL submit a research proposal, a letter describing their interest in participating, and a letter of support from their library dean or director. Each application is reviewed by two Advisory Board members, and then the two project directors construct a cohort. The selected participants (called *scholars*) commit to a yearlong development process that begins with the summer workshop and continues during the following academic year.

The selected scholars spend 11 days living as a community in the university apartments on the campus of Loyola Marymount. During the day, two faculty members provide instruction and supervise hands-on practice with research components; at night, the scholars revise the design of their individual research projects, based on the instruction received that day. At the end of the workshop, the scholars return to their home institutions, ready to conduct their projects. Over the next year, the scholars meet monthly online to update one another and to get and receive help in the progression of their projects. The entire commitment of time for the scholar is one full year, beginning with the summer workshop.

Literature Review

In addition to mastering skills required to conduct research, novice librarian researchers must build proficiency in cultivating social networks.[3] *Social networks* are naturally occurring groups of people that can be characterized in terms of their *composition* (defined as the quantity and type of individuals in a network) and *structure* (defined as the connections among network members).[4] The social networks of interest in this study are the people with whom novice researchers have regular interaction and the relationships among those people.

In addition to mastering skills required to conduct research, novice librarian researchers must build proficiency in cultivating social networks.

We did not discover any literature that discusses the personal networks of novice librarian researchers. Our focus in this review, then, is to elaborate on how the broad literature about social network analysis, which studies relationships and interactions among the members of a social group to understand how it is structured and how it functions, can be applied to answer our research questions and to define the appropriate measures we will use in our analysis.

In the social network literature, social network ties have often been divided into instrumental and expressive ties.[5] *Instrumental ties* emerge through careers and employment and include exchange of resources necessary for performing work tasks, such as collaborating on projects, exchanging resources or information, or providing advice or access. Instrumental ties can also play career developmental roles, such as mentoring, enabling or guiding career direction, advocacy, or inclusion in career-enhancing activities. For novice researchers, instrumental ties play key roles in research collaboration and mentoring as they attempt to complete research projects. Instrumental ties also can

expose novice researchers to new research methods or research questions. *Expressive ties* enable exchange of friendship and social or emotional support, and they are not necessarily linked to formal organizational structures. Novice researchers may rely on expressive ties for help coping with stresses related to a new professional role as well as for objective advice and emotional support. Network ties can be either instrumental, expressive, or both,[6] and novice academic researchers require both types of ties in their professional networks distributed across multiple mentors to enable their transition from student to professional.[7]

Methods of social network analysis provide the tools necessary to measure IRDL scholars' professional networks.[8] Identifying appropriate boundaries for whom to include in a social network analysis study is a primary question to answer in order to provide appropriate data to address research questions.[9] There are two primary approaches to collecting and analyzing social network data.[10] The most common approach is the *whole network approach*, in which each member of a defined group provides data about his or her relationship with every other member of the group.[11] This approach is especially appropriate for understanding networks among people who share a common affiliation (for example, members of a school, employees of a business, or residents of a neighborhood). This approach could be used to understand the social network ties among a cohort of IRDL scholars.

The second most common approach is the *personal* or *egocentric network approach*.[12] When the focus of a study is to understand the social ties surrounding an independently sampled set of focal individuals, the personal or egocentric approach is more appropriate.[13] The ties typically uncovered from personal network data collection include a range of types of social affiliation, such as family, friends, neighbors, and coworkers. Although some studies of personal networks have collected relationship and other data from these network ties directly,[14] practical limitations usually preclude collecting relationship data from more than a few of these network ties (referred to as network *alters*). Therefore, personal network data collection more often relies on focal individuals (referred to as *egos*) to report on these relationships themselves, drawing upon their own *cognitive social structure*—that is, their perceptions of the social relationships between all possible pairs of individuals in the network, including themselves.[15]

We use the personal network approach in this project because we are exploring how participating in IRDL may influence novice librarian researchers to change their professional networks. These changes include positive compositional changes (that is, adding or removing types of network members, or both) and structural changes (that is, strengthening, weakening, or adding connections among network members). In addition, the personal network approach is more important for understanding professional network development than for analyzing organizationally bounded networks because professional networks include important ties to individuals outside of one organization.[16] This is especially true for academic researchers, who increasingly collaborate and coauthor with colleagues within and outside of their organizations and disciplines,[17] and this trend is true of researchers in library and information science.[18]

The project directors were mindful in their construction of the institute that they were working with adult learners, peer professionals. They developed the curriculum and the social structure of the institute to increase research confidence (self-efficacy),

based on the work of Albert Bandura, who said: "Learning environments that construe ability as an acquirable skill, deemphasize competitive social comparison, and highlight self-comparison of progress and personal accomplishments are well suited for building a sense of efficacy that promotes academic achievement."[19] Few studies examine the social aspects of the professional learning environment, but experts agree that this aspect is an important component of the design of such environments.[20] The design of IRDL intentionally includes an emphasis on making research connections, and so it is reasonable to examine the effect of this effort on the resulting networks of the participating scholars.

Social network analysis provides many concepts and associated measures for conducting studies of the networks of novice library researchers. The social network of one individual operates as a complex system with emergent compositional and structural properties that affect the focal individual.[21] Compositional measures of personal networks can be assessed by aggregating all the separate measures of individual network contacts in one personal network. For example, composition can be measured through calculating the proportion of network ties with a certain characteristic, such as the proportion of network members who provide social support.[22]

Structural measures of personal networks are constructed for each ego's personal network with the same techniques as whole network analyses.[23] These network measures are aggregations of the matrix of *strength of tie* relationship measures among all network ties mentioned by an ego.[24] Personal network studies typically derive raw relationship data from interviews with a sample of respondents, who cognitively evaluate the strength of ties among their network contacts.[25] Tie strength can include evaluations of how closely network ties link individuals to each other or how frequently they interact. Another indicator of tie strength is a high degree of *multiplexity*, or the number of relationship categories (for example, friends, colleagues, and coauthors) shared between network ties.[26]

Emergent structural properties of personal networks are aggregate calculations of ties among network alters. For example, density is a ratio measure of the number of connections among network members compared to the total number of possible ties.[27] High density in a personal network indicates high degrees of cohesiveness, which can benefit the efficient flow of information in a network. However, highly dense networks include many network members who are structurally redundant and will likely have access to the same information and resources. The network concept of the "strength of weak ties" indicates that having connections to network members who are not all connected to the same people may provide greater access to novel information, opportunities, and resources compared with highly dense networks.[28] Densely connected networks with strong ties can require greater effort to maintain and develop, and professionally beneficial networks will likely include a mixture of types of network ties.[29] Some emergent properties of networks are combinations of both composition and structural features. For example,

…having connections to network members who are not all connected to the same people may provide greater access to novel information, opportunities, and resources compared with highly dense networks.

the concept of *social capital*—that is, the collective value of social networks for promoting social cohesion and providing individuals with benefits such as support, resources, opportunities, and novel ideas—recognizes that networks can include helpful network contacts. But connectivity among these resources determines opportunities for taking advantage of them in times of need or crisis.[30] Visualizations of personal networks can aid analysis and identification of these emergent compositional and structural properties and can trigger additional discussion about the network dynamics with a respondent.[31] Personal network visualizations allow for display of both compositional and structural features of the network.

Methods

To understand how participating in a program like IRDL may affect the composition and structure of the personal research networks of the scholars, we constructed this exploratory research project. We used the Web-based survey tool EgoWeb 2.0 (see http://egoweb.info/), designed to collect and analyze personal network data, to gather responses from each IRDL scholar.[32] The survey was administered four times: (1) before the summer workshop, (2) immediately after the summer workshop, (3) six months after the workshop, and (4) one year after the workshop. A link to the survey was sent to each scholar via e-mail, to complete independently. The Institutional Review Board of Loyola Marymount approved the survey protocol.

Study Design

To describe the impact of IRDL on the networks of librarian researchers, in particular how it impacts network size, frequency of contact with people in their networks, and whether they perceive that they are giving or receiving help and support in their research conversations,[33] we collected egocentric network data—that is, network data centered on the individual—from each IRDL participant. Because we were interested in how those networks develop over time, we constructed a longitudinal study.[34] For our purposes, we defined the particular network of focus to be the research network of each of the IRDL scholars. To this end, we asked the scholars to list the names of the people (with a prompt to consider professional colleagues, personal friends, and family) with whom they talked about ideas or with whom they worked more closely, related to research. We asked questions about how often they communicated, a characterization of the interactions, and how those people might know the others in the list.

Participants

We surveyed each of the 25 IRDL scholars from the first cohort (2014–2015), so the entirety of the cohort is represented in this research. All the scholars are academic or research librarians employed in single, full-time positions at their respective institutions of higher education in the United States, representing a mix of research institution, community college, college, and university libraries. All scholars described themselves as novice researchers at the beginning of their IRDL experience.

Survey Procedure

The first wave of data (2014, T1) was gathered immediately before the scholars arrived at the summer workshop. The second wave was collected on the last day of the workshop, approximately two weeks after the completion of the first wave (2014, T2). The third wave was gathered about six months after the workshop (2015, T3). The fourth wave was assembled at the one-year mark after the workshop (2015, T4).

We have chosen to measure the networks over four waves to improve our chances of understanding change; earlier research notes that quantification of change is best captured from more than two observations.[35] Since IRDL is designed as a yearlong experience, it is reasonable to capture data from the scholars over that time, in four waves. Using four waves is appropriate so that we may follow the development of these dynamic networks from before the institute begins to one year later, understanding that change is incremental and a process.[36] We chose to measure in four waves at strategic times in our expected development of their networks: wave 1 before participation in the summer workshop, expecting that the network size would be small at that point; wave 2 at the end of the summer workshop to see if the network size adjusted for the possible new research colleagues met during the workshop, as well as the scholars' rethinking of existing persons in their networks; wave 3 at six months after the summer workshop, expecting to see what is called "churn" in a network as the scholars returned to their home institutions and began to actively create new ties and strengthen or loosen existing ties, as their research needed;[37] and wave 4 at one year after the summer workshop, expecting to see the research networks stabilize as the scholars become more mature in their research and adjust whom they include in their research networks.

Survey Instrument

Personal network data are typically gathered in three sections: the generation of names of people in the respondent's network (network elicitation), questions about each of those people (network composition), and questions about the relationships of those people (network structure). Given that responding to a personal network survey can be burdensome on the respondent,[38] we were eager to use a tool that alleviated some of this burden through a well-designed, Web-based interface. We chose EgoWeb 2.0 for this purpose. EgoWeb 2.0 was developed by a member of the research team and is specifically designed to collect personal network data. There is no other complete tool available that collects these kinds of data, includes visualizations, and provides statistics for the researcher, all in a Web-based interface.

With EgoWeb 2.0, one can establish a survey to gather the network data from all three sections noted earlier and then administer the survey via a unique uniform resource identifier for each of the scholars. We constructed the survey to involve four main components: (1) network elicitation, (2) network composition, (3) network structure, and (4) network visualizations.

Network Elicitation

The authors were guided by the work of Daniela Golinelli, Gery Ryan, Harold Green Jr., David Kennedy, and Suzanne Wenzel and by that of Christopher McCarty, Peter

Killworth, and James Rennell to determine the appropriate number of names to solicit during a personal network survey.[39] We requested that the scholars begin by identifying "up to 20 people to whom you go to get or give advice/help related to research. You may just bounce ideas off of some of these people, and with others you may work more closely and often. These may or may not be people you communicate with on a regular basis and may be professional colleagues, personal friends, and family." As suggested in the procedures noted by McCarty, we stated in the survey that the scholars could list only the first names, if they were able to distinguish the people in their list that way.[40] In wave 2 of the survey, we expanded the number of names to 40 to capture the impact of the introduction during the two-week IRDL workshop of 24 new peers with whom the participants might have had research conversations, and to encourage them to consider peripheral or weaker ties to include in their networks.[41] From wave 2 and future waves, we kept the list of possible names at 40.

Network Composition

We asked several questions about the relationship of the scholar to each of the people in their list: how often they talked about research with each of those people in the last 30 days (not at all, once or twice, three or more times); a description of the relationship with each of the people (personal friend, professional colleague, or both friend and colleague); how they would characterize the majority of their research interactions ("I'm usually asking this person for advice or help"; "I'm usually giving this person advice or help"; or "It's pretty even; I ask for help but also give help in equal amounts"); how they mainly interact with the people (in person, online forum, telephone, text, video conference, or e-mail); how they would characterize the type of interactions with each ("We usually just chat about research"; "We've done some small projects together"; or "We've worked on some major projects together"). In wave 2 and future waves, we added a question to find out if any of the people mentioned were IRDL scholars.

Network Structure

We then asked if each of the people in the list interacted with any of the others for research-related purposes ("Yes, they know each other and have research interactions"; "Yes, they know each other but don't talk about or do research together"; "No, they don't know each other"; or "I don't know if they know each other"). In waves 3 and 4, we also asked the scholars to report if they themselves had undergone any change in job status or place of residence to help us understand possible changes to the lists of names (persistence, newness, or loss).

Network Visualizations

A feature of EgoWeb 2.0 is that, at the completion of the survey, the tool creates a visualization of the data entered during the survey. The authors copied the visualization of each scholar's network into a separate document and shared it with the scholars via e-mail before they completed their next surveys, to use as a reference point. We expected the scholars to use the visualization as a memory jog, as well as to appreciate the changing nature of their own networks.

Findings

At T1, there were 25 scholars in the program, but at T2 and continuing there were only 24 because one of the scholars dropped out of the program. Data from that scholar were removed from analysis completely and are not represented in the findings. At T1, a survey coding error affected one scholar throughout the survey; though that scholar provided data at all four waves, those data are not included in this analysis. The findings comprise a full data set of 23 scholars.

Visualization has long played a role in social network analysis,[42] and we find the visualizations created in EgoWeb 2.0 especially helpful in providing an at-a-glance view of the development of the IRDL scholars' personal research networks over the four waves of data collection. Figure 1 shows the changes in the research network of one IRDL scholar (anonymized) from T1 to T4. The scholar used in the figure typifies the kinds of changes we observed in the network while conducting our analysis.

In the first part of the image, representing T1, we see a relatively small network described. In T2, the dense cluster is constructed from the people the scholar has just met during IRDL, and they all discuss research together. In the third part of the image, representing T3, we see a decrease in people in the network as that new community disperses, though a few scholars from IRDL are retained. At T4, the last part of the image, we observe the research network as the scholar is back at his or her home institution and still changing who is included in the network.

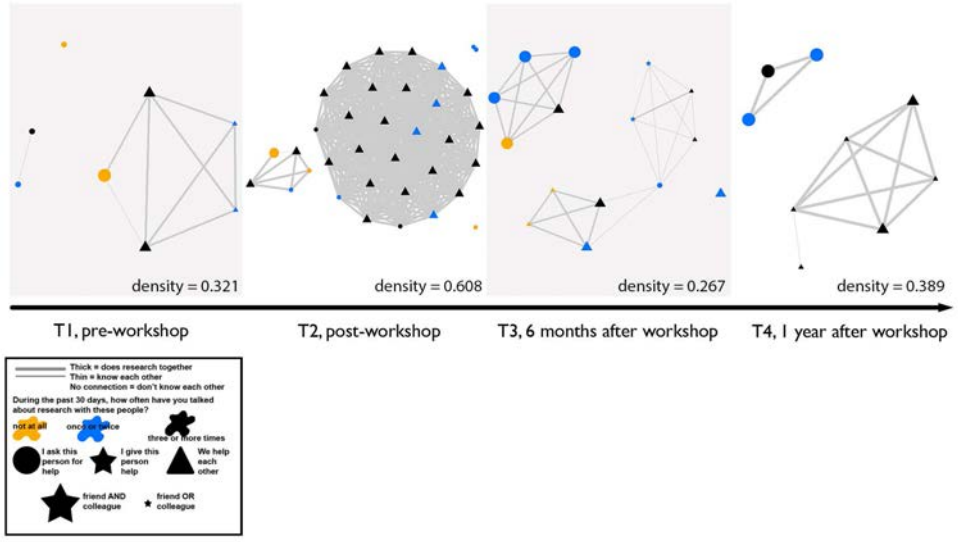


Figure 1. A visualization of the changes in the research network of one Institute for Research Design in Librarianship (IRDL) scholar from T1 to T4. A thick line connecting two nodes signifies that the scholar and these people do research together. A thin line means only that they know each other. The shape of the node is the answer to the question "How would you characterize the majority of your research interactions with each of the following people?" The answer "I'm usually asking this person for advice or help" is represented with a circle; the answer "It's pretty even; I ask for help but also give help in equal amounts" is shown with a triangle.

In the figure, a thick line connecting two nodes signifies that the IRDL scholar and these people do research together. A thin line means only that they know each other. A node without a connecting line signifies that the other people in the network do not know him or her. The color of the node answers the question "During the past 30 days, how often have you talked about research (help, advice, bounce ideas off of) with each of the following people?" The answer "Not at all" is signified by the lightest gray; the answer "Once or twice" by the medium gray; the answer "Three or more times" by the darkest color (black). The shape of the node is the answer to the question "How would you characterize the majority of your research interactions with each of the following people?" The answer "I'm usually asking this person for advice or help" is represented with a circle; the answer "I'm usually giving this person advice or help" is represented with a star; the answer "It's pretty even; I ask for help but also give help in equal amounts" is shown with a triangle. The size of the node is the answer to the question "How would you mainly describe your relationship with each person?" The answers "personal friend" and "professional colleague" are very small; the answer "both friend and colleague" is large.

Using Theo van Tilburg's description of stability in a network over time, we observe those network members identified in only one wave, in two waves, three waves, or all four waves.[43] See Table 1 for a summary of the observations. We looked at the names of the people with whom each scholar had research interactions and noted those who were repeated across the four waves, to illustrate persistence in network composition. On average, the group maintained research interactions across four waves with about 15 percent of their network, with a range of cohort persistence from zero (no network member identified in all four waves) to 38 percent of the initial network cohort retained.

To describe the size of the networks, we looked at the minimum and maximum numbers of people mentioned at each wave, which indicated the numbers of people with whom the IRDL scholars interacted for research purposes during the course of one year. We then compared this across the waves, to examine the difference. The resulting descriptive statistics are recorded in Table 2. At T2, we observe the greatest total increase of people in the networks, with a gain from T1 of 321; on average, each network increased by 13.95 people. At T3, we observe a loss of 199 from that gain at T2, but the total network size is still larger than at T1, by 122; on average each network decreased by 8.65 people. At T4, we observe an increase of 4 from T3, with a total network size increase from T1 to T4 of 129; on average each network increased by 0.30 people. The total network increases from T1 to T4 by 129 people, an average of 5.60 network members.

We find it useful to plot on a chart the number of people mentioned by each scholar at each wave. Looking at the number of people mentioned by each scholar enables a micro and macro view of the changes occurring over one year. In Figure 2, we plot the numbers of each scholar, which permits us to see the individual rate of change. Plotting each scholar alongside the other scholars in the cohort enables us to see collective trends during that time frame. See Figure 2, which illustrates the increase of people mentioned from T1 to T2, the decrease at T3, and the leveling at T4.

In examining the stability of the network, we learned that 107 people were mentioned in all four waves. Of those 107, the scholars described some as personal friends, some as professional colleagues, and some as both friends and colleagues. Fourteen (13 percent)

Table 1.
Stability of total network composition

	T1		T2		T3		T4	
	N	Percentage	N	Percentage	N	Percentage	N	Percentage
Only one mention	27	10.89%	219	38.49%	70	18.92%	128	33.95%
Only T1 and T2	60	24.19%	60	10.54%				
Only T1 and T3	2	0.81%			2	0.54%		
Only T1 and T4	3	1.21%					3	0.80%
Only T2 and T3			55	9.67%	55	14.86%		
Only T2 and T4			20	3.51%			20	5.31%
Only T3 and T4					38	10.27%	38	10.08%
T1, T2, and T3	31	12.50%	31	5.45%	31	8.38%		
T1, T2, and T4	14	5.65%	14	2.46%			14	3.71%
T1, T3, and T4	4	1.61%			4	1.08%	4	1.06%
T2, T3, and T4			63	11.07%	63	17.03%	63	16.71%
Mentioned in all	107	43.15%	107	18.80%	107	28.92%	107	28.38%
Total	**248**	**100%**	**569**	**100%**	**370**	**100%**	**377**	**100%**

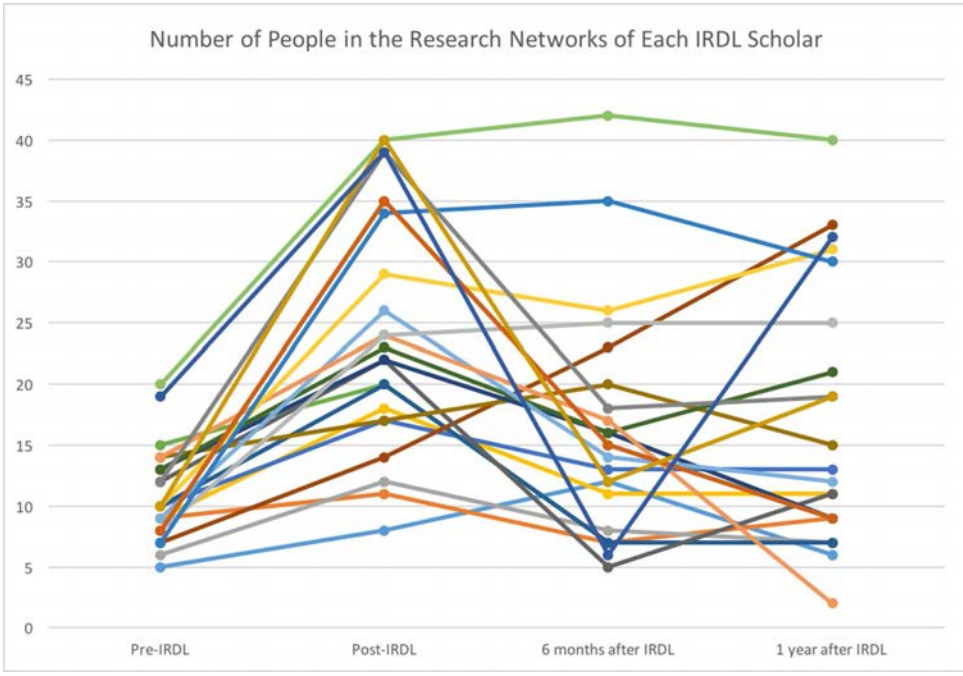


Figure 2. Changes in the number of people in the research networks of each Institute for Research Design in Librarianship (IRDL) scholar over time

Table 2.

Total network size and average size at each wave

	T1	T2	T3	T4
Network size				
Minimum	5	8	5	2
Maximum	20	40	42	40
Average (standard deviation)*	10.78 (3.83)	24.74 (9.91)	16.09 (9.26)	16.39 (10.60)
Total	**248**	**569**	**370**	**377**
Change from T1 to T2				
Average (standard deviation)	+ 13.95 (9.00)			
Total	**+ 321**			
Change from T2 to T3				
Average (standard deviation)		–8.65 (10.69)		
Total		**–199**		
Change from T3 to T4				
Average (standard deviation)			+ 0.30 (7.85)	
Total			**+ 7**	
Change from T1 to T4				
Average (standard deviation)		+ 5.60 (10.08)		
Total		**+ 129**		

*The number in parentheses, the standard deviation, indicates how tightly the examples cluster around the average, or in other words, how spread out numbers are.

were characterized as personal friends, 34 (33 percent) were described as professional colleagues, and 59 (54 percent) as both friend and colleague. Of the 14 personal friendships, 8 were described as reciprocal in terms of asking for and receiving help, related to research. Of the 34 professional colleague relationships, 20 were identified as being authoritative, from whom the scholars asked for advice or help. Of the 59 both-friend-and-colleague relationships, 41 were described as reciprocal, the highest number and percentage of all the relationships and levels of support. See Table 3 for more data from this analysis.

Table 3.

Category of relationship by type of support (those named across all four waves, N = 107)

	Personal friend		Professional colleague		Both friend and colleague	
	n	Percentage	n	Percentage	n	Percentage
I'm usually asking this person for advice or help.	6	42.86%	20	58.82%	14	23.73%
I'm usually giving this person advice or help.	0	0.00%	4	11.76%	4	6.78%
It's pretty even; I ask for help but also give help in equal amounts.	8	57.14%	10	29.41%	41	69.49%
Total	**14**	**100%**	**34**	**100%**	**59**	**100%**

To signify the strength of a relationship, we were interested to learn if those people identified as "both friend and colleague" and with whom advice was reciprocal worked on research projects together. We looked at the results of the *strength* question and found that, of the 41 described as "both friend and colleague" with reciprocal advice ("It's pretty even; I ask for help but also give help in equal amounts"), 32 of them (78 percent) had also worked on one or more major projects together (for example, put together a conference session or published an article together). We then looked at the same interaction at the "professional colleague" variable and found that 6 of those 10 (60 percent) had worked on one or more major projects together. Only one of the eight personal friends with reciprocal advice had also worked on one or more major projects together.

We examined the ratio of the number of connections among network members compared to the total number of possible ties (*density*) to understand the cohesion of the research networks of the scholars. This measure is built from each scholar's evaluation of the relationships among the people in their research networks ("I don't know if they know each other"; "No, they don't know each other"; "Yes, they know each other but don't talk about or do research together"; or "Yes, they know each other and have research interactions"). The density scores of each scholar were averaged at each wave of data collection. At T1, the average density was 0.45. The standard deviation (SD), a measure of how spread out the numbers were, was 0.19. At T2, the average density was

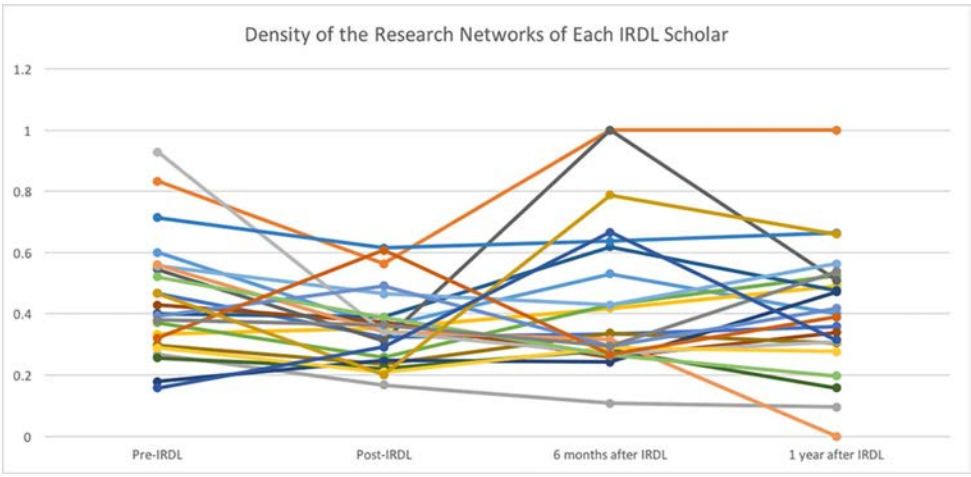


Figure 3. Density of the research networks of each Institute for Research Design in Librarianship (IRDL) scholar over time

0.35 (SD = 0.13). At T3, the average density was 0.44 (SD = 0.24). At T4, the average density was 0.41 (SD = 0.21). An interesting finding is that, as the number of network members increases at T2, the density decreases. It is reasonable to expect density to decrease at this time because the new members have just been introduced into the networks between T1 and T2 and have not yet had time to connect with existing members in the networks; this lack of connections is signified by a decreased density score. At T3 and T4, the density increases slightly as the research networks begin to reformulate, with the addition of the new members. Figure 3 illustrates the density of the research networks of each scholar.

Discussion

One of the questions we attempted to answer with this exploratory research project was to discover if participating in an institute like IRDL has an effect on the personal research networks of novice librarian researchers. Our analysis from the 23 novice researcher librarians suggests that participating in an institute like IRDL has an effect on their research networks. We see compositional evidence of a small network at the outset expanding throughout the year of participating in the Institute for Research Design in Librarianship, including the expected "churn" (addition and loss of people in the networks) as the scholars mature in their research agendas.

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The difference scores reported in our findings (measurements of people in the networks mentioned from any T to another T) demonstrate that network size

changes. For our purposes in this research, we believe that difference scores, though simply computed, sufficiently answer our initial inquiry of whether participating in the institute affects a scholar's network; it is clear that there is an effect. We expect to use difference scores throughout the measurement of future cohorts, with an eventual combined data set of 12 time points, to demonstrate this effect over time.

Another of the questions we explore in this project is to describe to what extent the networks of the scholars change during the course of the yearlong IRDL program. Although the cohort can genuinely be described as a novice group in regards to the mastery experiences gained in the IRDL, some in the group are not novices at building a personal learning network. The range of numbers of people mentioned in the network elicitation portion of the survey suggests that some in the cohort already have established a working network, whereas others may be just starting to build theirs.

Since the scholars change at different rates, with some in the cohort adding more people to their networks than others, there may be an underlying factor of motivation and readiness to change. We agree with the statement that "The amount of true change that takes place for any given subject between any two time periods is a result of that subject's individual underlying growth trajectory."[44] To better describe this trajectory, with the second and future cohorts we will introduce a contemplation ladder, adapted from the one validated by Lois Biener and David Abrams, to ask the scholars to circle on an image of a ladder where they feel they stand in their readiness to make changes to their research networks.[45] In our evaluations of future cohorts, we expect to use the answers to this change ladder to help us understand why at certain points some scholars add more or fewer people to their research networks.

Of the 107 persistent members of the networks of scholars in the Institute for Research Design in Librarianship, the scholars described more than half of them (55 percent) as both friends and colleagues.

Of the 107 persistent members of the networks of scholars in the Institute for Research Design in Librarianship, the scholars described more than half of them (55 percent) as both friends and colleagues. Of those friend-colleague relationships, we see the highest percentage of reciprocal assistance in giving and seeking research advice, at about 69 percent. Those relationships also had the highest percentage of working on a major project together, such as organizing a conference session or publishing an article. We look forward to our analysis of future IRDL cohorts to see if this kind of relationship is reported similarly.

Limitations and Future Research

Our analysis suggests that we have observed a structural change in the networks of novice researcher librarians, but at this point in our research we cannot make a generalized statement about the interventional effect of IRDL on the scholars' research networks. In the future, we may replicate the network study with a control group of working academic librarians who did not participate in the program, to observe how their research networks change. With that information, we will be better poised to know whether the changes

in the research networks we observe result from participating in the IRDL program or may be explained simply by a librarian's growth in the profession.

In our survey, we did not inquire whether the people mentioned in the scholars' networks were employed at the same institution as the scholar or if they were part of the same discipline. Having this information would have better situated our findings within the context of the professional network development literature noted in our review.[46] We can add these questions in future iterations of our data collection to better describe if librarians mimic other academic researchers, who collaborate both within and outside of organizationally bounded networks.

Kennedy and Brancolini note that some academic librarians do not complete research due to a "lack of support (both emotional and monetary)."[47] One of our long-term goals for this research is to examine whether increasing one's personal network assists in completing research. We are limited in commenting on this because the scholars from the first cohort are still conducting their research projects. We are tracking the output from the participants of IRDL and expect that we will eventually gain a better understanding of how influencing the support component via an expansion of the IRDL participants' personal research networks may relate to the completion of research projects.

. . . taking part in an institute like the Institute for Research Design in Librarianship can trigger not only the development of an individual's network but also the growth of a larger support and collaboration network.

In our review of the literature, we found no publications that examined the evolving networks of librarian researchers, and so this research both addresses a gap in the literature and suggests future research in this area. This work helps us begin to understand the process of change in research networks over time and how taking part in an institute like the Institute for Research Design in Librarianship can trigger not only the development of an individual's network but also the growth of a larger support and collaboration network.

Summary

We conducted this exploratory research project to learn if participating in a continuing education program like IRDL has an effect on the personal research networks of novice librarian researchers, and how those networks evolve over time. Since IRDL is designed on two components of Bandura's self-efficacy model, mastery experiences and social persuasion,[48] it is reasonable to measure the social persuasion component in this situation. Using social network analysis is appropriate for this measurement. In our analysis, we find that participating in IRDL affects the evolution of personal research networks over the course of a year, with the greatest impact on the networks occurring immediately after the workshop component of the yearlong program.

Marie R. Kennedy is the serials and electronic resources librarian in the William H. Hannon Library at Loyola Marymount University in Los Angeles; she may be reached by e-mail at: marie.kennedy@lmu.edu.

David P. Kennedy is a senior behavioral and social scientist at the RAND Corporation and a professor at the Pardee RAND Graduate School in Santa Monica, California; his e-mail address is: davidk@rand.org.

Kristine R. Brancolini is dean of the William H. Hannon Library at Loyola Marymount University in Los Angeles; she may be reached by e-mail at: brancoli@lmu.edu.

Acknowledgment

This project was made possible in part by the Institute of Museum and Library Services grant RE-06-13-0060-13.

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