

Doris Duke Fellowships Network Analysis Report: 2018-2019

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Disclaimer

The points of view, analyses, interpretations, and opinions expressed here are solely those of the authors and do not necessarily reflect the position of the Doris Duke Fellows or the Doris Duke Charitable Foundation.

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EXECUTIVE SUMMARY

Established in 2010, the Doris Duke Fellowships for the Promotion of Child Well-Being focus on identifying and nurturing 15 promising doctoral students each year from multiple disciplines. The program engages fellows for two years to collectively address child well-being by applying research-based solutions to policy and practice challenges. The fellowships' ongoing implementation is guided by three core operational objectives:

- Selecting individuals with the skills, passion, and institutional support necessary to sustain long-term professional involvement in the child well-being field.
- Selecting cohorts of fellows that collectively represent a diverse group of scholars in terms of their disciplines, research interests, backgrounds, and technical expertise.
- Creating an active, self-generating learning network among the fellows through ongoing web-based conferences, annual meetings, informal meetings at relevant national conferences, peer mentoring, and shared research projects.

For the past four years, we surveyed current and graduated fellows regarding the strength of the network both within and across cohorts. This report summarizes the results of our most recent survey of the fellowships' eight cohorts. Of these 120 individuals, 30 were still enrolled during the data collection period (July 2018–June 2019) and 90 had graduated from the fellowships program.

Methods

We use social network analysis to measure and map the connections among fellows and the relative strength of these connections. Each fellow is asked to document the number of virtual and in-person contacts they have had with other fellows during the data collection period. Fellows currently enrolled in the program are asked not to include interactions with fellows that occur during mandatory fellowships events such as our annual meeting or required small group interactions. Data are collected through a web-based survey distributed to all 120 fellows in the fellowships network.¹ We analyzed the data and created graphs using Node XL Pro, an open source network analysis extension for Microsoft Excel. A total of 112 fellows responded to the survey (93%). Eight fellows did not complete the survey.²

In this report, we first describe connectivity within each cohort. We then focus on the connections observed across the full network. We also present the results of a multivariate analysis that assessed the degree to which various factors accounted for variation in a fellow's

¹ We used REDCap (Research Electronic Data Capture) for survey distribution.

² Two fellows each from Cohorts Two, Three, Four, and Five did not complete the survey, which will result in a lower total reported connections for these cohorts compared to what actually occurred.

total number of connections. The report concludes with a summary of key trends and implications for the network moving forward.

Key Within-Cohort Findings

We continue to see variance in how fellows are connected to one another within their cohorts, as seen in Table 1. Highlights from the within-cohort analysis include:

- The average number of cohort peers that fellows connected to varied from 4.1 to 10.7 during the study year.
- Fellows in five cohorts reported connecting with at least half of the other fellows in their cohorts, although there was wide variation (13% to 100%).
- One of our primary indicators of a cohort’s interactions is its *graph density*, which indicates the degree to which all of the possible connections among the 15 fellows in a cohort were made. In 2018-2019, cohorts widely varied in graph density, with the lowest being 30% (indicating that only 30% of possible connections were made within the cohort) and the highest being 76% (indicating roughly three-quarters of all possible connections between the 15 fellows took place).
- Four of the seven cohorts with data in the prior year reported increased connectivity, with an average increase of 16%; the average decrease in the other three cohorts was 6%.
- Fellows are placed in a small group of five fellows at the start of their fellowships experience and remain in these small groups throughout their two years in the program. We examined how connected these small groups continue to be, and found that in four of the cohorts, more than half of all possible connections between the five fellows in the same small group occurred during the study year for all small groups.

Table 1. Summary of Within-Cohort Connections

Cohort	One	Two	Three	Four	Five	Six	Seven	Eight
Average number of within-cohort peers fellows connected with	7.3	4.6	8.4	6.4	8.9	8.8	10.7	4.1
% of cohort connecting with at least 50% of cohort peers	67%	27%	67%	33%	80%	87%	100%	13%
Overall Cohort Density	52%	35%	60%	46%	65%	63%	76%	30%
Density trend from previous year	-8%	+5%	+12%	-4%	+25%	-5%	+20%	n/a
# of small groups with density > 50% (max of 3)	2	1	3	3	2	3	3	1

¹ Graph Density = Proportion of all possible connections that occurred.

Key Cross-Cohort Patterns

As we observed in the within-cohort analysis, there is variation in each cohort’s connectivity with the full network. Cohort Eight fellows were included in the survey for the first time in 2018-2019, representing a 14% increase in network members.

- There was a 40% increase in total number of reported connections over the prior year. This is the largest percentage jump in reported connections over the past four years.
- The majority of the 3,493 reported connections (2,032, or 58%) in 2018-2019 were reciprocated connections, meaning that both fellows in an interaction recorded the same type of connection. Our best estimate of the number of unduplicated connections this year is 2,477, which is 48% more unique connections compared to the prior year.
- Five of seven cohorts increased the proportion of their total connections that occur outside of their cohort compared to the prior year.
- Overall, 72% of all reported connections involved fellows from different cohorts, representing a 3% increase over the previous year. Strategies such as increased graduated fellow attendance at the mid-year meeting, staff-driven connections between current and former fellows, network-wide communication on behalf of the Leadership Committee,³ writing retreats, and peer mentors created greater opportunities for connections and relationships among fellows from different cohorts. The rate of cross-cohort connections suggests that the Doris Duke Fellowships network is transitioning into a single network, rather than operating as eight distinct networks.

Multivariate Analysis

We conducted hierarchical multiple regression analysis to identify the most salient factors in explaining variation in the number of connections fellows reported with other fellows. Our independent variables included:

- Small group density: proportion of possible connections between the five group members over the past four surveys;
- Discipline density: number of fellows who shared the same discipline;
- Length in fellowships: number of years each fellow had been in the fellowships; and
- Geographic proximity: number of fellows in the same metro area.

Two variables stood out as significant predictors of total connections—small group density and discipline density. As expected, fellows who were in small groups that maintained higher connectivity reported a larger number of total network connections this year. From the beginning of the fellowships program, we provided fellows a concrete opportunity to collaborate across disciplines with a smaller number of colleagues on a joint project. As such, we assigned each fellow at the time of enrollment to one of three small groups. Participants in small groups that maintained relatively strong connections with each other were more likely to connect with additional fellows.

³ The Leadership Committee, comprised of one representative from each cohort and three at-large members, met routinely throughout this year to discuss the sustainability of the fellowships network. Committee members sought input and provided updates to their cohort peers on a regular basis.

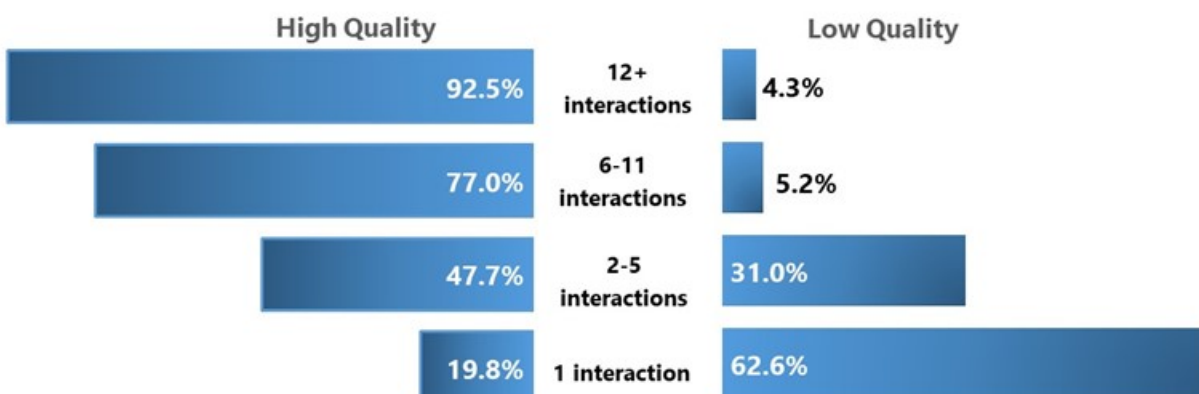
Fellows from disciplines who were more broadly represented in the fellowship network (e.g. social work, psychology) were more likely to report a larger number of total connections than those who had fewer colleagues in the program sharing their academic discipline (e.g., criminal justice, sociology). On one hand, it is intuitive to assume fellows would find greater common ground with people enrolled in similar programs and sharing a similar disciplinary focus. Professional organizations are typically structured around single disciplines; academic departments are usually discipline specific; and many journals continue to focus on a sole discipline. The fellowships program has been challenging this structure since its inception, forming cohorts that reflect greater discipline diversity and creating opportunities for interdisciplinary connections. Although the overall number of interdisciplinary connections continues to be strong and is growing (as evidenced by overall survey results discussed elsewhere), having a critical mass of colleagues in your discipline within the network may provide fellows greater initial comfort in forming connections within this peer group.

Network Quality

Fellows in six of the eight cohorts rated connections with their cohort peers as higher quality than their connections with fellows outside their cohort, which is to be expected. The fellowships is built on a peer learning model, and relationships amongst fellows in the same cohort are prioritized during the two-year active fellowships period.

The average quality rating for all connections (3.0) was slightly lower this year as compared to last year (3.2, on a 5 point scale). This slight decline may in part reflect the notable increase in the number of one-time connections. Reported connections that reflect a single interaction with another fellow increased 8% over the previous year. In the most recent survey, nearly half of reported connections occurred only one time and of these, over 60% received low quality ratings. As demonstrated in Figure 1, the overwhelming majority of connections with six or more interactions during the year are rated high quality. We found connection quality is strongly correlated with the interaction frequency ($r=0.49$, $p<.001$).

Figure 1. Quality Rating by Interaction Frequency



Conclusion

The eight cohorts in the Doris Duke Fellowships for the Promotion of Child Well-Being represent a diverse group of emerging scholars. Through participation in activities during their two-year fellowships term and subsequent access to the full fellowships network, these scholars have the opportunity to collaborate within and across cohorts, disciplines, and small groups. The network survey found that substantial interactions occur between the fellows, both within and across cohorts, beyond interactions at fellowships events. Key themes include:

- **100% of all fellows are connected to the network.** While 15 new fellows are added to the network each year, fellows this year increased the average number of other fellows with whom they connected by 26%. Fellows are increasing the number of fellows they connect with, expanding across cohort boundaries, and are remaining engaged with the entire network after their time in the program.
- **Fellows retain a strong connection to those in their cohort.** Within-cohort engagement remains strong, regardless of how many years have lapsed since program enrollment. Additionally, fellows rate their connections among cohort peers as high quality, indicating that these interactions are meaningful and additive to their development as a leader in the field.
- **At the same time, fellows are extending their relationships beyond their enrollment cohort.** The majority of the 3,493 interactions respondents reported this year (72%) are occurring across cohort boundaries, a 3% increase over the previous year's data and a 30% increase over the past four years. Fellows increasingly collaborate on a wide range of activities and engage fellows across the network. These include journal articles and professional presentations as well as efforts to influence public policy and reform practice.

- ***Interdisciplinary collaborations are increasing.*** Aligning with one of the four primary goals of the fellowships—to increase interdisciplinary knowledge and research—61% of all reported connections are ones that crossed disciplinary boundaries, which is an 11% increase from the prior year.

Building a strong professional network is an extensive and challenging process, and many factors contribute to making a social network thrive. In this survey, we track only a handful of elements and observe how they contribute to network connectivity. In the coming year, we anticipate that the COVID pandemic will have had measurable impact on the number of connections among fellows and the nature of these connections, including a spike in virtual connections. To better assess this pattern, our survey will assess COVID's impact on network connectivity broadly and within cohorts, as well as innovative solutions fellows may have found to remain connected.

INTRODUCTION

Resolving many of the complex and interdependent threats to healthy child development and well-being requires individuals interested both in unraveling the problem and in working across disciplines to develop new knowledge. Researchers Daro and Cohn Donnelly reflected on child maltreatment research and practice in the opening chapter of a book about the advances in child abuse prevention knowledge. They noted, “The most effective solutions [to prevent child maltreatment] are increasingly ones that embrace an array of strategies targeting all levels of the ecological framework” (Daro & Cohn Donnelly, 2015, p.4).

The Doris Duke Fellowships for the Promotion of Child Well-Being embrace this truth as reflected in doctoral education and training. From its establishment in 2010, the fellowships recognized the myriad challenges facing the child abuse prevention field and the importance of innovation and new frameworks in creating an effective response. We selected 120 fellows from diverse disciplines across eight cohorts for two-year program terms. During the two years, fellows have certain expectations for engagement; after the two years fellows are considered graduated fellows and remain part of the fellowships network. The program’s implementation is guided by three core operational objectives:

- Selecting individuals with the skills, passion, and institutional support necessary for sustaining long-term professional involvement in the child well-being field.
- Selecting cohorts of fellows that collectively represent a diverse group of scholars in terms of their backgrounds, disciplines, research interests, and technical expertise.
- Creating an active, self-generating learning network among the fellows through ongoing web-based conferences, annual meetings and informal meetings at related national conferences, peer mentoring, and shared research projects within small groups of fellows.

For the past four years, we have surveyed current and graduated fellows regarding their connections with other fellows both within and outside their cohorts using the same instrument. This document reports on our most recent survey, the first to include all eight cohorts. Of these 120 individuals, 30 were still enrolled in the fellowships for the data observation period (July 2018-June 2019) and 90 had completed the program. Repeating the survey each year allows us to assess the frequency and quality of interactions fellows enjoy with their colleagues while in the program, and assess the extent to which these relationships are sustained over time.

Organization of the Report

We use social network analysis to map and measure the connections among fellows and the relative strengths of these connections. The report first presents individual cohort data for the current study year, followed by the results for the full fellowships network. Where appropriate, we compare the current network profiles to those generated in the previous report. We include

the results of a multivariate analysis that seeks to explain the variation in fellows' connections. We conclude the report with a discussion of trends and implications for the future of the network.

METHOD

According to the International Network for Social Network Analysis (SNA), network analysis is “based on the intuitive notion that these patterns are important features of the lives of the individuals who display them. Network analysts believe that how an individual lives depends in large part on how that individual is tied into the larger web of social connections” (Freeman, n.d.). Unlike other approaches, “the fundamental distinction of social network analysis research is that relationships—who is connected to whom—are of paramount importance in explaining behavior. . . network analysis offers many exciting tools and techniques useful in research” (Valente, 2010, p. vii-viii). Because social network analysis emphasizes the importance of relationships to explain behavior, we use this method to look at the relationships formed in, and because of, the fellowships as well as the strength of such connections.

In this report, we use social network analysis to illustrate the extent to which fellows within a given cohort communicate with others in their cohort and examine what factors—such as academic discipline or membership in the same small group (as a proxy for early shared research interests)—lead to greater, more frequent interactions.⁴ We also examine relationships across the eight cohorts and how connected each cohort is to the network as a whole. In considering cross-cohort interactions, we consider the role academic discipline and physical location may play in connecting fellows and the rated quality of connections. To visually illustrate these interactions, we developed networking graphs for each individual cohort as well as for the full sample. Graphs were created using NodeXL Pro, an open source network analysis extension for Microsoft Excel.

Data Collection

Data were collected through a web-based survey distributed to all 120 fellows in the fellowships network.⁵ Using this survey, fellows reported the number and type (e.g., in-person, phone, email) of interactions they had with other fellows, both within and outside their cohort, between July 2018 and June 2019. A total of 112 fellows responded to the survey (93%). Eight fellows did not complete the survey.⁶ Additionally, one fellow who completed the survey did not report a single connection during the reporting year. However, all fellows remained engaged in the network because at least one fellow who responded to the survey reported an interaction with them at some point during the reporting period.

When reporting contact with another fellow, the respondent indicated the frequency of this contact on a 6-point scale: 0 = no contact; 1 = single contact; 2 = 2–5 contacts a year; 3 = 6–11 contacts a year; 4 = 12–23 contacts a year; and 5 = 24 or more contacts a year. Respondents

⁴ Upon entering the fellowships program, fellowships staff assign five fellows from each cohort into one of three small groups. Fellows in each group share similar research interests but are assigned to ensure diversity within the group on a variety of domains, including discipline, geography, and demographic characteristics.

⁵ We used REDCap (Research Electronic Data Capture) for survey distribution.

⁶ Two fellows each from Cohorts Two, Three, Four, and Five did not complete the survey, which will result in a lower total reported connections for these cohorts compared to what actually occurred.

also rated the quality of the contact on a 5-point scale from 1 (i.e., a weak, short connection) to 5 (i.e., a strong, lengthy connection).

In recording their contact with other fellows, respondents from Cohorts Seven and Eight were asked **not** to include interactions that occurred during the two required fellowships meetings each year and **not** to include connections made discussing their small group project work. As such, the level of contact reported in this document for these two cohorts reflects the minimal level of contact outside of mandatory fellowships interactions among current fellows during 2018–19.

When two fellows report a connection with each other of the same type (i.e., virtual or in person), we count that as two connections. We call this a reciprocated connection. For example, if Fellow A reports an in-person connection with Fellow B, and Fellow B reports an in-person connection with Fellow A, that is counted as two connections in the total number of connections. On the graphs, reciprocated connections are displayed using the highest frequency and average quality reported between the pair.

When only one fellow reports a connection with another fellow of a certain type (in-person or virtual), we count that as one connection. For example, if Fellow A reports an in-person connection with Fellow B, but Fellow B does not report an in-person connection with Fellow A, that is counted as one connection in the total number of connections.

Key for Networking Graphs

In developing the graphs, we utilized a number of techniques to make the data and their implications more accessible to the reader. The variation in both the width and darkness of the lines between two given fellows reflects variation in the frequency and reported quality of these interactions. The *width* of each line indicates the frequency of the reported in-person or virtual contacts between two fellows; the broader the line, the greater the number of contacts. The *darkness* of each line indicates the average reported quality of all of the in-person or virtual connections between two fellows; the darker the line, the higher the reported quality. A fully opaque line of a darker color signifies connections of the highest quality. The variation in the color and type of lines reflects the variation in the type of connection reported. *Solid, steel blue* lines represent in-person connections. *Dashed, grey* lines represent virtual connections. Virtual and in-person connections frequently overlap, indicating that fellows reported both types of connections.

Social Network Analysis Terminology

Throughout this report, we use terminology commonly employed in reporting network analysis. These terms and related definitions are noted below.

- **Edges** are the connections between individuals within a social network. In our network, edges code *in-person* (i.e., solid, steel blue lines) or *virtual* (i.e., dashed, grey lines) connections between fellows.

- **Vertices** are the individuals that make up a social network. In our network, the vertices are the fellows.
- **Degree** denotes the number of direct connections of each vertex (i.e., fellow) in the network. In our report, it is the number of other fellows an individual has connected with during the year (*not* the number of times they connected with other fellows). Fellows with the highest degree are communicating with the greatest number of other fellows in the network.
- **Retention rate** is a measure of the vertices (i.e., fellows) within a cohort that have connected with at least half of their cohort peers during the survey period. Because each fellow has 14 peers in their cohort, a fellow is considered *retained* in their cohort network if their number of degrees is seven or higher—meaning they connected with seven or more other fellows in their cohort. The rate is calculated by dividing the total number of fellows in a network (15 for each cohort) by the number retained in that network and converting to a percentage.
- **Graph density** is the ratio between the number of edges (i.e., connections between fellows) in the graph and the total number of possible edges available in the network (if each fellow interacted virtually and in-person with all of the other fellows in network). Thus, the higher the graph density, the higher the percentage of possible connections captured within the graph.
- **Betweenness centrality** indicates the power of a vertex (i.e., fellow) to broker connections between other fellows within the network. Thus, fellows with a high betweenness centrality are essential to the connectivity of the network, even if they do not have the highest degree. These fellows are most essential for connecting to fellows who are not accessing the network through other connections with fellows.

FINDINGS

Summary of Within-Cohort Connections

In this section, we present data explaining how the fellows within each cohort interacted with each other during the year. We detail the network density for each cohort as well as for small groups and academic disciplines. We provide the average degree for the cohort (i.e., the average number of fellows that each fellow connected with), as well as the cohort’s retention rate (i.e., the percentage of fellows connecting with at least half of their cohort peers during the year).

Cohort Findings

Cohort One

By the numbers

Network Density: 0.52 (52%) Average Degree: 7.3 Retention Rate: 0.67 (67%)
Consistently strong, connected cohort

Cohort One was selected in 2011 and graduated from the fellowships in 2013. All 15 Cohort One fellows connected with at least one of their peers during the reporting period. The cohort network exhibited a graph density of 52% and an average degree of 7.3 (described in more detail below). These numbers are slightly lower than the previous year and fall in the middle for the eight cohorts. Figure 2 shows the interactions among the 15 Cohort One respondents, with the fellows’ nodes color-coded to reflect their small group assignment. For Cohort One, the fellows were split into three small groups that centered on child welfare practice and reforms, youth development and policies, and early intervention.

Figure 3 presents the same data but highlights each fellow’s specific discipline. As displayed in Figure 3, 10 of the fellows identified social work as their discipline, shown in red. Of the remaining five fellows, three are in psychology (orange), one in criminal justice (pink), and one in public policy (black).

Description of the Network

Cohort One has a graph density of 0.52, meaning that 52% of possible edges (i.e., connections) between Cohort One fellows occurred during this reporting period. This was slightly lower than last year (0.60). The Cohort One network exhibited an average degree of 7.3, indicating that, on average, the 15 Cohort One fellows interacted with a little over half of their cohort. Despite a moderately well-connected network, there is one fellow (Fellow 111) that appears a critical connector to the network, given this fellow’s relatively high betweenness centrality score. This fellow played an important role as a bridge from the periphery to the core of the network. Six Cohort One fellows reported interacting with more of their Cohort One peers this year compared to the previous year, as shown in Table 2, while five reported interacting with fewer.

Two of the small groups remain in close contact. Additionally, among all reported Cohort One connections with quality ratings (99% of connections), 52% were rated high quality (a 4 or 5 on a 5-point Likert scale). While the density of this cohort has dropped slightly each year, the cohort still remains strongly connected even six years out of the fellowship. Additionally, analysis in the next section shows their connectivity to the full network increases each year.

Small Group Affiliation

The sustained and variable impacts of the initial small group placements within Cohort One are visible in Figure 2. Within the early intervention group, all fellows appear strongly connected to each another and the network, shown by the wide and dark lines connecting them. Similarly, the youth development group shows four of its members strongly connected to each other. Both of these groups also had a strong graph density of 0.90, indicating that 90% of all possible connections that could occur during the reporting year did occur. These two small groups have remained closely connected for several years.

Consistent with past years survey data, four of the members of the child welfare practice and reform group appear on the periphery of the graph, and have weak and few ties to the network. The graph density for this group is 0.10, illustrating how relatively few connections between these group members occurred. This group's connections have been consistently low over the years. The relative weak ties among the members of this group suggests that members in this small group did not establish the same strength of relationships early on that we observed among fellows in the other two groups.

Disciplines

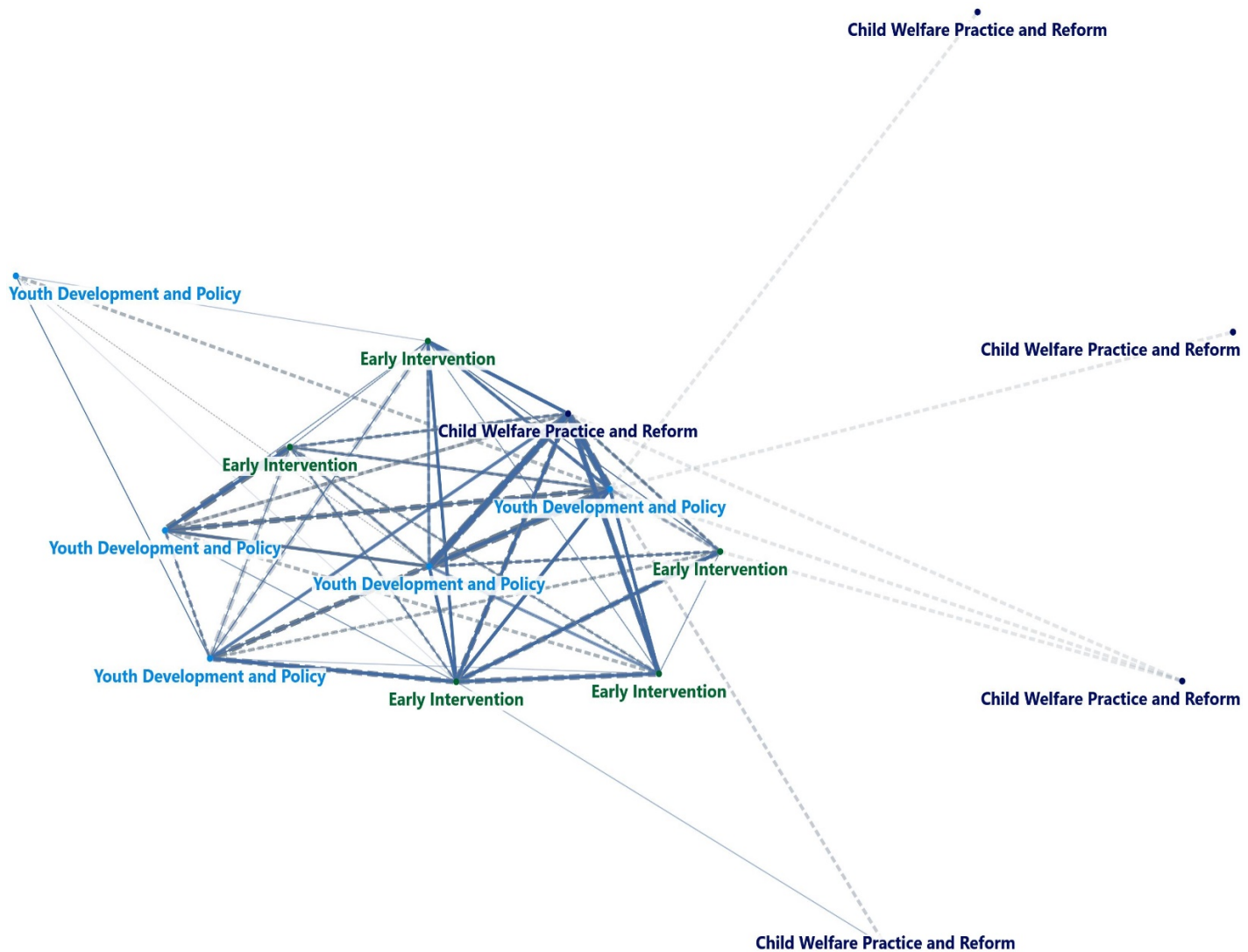
The effect of academic discipline on the Cohort One network is difficult to discern due to the significant majority of social work students, shown in red, within this cohort. However, acknowledging that this network has a dominant social work focus, we still see many interdisciplinary connections (see Figure 3). Among all Cohort One within-cohort connections, 46% were interdisciplinary, which is a 19% increase from last year (39%). Indeed, many of the social work fellows are clustered in an obvious group with a graph density of 0.64. The three fellows in psychology did not engage with each other during the year and thus have a graph density of 0.0. Additionally, the relative strength of connections the fellow in public policy has with their Cohort One peers in all disciplines illustrates that interdisciplinary connections have been maintained over time even in a cohort with one dominant discipline.

Retention

During 2018-2019, all 15 fellows were in contact with each other, up from 14 connected fellows the previous year. Ten Cohort One fellows are in contact with more than six other fellows, for a retention rate of 67%. This is the same retention rate as the previous three years. The five fellows with fewer than seven degrees lie on the periphery of the network, as shown in Figures 2 and 3 by the relatively few lines from these nodes. These fellows are at risk of losing contact with the group, however Fellow 111 (with the high betweenness centrality score) appears critical to keeping them engaged by connecting with each of them through the year (a degree of 14

indicates this fellow connected with each fellow in Cohort One). Maintaining the same retention rate, and six fellows connecting with more fellows during this year, suggests the cohort maintains its strong connections over time.

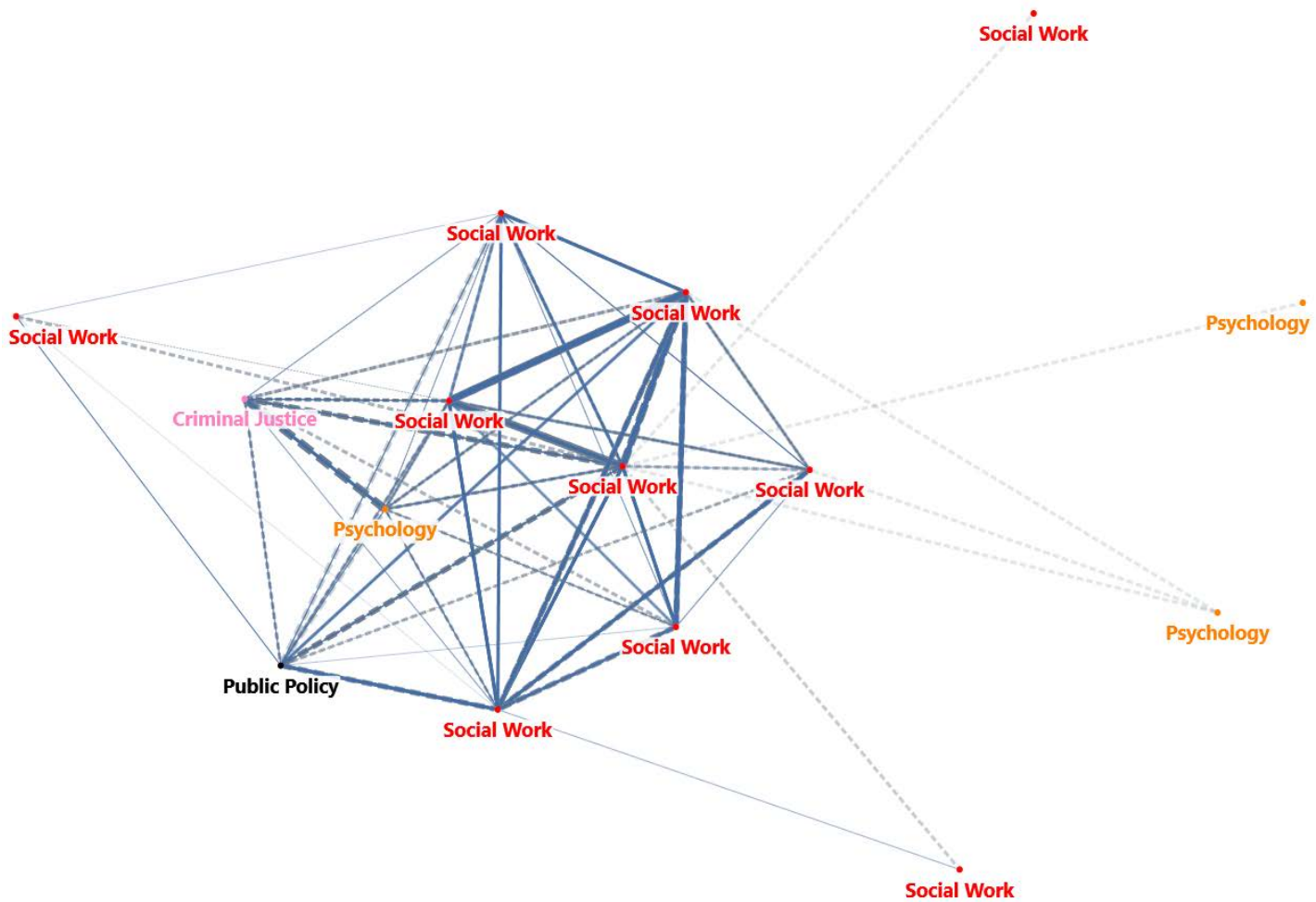
Figure 2. Cohort One Network: Small Group Affiliation



Notes:

- Dashed, grey lines represent virtual interactions; solid, steel blue lines indicate in-person interactions.
- The width of the line shows the total number of in-person and virtual interactions between two fellows. The broader the line, the greater the number of interactions.
- The darkness of the line shows the average reported quality of all interactions between two fellows. The darker the line, the higher the reported quality.

Figure 3. Cohort One Network: Academic Discipline



Notes:

- Dashed, grey lines represent virtual interactions; solid, steel blue lines indicate in-person interactions.
- The width of the line shows the total number of in-person and virtual interactions between two fellows. The broader the line, the greater the number of interactions.
- The darkness of the line shows the average reported quality of all interactions between two fellows. The darker the line, the higher the reported quality.

Table 2. Cohort One Descriptive Statistics

Fellow	Degree	Degree Change from Prior Year	Betweenness Centrality
Fellow 111	14	1	35.452
Fellow 110	11	2	5.786
Fellow 101	10	0	2.952
Fellow 105	10	0	1.286
Fellow 113	10	-3	1.286
Fellow 106	10	1	1.286
Fellow 107	9	1	0.286
Fellow 112	8	0	1.667
Fellow 104	8	2	0.000
Fellow 109	8	0	0.000
Fellow 108	5	-2	0.000
Fellow 115	3	3	0.000
Fellow 114	2	-1	0.000
Fellow 102	1	-2	0.000
Fellow 103	1	-2	0.000
	This year	Last year	
Network Average	7.30	7.90	
Network Median	8.0	8.0	
Network Density	0.524	0.60	
Discipline Density			
Social Work		0.622	
Psychology		0.00	
Criminal Justice		N/A	
Public Policy		N/A	
Small Group Density			
Early Intervention		0.900	
Youth Development and Policy		0.900	
Child Welfare Practice and Reform		0.100	

Notes:

- *Degree*: Number of connections attached to that fellow.
- *Betweenness Centrality*: How important each node/fellow is in providing a “bridge” between different parts of the network.

Cohort Two

By the numbers

Network Density: 0.35 (35%)

Average Degree: 4.6

Retention Rate: 0.27 (27%)

Consistently less connected but experienced an uptick this year

Cohort Two was selected in 2012 and graduated from the fellowships in 2014. During 2018-2019, 14 of 15 Cohort Two fellows were in contact with each other, which is two more connected fellows than the past two years for this cohort. This cohort has a graph density of 35% and an average degree of 4.6 (described in more detail below). Figure 4 documents the connections among the 14 active Cohort Two fellows, with the fellows' nodes color-coded to reflect their small group assignment. For Cohort Two, these small groups included enhancing parental capacity, child welfare system reform, and implementation/ program evaluation.

Figure 5 presents the same data but highlights each fellow's specific discipline. As noted in Figure 5, the majority of the fellows identify social work as their discipline (red). Of the remaining fellows, three are in a psychology field (orange), two in health care related fields (green), and one in sociology (blue).

Description of the Network

Cohort Two had a graph density of 0.35, meaning that 35% of possible edges (i.e., connections) between fellows occurred. This is the second-lowest among all cohorts but is a 17% increase from the previous year's density (0.30). These fellows have been out of the program for five years and have consistently demonstrated weaker connections than other cohorts. However, in addition to an increased density, two fellows that dropped out of the network for the past several years reengaged during the 2018-2019 reporting period.

The average degree of connection among the 14 active fellows is 4.6, which is an increase from the prior year's average of 3.3. Because this network has more peripheral members, certain fellows at the core of the network have high betweenness centrality scores, as noted in Table 3. These fellows are responsible for keeping the handful of periphery members engaged in the network, and thus have the highest betweenness centrality scores. While connections between cohort members are fewer, over half of these connections are rated high quality. Among all reported Cohort Two connections with quality ratings (96% of connections), 54% were rated high quality.

Small Group Affiliation

The impacts of small group connections are fairly negligible in this cohort, as seen in Figure 3. The small group structure is strongest among the child welfare reform group, home to four fellows lying in the center of the graph. This group has a graph density of 0.8, meaning 80% of possible connections between group members occurred, an increase from 0.6 last year. The graph in Figure 4 also shows that these connections were typically frequent and strong. The

implementation evaluation group also shows some connectivity, and are more connected than last year's survey, though the group has weaker and less frequent connections than the child welfare reform group. This group has a graph density of 0.4. The final group had zero connections during the reporting year, same as the year prior.

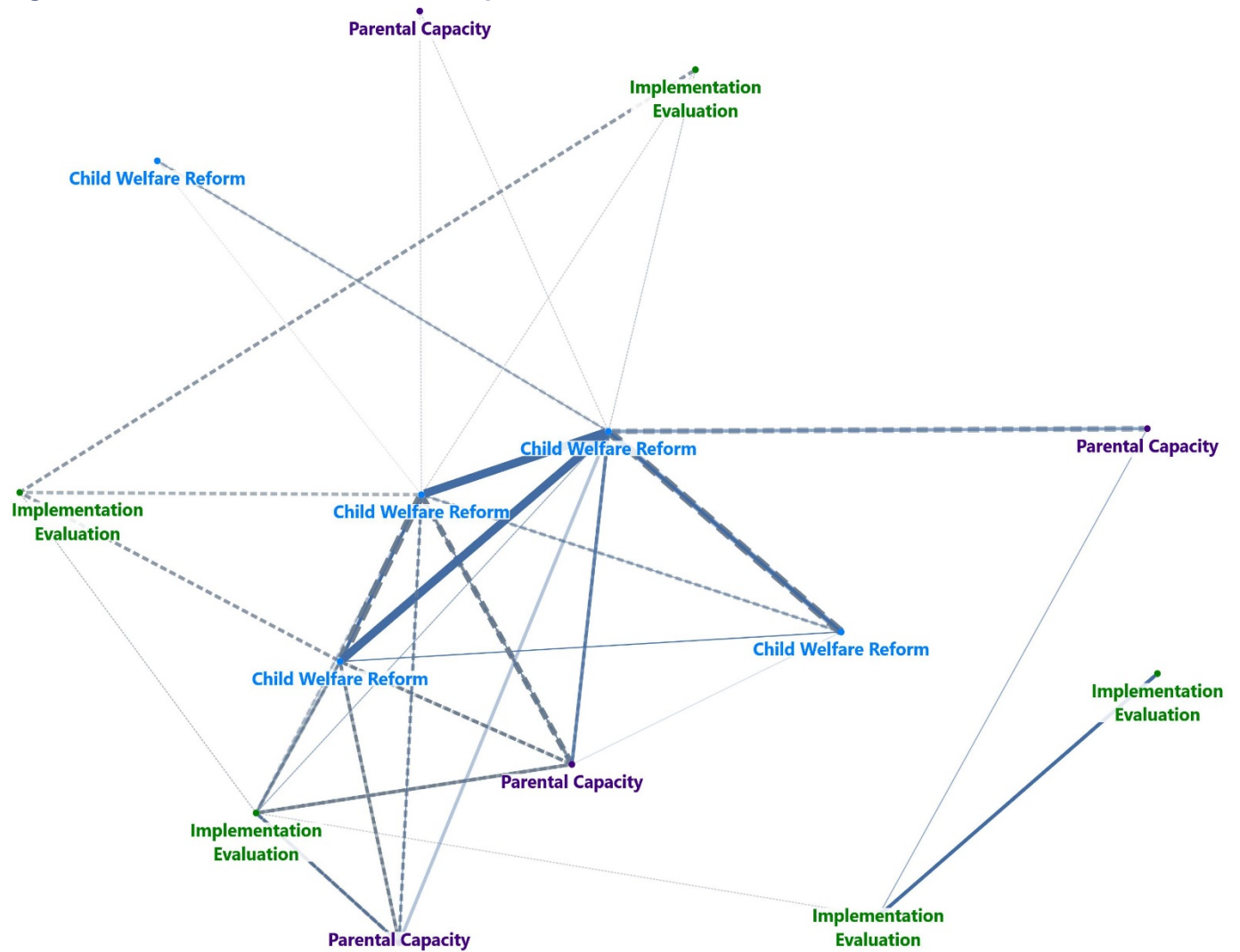
Disciplines

The effect of disciplines on the Cohort Two network was very similar to the effects observed in Cohort One. Like Cohort One, the majority of active fellows in Cohort Two are in social work (53%) and, in both networks, social work fellows formed the core of the network. Figure 5 shows three social work fellows, shown in red, with strong connections between themselves at the center of the graph. In Cohort Two, the social work fellows had a strong graph density of 0.68, very similar to their graph density from the previous year (0.62). However, unlike Cohort One, the Cohort Two fellows in the psychology field did not have any interactions with one another during the reporting period. For a third year in a row, they had a graph density of 0.0. The fellows from health care-related fields also had a graph density of 0.0. It is difficult to ascertain the effect of discipline on this cohort because of the dominance of the social work discipline. Among all Cohort Two within-cohort connections, 38% were interdisciplinary. However, these data suggest that discipline affiliation can affect the network's overall shape, as shown in Figure 5, through the strength of the social work connections.

Retention

The connectivity in Cohort Two, though still on the lower end among the eight cohorts, did rise during the reporting year. Four fellows connected with at least half of the other fellows in Cohort Two for a 27% retention rate (up from 7% last year). Additionally, two fellows rejoined the network after being absent for a handful of years. While many fellows lie on the periphery of the network, there are some strong connections happening at the core of the network, as shown by the nodes at the center of the graphs. Reflecting these increases, nearly all Cohort Two fellows reported more interactions with their cohort peers this year as compared to the prior year, as shown in Table 3. Cohort Two has consistently had weaker cohesiveness than other cohorts in the fellowships network, but showed a promising increase during this reporting year.

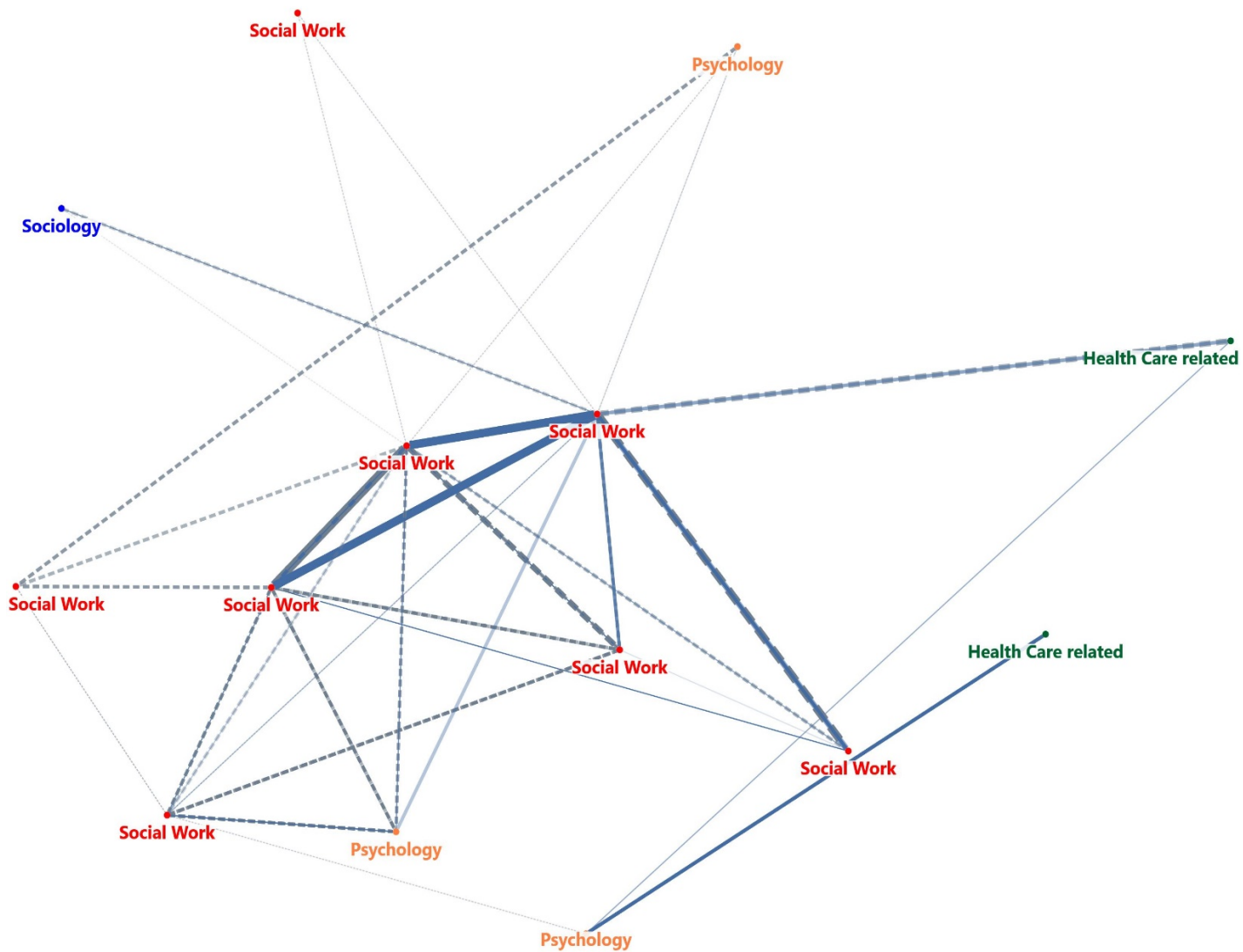
Figure 4. Cohort Two Network: Small Group Affiliation



Notes:

- Dashed, grey lines represent virtual interactions; solid, steel blue lines indicate in-person interactions.
- The width of the line shows the total number of in-person and virtual interactions between two fellows. The broader the line, the greater the number of interactions.
- The darkness of the line shows the average reported quality of all interactions between two fellows. The darker the line, the higher the reported quality.
- One Cohort Two fellow had no reported interactions with any other Cohort Two fellow and is not represented in this graph.

Figure 5. Cohort Two Network: Discipline



Notes:

- Dashed, grey lines represent virtual interactions; solid, steel blue lines indicate in-person interactions.
- The width of the line shows the total number of in-person and virtual interactions between two fellows. The broader the line, the greater the number of interactions.
- The darkness of the line shows the average reported quality of all interactions between two fellows. The darker the line, the higher the reported quality.
- One Cohort Two fellow had no reported interactions with any other Cohort Two fellow and is not represented in this graph.

Table 3. Cohort Two Descriptive Statistics

Fellow	Degree	Change from Prior Year	Betweenness Centrality
Fellow 213	10	2	23.267
Fellow 210	10	4	15.35
Fellow 207	7	3	18.333
Fellow 211	7	2	2.85
Fellow 212	5	0	0.65
Fellow 209	4	1	0
Fellow 202	4	2	1.167
Fellow 215	4	2	0
Fellow 206	3	3	0.45
Fellow 205	3	2	12.7
Fellow 208	2	2	0
Fellow 203	2	1	3.233
Fellow 214	2	1	0
Fellow 204	1	-1	0
	This year	Prior year	
Network Average	4.60	3.30	
Network Median	4.0	2.5	
Network Density	0.352	0.303	
Discipline Density			
Social Work		0.679	
Psychology		0.0	
Health Care related		0.0	
Sociology		N/A	
Small Group Density			
Child Welfare Reform		0.80	
Implementation Evaluation		0.40	
Parental Capacity		0.00	

Notes:

- *Degree*: Number of connections attached to that fellow.
- *Betweenness Centrality*: How important each node/fellow is in providing a “bridge” between different parts of the network.

Cohort Three

By the numbers

Network Density: 0.60 (60%)

Average Degree: 8.4

Retention Rate: 0.67 (67%)

Experienced large gains in connectivity

Cohort Three was selected in 2013 and graduated from the fellowships in 2015. Cohort Three had 15 active fellows, exhibited a graph density of 0.60, and an average degree of 8.4 (described in more detail below). Figure 6 documents the connections among the 15 Cohort Three fellows, with the fellows' nodes color-coded to reflect their small group assignment. For this cohort, the fellows were assigned to small groups focusing on early childhood, parenting capacity within the context of trauma-informed care, and the development and testing of new measures and risk assessment strategies.

Figure 7 presents the same data on interactions among the fellows but highlights each fellow's specific discipline. As noted in Figure 7, six of the 15 fellows identified social work as their discipline, shown in red. Of the remaining nine fellows, three identified child or human development (purple); two in both psychology (orange) and a health care related field (green); one in Public/Social policy (black) and another one in education (navy).

Description of the Network

Cohort Three had a graph density of 0.60, meaning that 60% of possible edges (i.e., connections) between fellows occurred. This was a 25% increase in density over last year, when the cohort reported a graph density of 0.48. Overall, the number of within-cohort connections for Cohort Three also increased this year. As shown in Table 4, Cohort Three had an average degree of 8.4, meaning that, on average, a fellow in Cohort Three interacted with nearly two-thirds of their cohort peers during the reporting period.

There are a handful of fellows that were strongly connected to the network. Four Cohort Three fellows connected with every other member of their cohort (Table 4). In addition, many of the connecting lines between the central fellows in the figures below show wide lines, indicating connections happening with higher frequency. However, there are also many thin and light lines in the graph, indicating a considerable number of within-cohort connections were lower quality. Among all reported Cohort Three connections with quality ratings (97% of connections), 42% were rated high quality (vs. 48% rated low quality).

Small Group Affiliation

In this cohort network, small group affiliations play a limited role in the network's structure. The cluster of fellows in the measurement group in Figure 6 show the strong connections from this small group, which also had a graph density of 0.7, meaning that 70% of the possible connections were made. The members of the early childhood group had a graph density of 0.9; however, the lines connecting them to each other appear less frequently (indicated by thinner

lines) than their interactions with other cohort peers. The members of the parenting group appear mostly on the periphery of the figure, and this group's graph density lies at 0.5. The weaker connections among this group, relative to the other two groups, is consistent with the previous year's survey data.

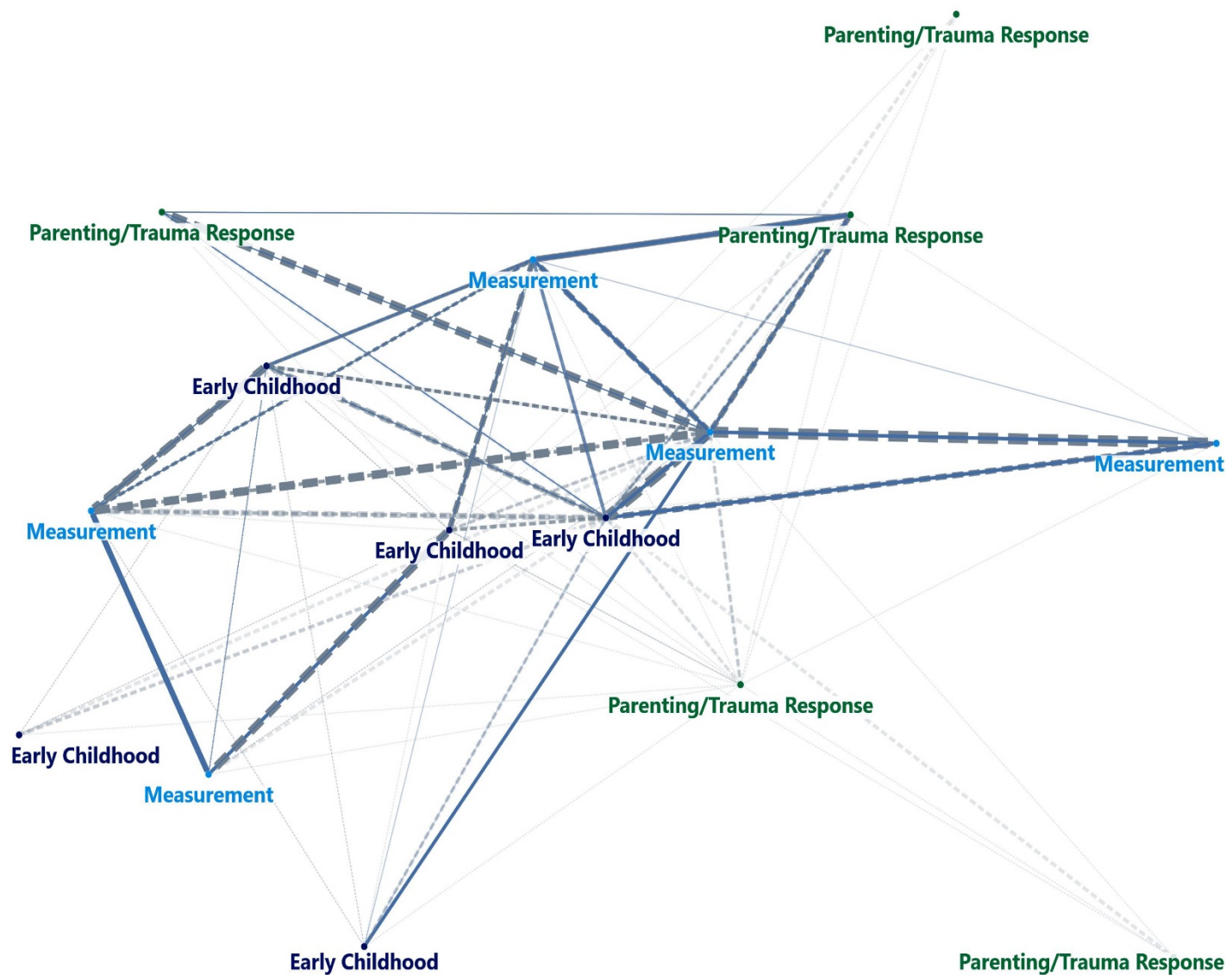
Disciplines

Cohort Three was the first cohort with fewer than half of the fellows (six) in social work. Reflecting this shift, 65% of all Cohort Three within-cohort connections were interdisciplinary (compared to 46% and 38% for Cohorts One and Two, respectively). Nonetheless, fellows within three of the discipline groups within this cohort reported strong connections to each other. The six social work Cohort Three fellows maintain strong connections and had a graph density of 0.87, as shown in Figure 7. The fellows in child/human development reported no connections during the year.

Retention

Nine Cohort Three fellows connected with more than six of the other fellows in their cohort, putting the retention rate for this cohort at 67%, compared to 47% last year. Most of the Cohort Three fellows connected with more of their cohort peers this past year than the year prior, with only one connecting with fewer fellows. Going back two years, Cohort Three's connectivity looked similar to this year, indicating last year's survey results were a dip in connectivity for the group, for any number of reasons, and not the start of a trend of diminishing connections and strength.

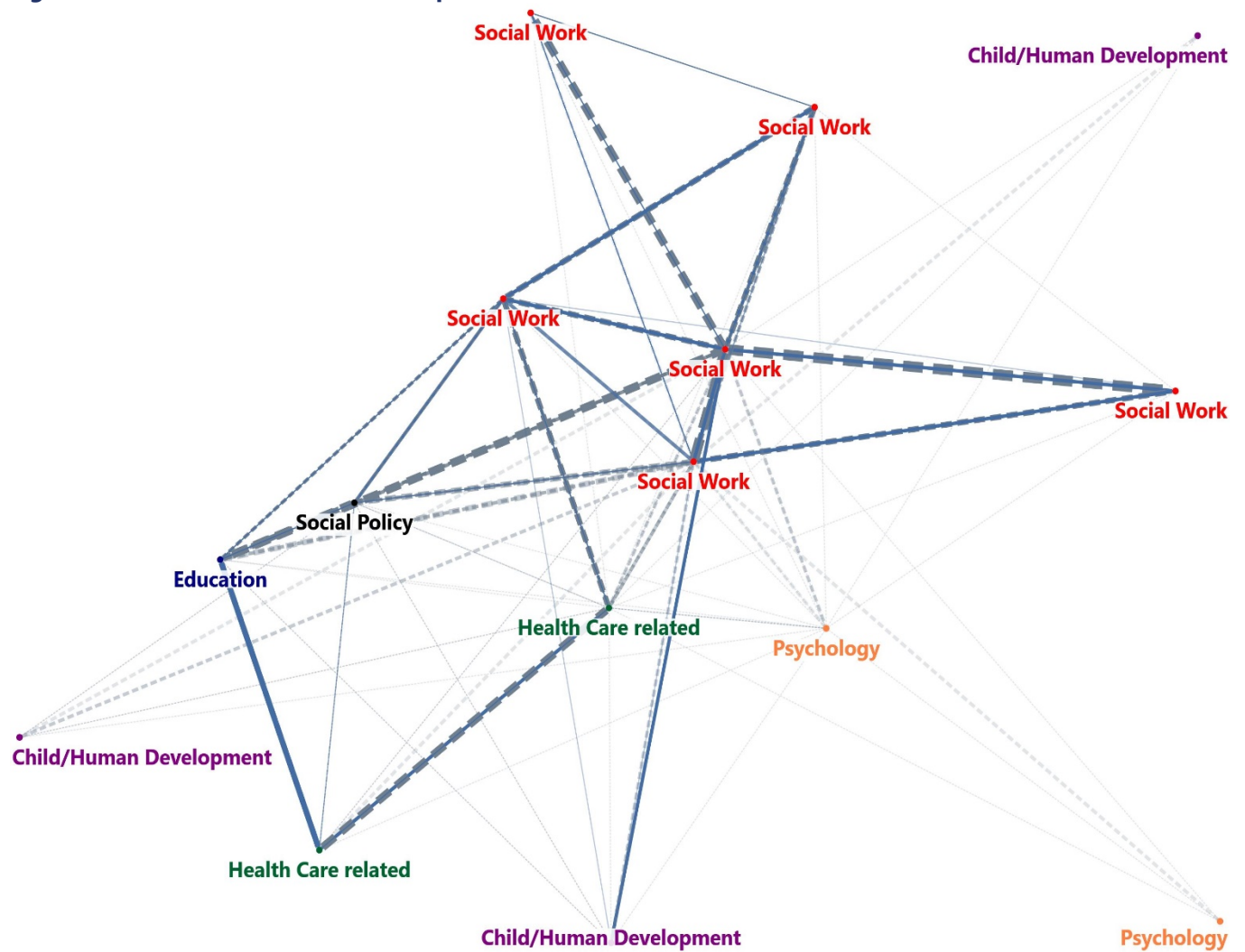
Figure 6. Cohort Three Network: Small Group Affiliation



Notes:

- Dashed, grey lines represent virtual interactions; solid, steel blue lines indicate in-person interactions.
- The width of the line shows the total number of in-person and virtual interactions between two fellows. The broader the line, the greater the number of interactions.
- The darkness of the line shows the average reported quality of all interactions between two fellows. The darker the line, the higher the reported quality.

Figure 7. Cohort Three Network: Discipline



Notes:

- Dashed, grey lines represent virtual interactions; solid, steel blue lines indicate in-person interactions.
- The width of the line shows the total number of in-person and virtual interactions between two fellows. The broader the line, the greater the number of interactions.
- The darkness of the line shows the average reported quality of all interactions between two fellows. The darker the line, the higher the reported quality.

Table 4. Cohort Three Descriptive Statistics

Fellow	Degree	Change from Prior Year	Betweenness Centrality
Fellow 306	14	6	9.733
Fellow 302	14	5	9.733
Fellow 311	14	5	9.733
Fellow 315	14	5	9.733
Fellow 313	9	2	1.133
Fellow 310	9	-4	1.2
Fellow 303	8	1	0.333
Fellow 301	7	1	0.4
Fellow 307	7	1	0
Fellow 305	6	0	0
Fellow 304	6	0	0
Fellow 308	5	1	0
Fellow 312	5	0	0
Fellow 314	4	1	0
Fellow 309	4	2	0
	This year	Prior Year	
Network Average	8.4	6.7	
Network Median	7	6	
Network Density	0.60	0.48	
Discipline Density			
Social Work		0.867	
Child/Human Development		0.00	
Health Care related		1.000	
Psychology		1.000	
Social Policy		N/A	
Education		N/A	
Small Group Density			
Early Childhood		0.900	
Measurement		0.700	
Parenting/Trauma Response		0.500	

Notes:

- *Degree*: Number of connections attached to that fellow.
- *Betweenness Centrality*: How important each node/fellow is in providing a “bridge” between different parts of the network.

Cohort Four

By the numbers

Network Density: 0.46 (46%)

Average Degree: 6.4

Retention Rate: 0.33 (33%)

Moderately connected with declining connectivity each year

Cohort Four was selected in 2014 and graduated from the fellowships in 2016. Cohort Four had 15 active fellows, exhibited a graph density of 0.46 and an average degree of 6.4 (described in more detail below). Figure 8 documents the interactions among the 15 Cohort Four fellows, with the fellows' nodes color-coded to reflect their small group assignment and initial research interests. For this cohort, small group assignments include strengthening parental capacity, improving early child development through more effective interventions, and adolescent development among high-risk youth.

Figure 9 presents the same data with respect to interactions among the fellows but highlights each fellow's specific discipline. As noted in Figure 9, the 15 fellows identified as eight different disciplines, making this cohort the most interdisciplinary. Six fellows are in social work, shown in red. Other disciplines represented in the cohort include: two fellows in psychology, shown in orange; two fellows in child/human development, shown in purple; and one fellow each in sociology (blue), criminal justice (pink), social policy (black), health care related fields (green), and education (navy).

Description of the Network

Cohort Four has a graph density of 0.46, meaning that 46% of possible edges (i.e., connections) between fellows occurred. This is a slightly lower density compared to the previous year (50%). As reported in Table 5, Cohort Four had an average degree of 6.4, meaning that, on average, a fellow in Cohort Four interacted with about half of their cohort peers during the reporting period. This is also a half degree lower than the previous year. Table 5 shows that the number of connections reported by Cohort Four fellows with their cohort peers dropped 26% from the previous reporting year (91 to 67).

A core group of three fellows (Fellows 403, 406, and 412) in this cohort had the highest betweenness centrality scores and connected with more of their cohort peers than anyone else, which are the same three fellows that were the most connected in this cohort the prior year. These fellows were not only among the most active but were most critical to keeping the cohort engaged, reaching out to the fellows who did not indicate many interactions on their own. The fellows at the core of Figure 9 are from different disciplines, which is not surprising given the interdisciplinary nature of the cohort. In line with the moderate connectivity numbers from Cohort Four, the fellows did not rate their interactions with each other very highly. Among all reported Cohort Four connections with quality ratings (90% of connections), only 17% were rated high quality. This is evident by the overwhelmingly light lines that make up Figures 8 and 9, especially relative to any other cohort's graphs.

Small Group Affiliation

In the Cohort Four network, small groups played an obvious role in the network's structure (see Figure 8), as all of the small groups are still closely connected. One of the small groups, parental capacity, had a graph density of 1.0, meaning that 100% of the possible edges (i.e., connections) between fellows within the small group occurred (Figure 8). This group also has a few fellows at the core of the network. The other two groups exhibit graph densities of 0.8, though Figure 8 shows that members of the at-risk youth group lie on the periphery of the network. It is evident from this figure that small group affiliation is likely critical to these fellows staying engaged in the network, as they connect with few other Cohort Four peers. Notably, there do not seem to be a high frequency of connections between this group as the lines connecting them are fairly thin.

For the third year in a row, the density of these small groups played an integral role in defining the fellowships experience for the Cohort Four fellows. Cohort Four fellows have been out of the fellowships for three years, and while the quality of interactions was rated lower, on average, than any other cohort, these fellows continued to maintain connections with their small group peers. This speaks to the strong role the small group strategy played for this particular cohort.

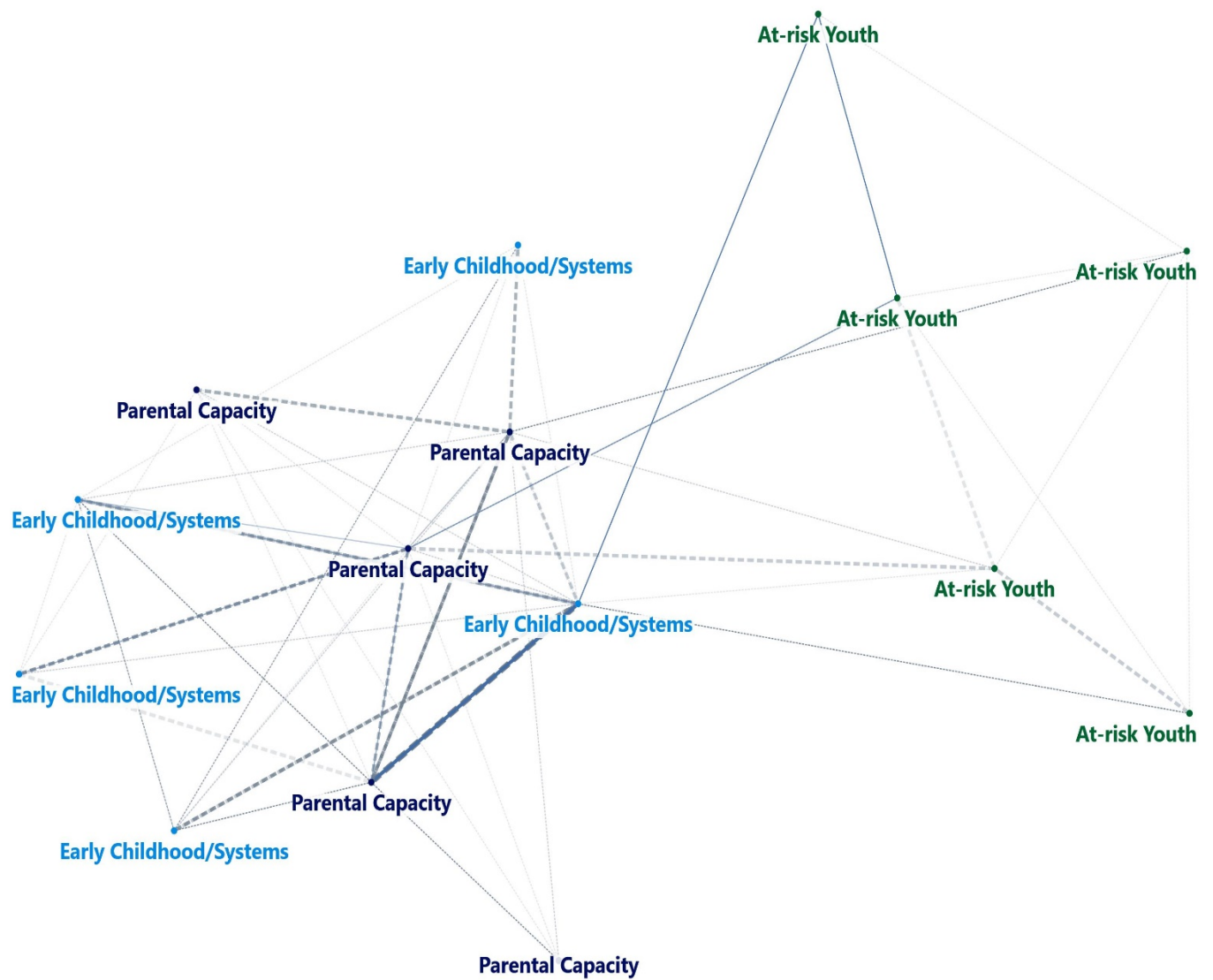
Disciplines

Cohort Four fellows' disciplines reflect the fellowships' overall trend toward greater discipline diversity. In Cohort Four, fewer than half (six) of the fellows were in social work, and the number of disciplines represented is at its highest among all cohorts (eight of the nine discipline categories are represented in Cohort Four). In this cohort, network discipline appeared to play an indiscernible role in network shape, as seen in Figure 9. Reflecting this fact, 76% of all Cohort Four within-cohort connections were interdisciplinary, among the highest across all cohorts in the network. However, when we look within disciplinary groups in Cohort Four, the fellows in social work exhibited a graph density of 0.53, despite being spread across small groups. Because of the diversity of the cohort, with no other discipline accounting for more than two fellows, no further disciplinary subgroup analysis would be meaningful.

Retention

Among the Cohort Four fellows, five of the 15 active fellows connected with more than six of the other fellows in their network. This drops their retention rate to 33%, compared to 67% last year. Additionally, nearly half of the fellows report fewer interactions with others in their cohort this year than in last year's survey. This lower within-cohort connectedness does not imply Cohort Four fellows did not gain as much from the network this past year. As discussed in the next section, Cohort Four was increasingly connected to the full network, increasing the proportion of connections made outside of their cohort by 19%.

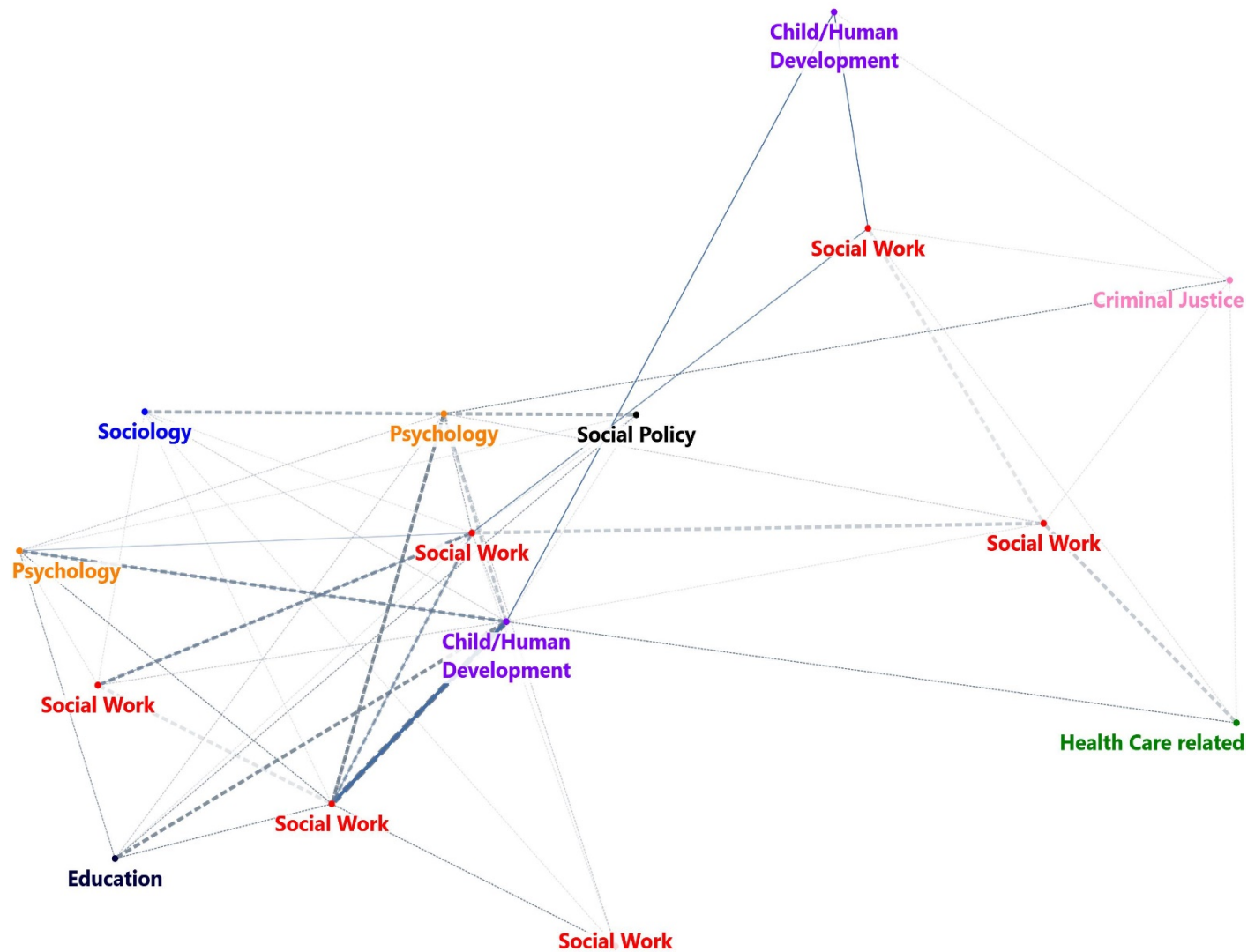
Figure 8. Cohort Four Network: Small Group Affiliation



Notes:

- Dashed, grey lines represent virtual interactions; solid, steel blue lines indicate in-person interactions.
- The width of the line shows the total number of in-person and virtual interactions between two fellows. The broader the line, the greater the number of interactions.
- The darkness of the line shows the average reported quality of all interactions between two fellows. The darker the line, the higher the reported quality.

Figure 9. Cohort Four Network: Discipline



Notes:

- Dashed, grey lines represent virtual interactions; solid, steel blue lines indicate in-person interactions.
- The width of the line shows the total number of in-person and virtual interactions between two fellows. The broader the line, the greater the number of interactions.
- The darkness of the line shows the average reported quality of all interactions between two fellows. The darker the line, the higher the reported quality.

Table 5. Cohort Four Descriptive Statistics

Fellow	Degree	Change from Prior Year	Betweenness Centrality
Fellow 412	11	2	19.833
Fellow 403	11	0	14.775
Fellow 406	10	1	12.358
Fellow 405	8	1	2.542
Fellow 410	7	0	1.083
Fellow 407	6	-2	2.283
Fellow 409	6	-2	1.175
Fellow 411	6	-2	0.200
Fellow 404	5	-3	2.225
Fellow 414	5	2	2.125
Fellow 401	5	0	0.200
Fellow 415	5	-4	0.000
Fellow 402	4	1	0.600
Fellow 408	4	-1	0.000
Fellow 413	3	-1	0.600
	This year	Prior Year	
Network Average	6.4	6.9	
Network Median	6	8	
Network Density	0.457	0.495	
Discipline Density			
Social Work			0.533
Psychology			1.000
Child/Human Development			1.000
Sociology			N/A
Social Policy			N/A
Education			N/A
Criminal Justice			N/A
Health Care related			N/A
Small Group Density			
Parental Capacity			1.000
Early Childhood/Systems			0.800
At-risk Youth			0.800

Notes:

- *Degree*: Number of connections attached to that fellow.
- *Betweenness*: How important each node/fellow is in providing a “bridge” between different parts of the network.

Cohort Five

By the numbers

Network Density: 0.64 (64%)

Average Degree: 8.9

Retention Rate: 0.80 (80%)

Traditionally active cohort within full network, nearly doubled cohort connectivity this year

Cohort Five was selected in 2015 and graduated from the fellowships in 2017. Cohort Five had 15 active fellows, exhibited a high graph density of 64%, and had an average degree of 8.9 (described in more detail below). The network density is second highest among the eight cohorts. Figure 10 documents the interactions among the 15 Cohort Five fellows, with the fellows' nodes color-coded to reflect their small group assignment. For this cohort, small group assignments include training and program implementation, risk and protective factors in child maltreatment prevention, and social determinants/systems.

Figure 11 presents the same data with respect to interactions among the fellows but highlights each fellow's specific discipline. Cohort Five is an interdisciplinary cohort, similar to that of Cohort Four, with five discipline categories represented. Six of the fellows identified psychology as their discipline, shown in orange in the figure. Of the remaining nine fellows, five identified social work (red), two fellows are in health care related fields (green), one fellow is in in child/human development (purple), and one fellow is in sociology (blue).

Description of the Network

Cohort Five had a graph density 0.638, meaning that nearly 64% of possible edges (i.e., connections) between fellows occurred. This reflects the highest density for Cohort Five since its first year in the fellowships. Cohort Five's average degree of connection of 8.9 is also a record high for the cohort. Additionally, only one fellow connected with fewer of their cohort peers this year compared to last – two had no change while 12 fellows connected with more fellows compared to the year prior.

Figure 10 shows a strong and large group of core members of the network. Additionally, we see that this core group of fellows is very interdisciplinary. Table 6 shows one fellow (Fellow 503) connected with every member of the cohort during the reporting year, and because Fellow 501 only had one connection, we see the critical role Fellow 503 had in keeping this fellow engaged in the network. This connection also explains Fellow 503's high betweenness centrality score. Reflecting the increased connectivity across the board for Cohort Five, the fellows also rated their connections much higher this year compared to last. Among all reported Cohort Five connections with quality ratings (97% of connections), 62% were rated high quality, which is an increase of 27% (49% of the prior year's connections had a high quality rating).

Small Group Affiliation

In the Cohort Five network, small groups played a role in the structure of the overall network. The training and program implementation and the risk and protective factors groups had strong

graph densities of 0.9 and 1.0, respectively. The level of connectivity among these small groups are similar to the previous years. On the other hand, the social determinants small group had a graph density of 0.40. Not surprisingly, this small group is home to three of the peripheral network members during the reporting year, similar to the previous year.

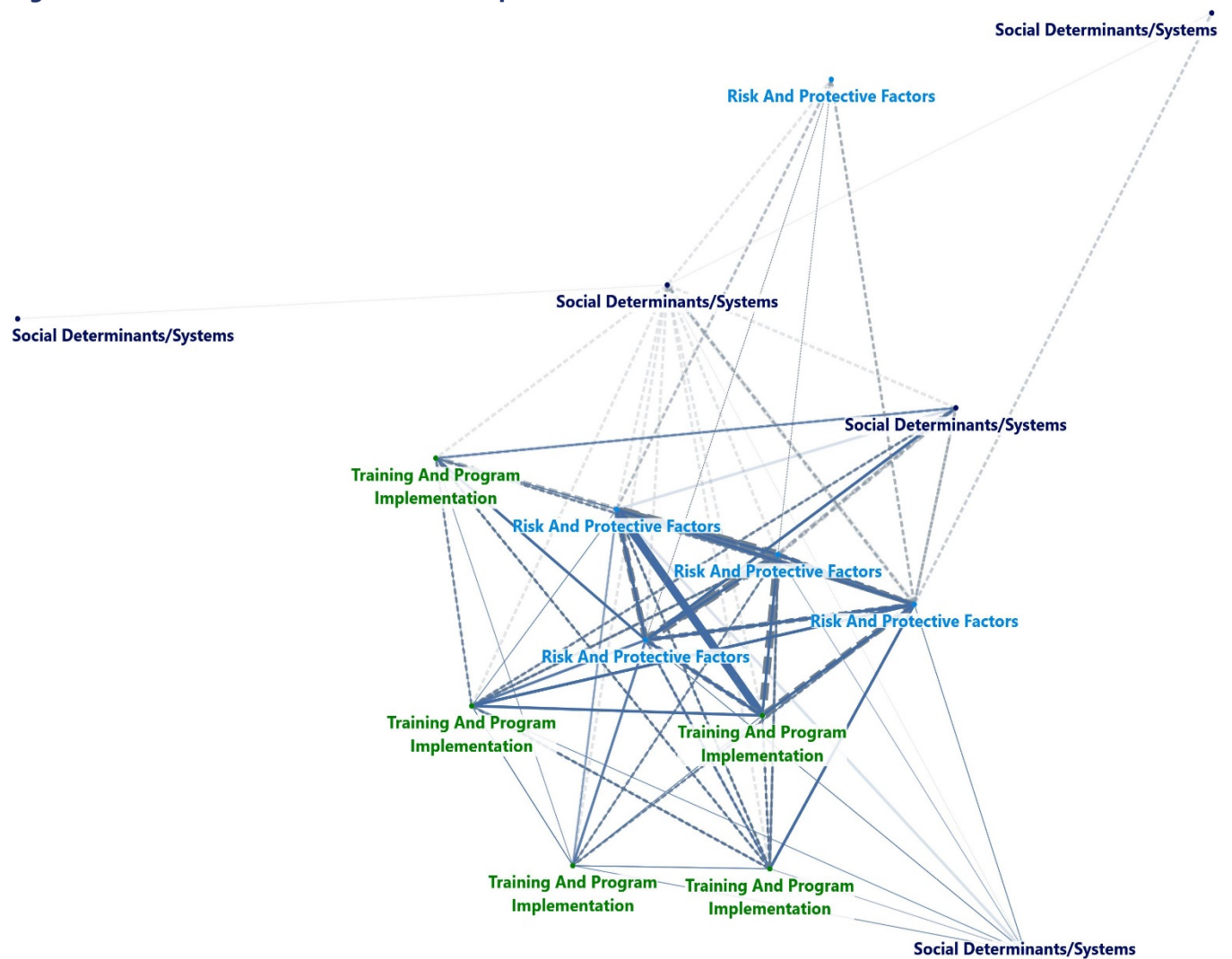
Disciplines

Cohort Five is a disciplinarily diverse cohort. In this cohort, discipline played a small role in the network structure, similar to the pattern observed in Cohort Four, as seen in Figure 11. Among all within-cohort connections in Cohort Five, 70% were interdisciplinary. The two disciplines with at least one-third of the fellows – social work and psychology – both exhibited a graph density of 0.8, despite being spread across small groups. Cohort Five fellows are clearly connecting both within and across discipline boundaries.

Retention

Among the Cohort Five fellows, 12 of the 15 fellows connected with at least half of the other fellows in the Cohort, putting their retention rate at 80%. This is double last year's rate of 40%. All but one Cohort Five fellow increased or had the same degree as the prior year. The average and median degree, along with network density, also nearly doubled from last year, indicating a more internally connected cohort across the board. It appears that Cohort Five has rebounded from their low connectivity with each other during their first year out of the fellowships. Our data follow a pattern of cohort reengagement during their second year out of the fellowship, once new jobs and locations have been established.

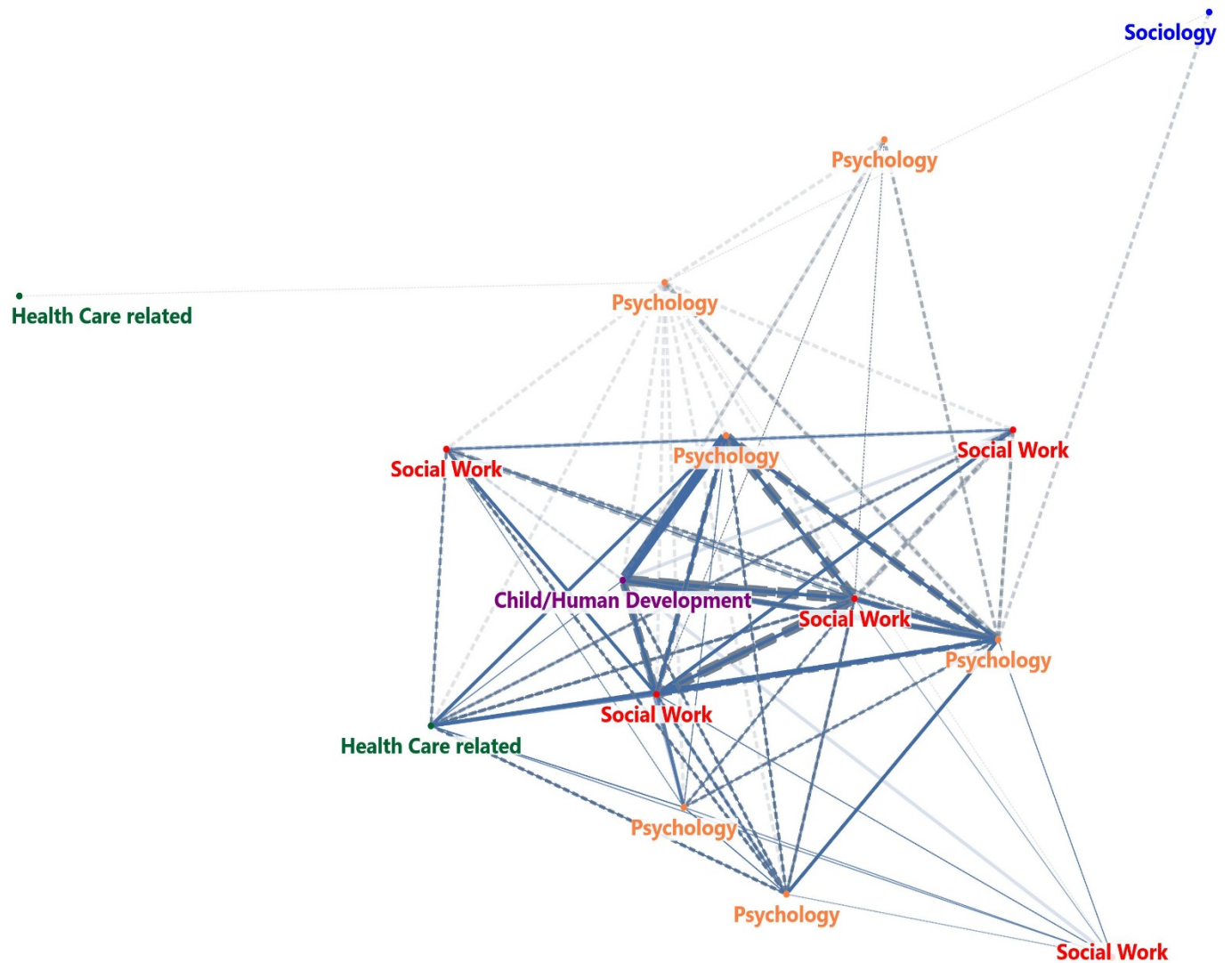
Figure 10. Cohort Five Network: Small Group Affiliation



Notes:

- Dashed, grey lines represent virtual interactions; solid, steel blue lines indicate in-person interactions.
- The width of the line shows the total number of in-person and virtual interactions between two fellows. The broader the line, the greater the number of interactions.
- The darkness of the line shows the average reported quality of all interactions between two fellows. The darker the line, the higher the reported quality.

Figure 11. Cohort Five Network: Discipline



Notes:

- Dashed, grey lines represent virtual interactions; solid, steel blue lines indicate in-person interactions.
- The width of the line shows the total number of in-person and virtual interactions between two fellows. The broader the line, the greater the number of interactions.
- The darkness of the line shows the average reported quality of all interactions between two fellows. The darker the line, the higher the reported quality.

Table 6. Cohort Five Descriptive Statistics

Fellow	Degree	Change from Prior Year	Betweenness Centrality
Fellow 503	14	12	20.894
Fellow 514	13	7	7.894
Fellow 508	12	3	2.394
Fellow 515	12	3	2.394
Fellow 505	12	5	2.394
Fellow 510	11	6	0.994
Fellow 506	10	5	0.375
Fellow 509	10	5	0.375
Fellow 511	9	2	0.286
Fellow 504	8	4	0.000
Fellow 512	8	-2	0.000
Fellow 502	7	0	0.000
Fellow 513	5	1	0.000
Fellow 507	2	1	0.000
Fellow 501	1	0	0.000
	This year	Prior year	
Network Average	8.9	5.5	
Network Median	10	5	
Network Density	0.638	0.39	
Discipline Density			
Psychology		0.800	
Social Work		0.800	
Health Care related		0.000	
Child/Human Development		N/A	
Sociology		N/A	
Small Group Density			
Risk And Protective Factors In Child Maltreatment Prevention			1.000
Training And Program Implementation			0.900
Social Determinants/Systems			0.400

Notes:

- *Degree*: Number of connections attached to that fellow.
- *Betweenness*: How important each node/fellow is in providing a “bridge” between different parts of the network.

Cohort Six

By the numbers

Network Density: 0.63 (63%)

Average Degree: 8.8

Retention Rate: 0.87 (87%)

Consistently strong cohort connections, increasingly connecting to full network

Cohort Six was selected in 2016 and graduated from the fellowships in 2018; this survey reflects Cohort Six' network connectivity during their first year as graduated fellows. Cohort Six had 15 active fellows in the network during the reporting year, exhibited a high graph density of 0.629 and an average degree of 8.8 (described in more detail below). Figure 12 documents the connections among the 15 Cohort Six fellows, with the fellows' nodes color-coded to reflect their small group assignment. For this cohort, small groups were formed around the unique parenting challenges facing families experiencing poverty, addressing risk and strengthening protective factors, and child welfare policies and interventions to support youth and young parents.

Figure 13 presents the same data with respect to interactions among the fellows but highlights each fellow's specific discipline. As noted in Figure 13, Cohort Six exhibits another very interdisciplinary cohort, with the 15 fellows representing six disciplines. One-third of the fellows identify psychology as their discipline (orange). The remaining fellows cover a range of disciplines, including three in child/human development (purple); two fellows each in sociology (blue), public/social policy (black), and social work (red); and one fellow in health care related discipline (green).

Description of the Network

Cohort Six had a graph density of 0.629, meaning that nearly two-thirds (63%) of all possible connections between Cohort Six fellows occurred. This is only a slight decrease from the prior year, when Cohort Six had a graph density of 0.676. Cohort Six remained a highly connected group during their first year out of the fellowships. It had an average degree of connection of 8.8, meaning that, on average, a Cohort Six fellow connected with nearly two-thirds of their cohort peers during the survey year. This is also a slight decrease from last year (9.5).

Because of this well-connected group, betweenness centrality scores are more moderate and narrow in range, shown in Table 7. No one fellow played a critical role in keeping another connected because the group overall was well connected. Similarly, small group assignments and disciplines (more below) played a small role in shaping this network, as nearly all have very strong connections and these strong connections seem to transcend small group and discipline boundaries. While connectivity is high, the quality of these connections was on the lower end among the eight cohorts. Among all reported Cohort Six connections with quality ratings (98% of connections), only 44% were rated high quality (compared to 64% of their connections rated high quality the prior year).

Small Group Affiliation

In the Cohort Six network, small groups played a role in the structure of the overall network, as evident by the connections maintained between small group members. Both the risk and protective factors and the parenting in poverty small groups had a graph density of 1.0, meaning 100% of the connections that could be made between group members for each group did occur. The third small group had a weaker density of 0.6. Figure 12 shows that members of the same small group appear mostly near each other in the graphs.

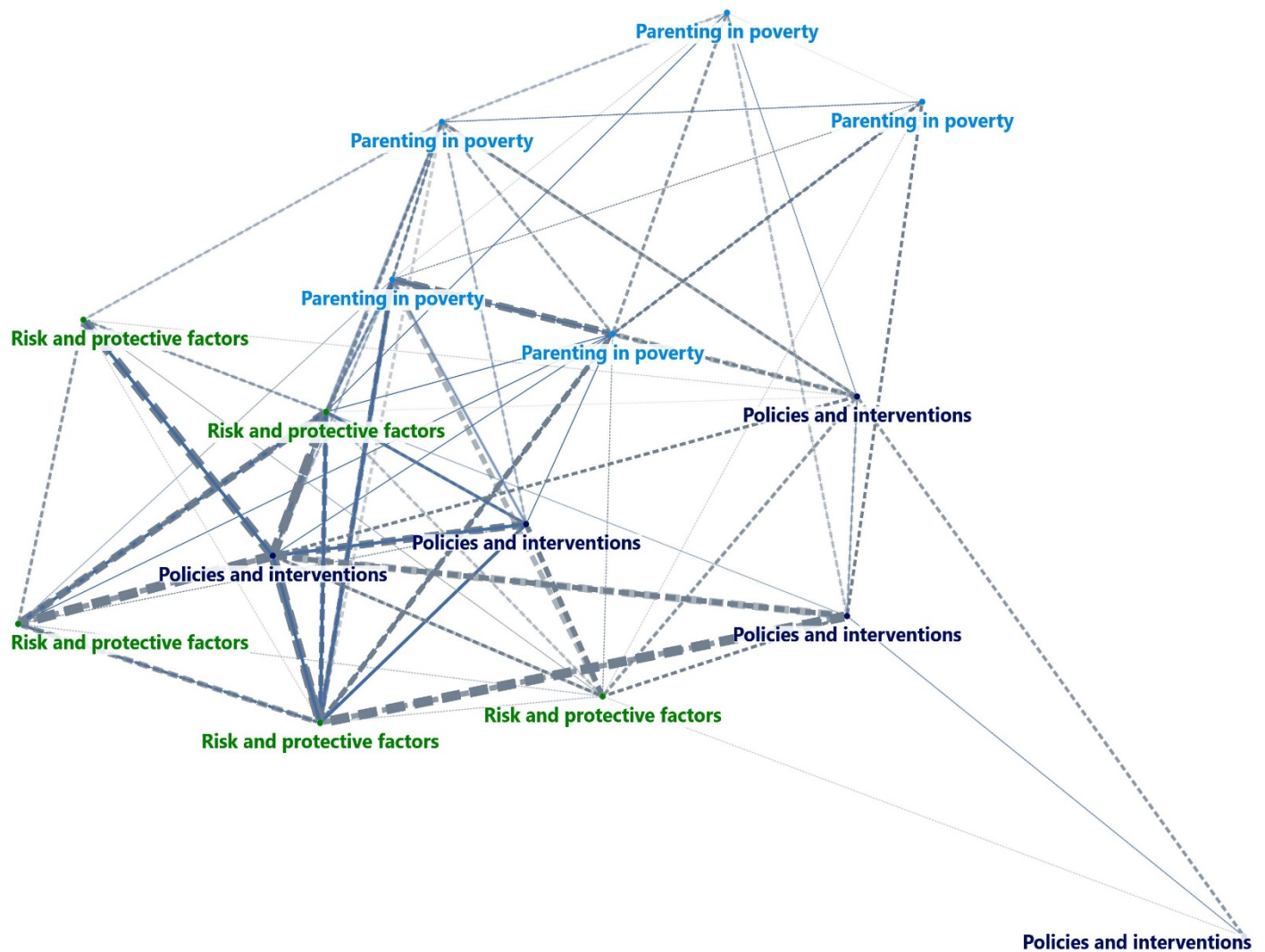
Disciplines

Cohort Six has a diverse group of academic disciplines among the 15 fellows. Discipline plays a minor role in shaping the structure of the network, as shown in Figure 13. The majority discipline in this group is psychology, similar to Cohort Five. The disciplines with more than two fellows – psychology and child/human development – have a graph density of 0.7 and 0.67 respectively. As seen in the overall network structure in Figure 13, the psychology fellows comprise most of the core of the network and showed mostly strong and frequent connections, as evident by the dark, wide lines connecting those fellows. However, the figure also shows these wide and darker lines often connecting fellows in different disciplines as well. Besides the high density within disciplines, the fellows in Cohort Six are reaching across disciplinary boundaries. Among all within-cohort connections in Cohort Six, 83% were interdisciplinary. This is the highest within-cohort interdisciplinary group of the eight cohorts.

Retention

Reflecting the stability of this network from the prior year, six fellows reported connecting with fewer peers while another six connected with more peers compared to the prior year (three had no change). Additionally, for the second year in a row, all but two of the 15 Cohort Six fellows connected with at least half of their cohort peers, putting the retention rate for this cohort again at 87%. This rate is the second highest among all cohorts (with Cohort Seven as the highest). It is particularly notable that these interactions occurred during their first year out of the fellowships, because that is traditionally a year of transitions and lower connectivity for cohorts. The fellows in Cohort Six have clearly established professional connections and friendships during their time in the fellowships network, growing more connected over the course of the two years, and sustained these relationships as they started their transition to new careers.

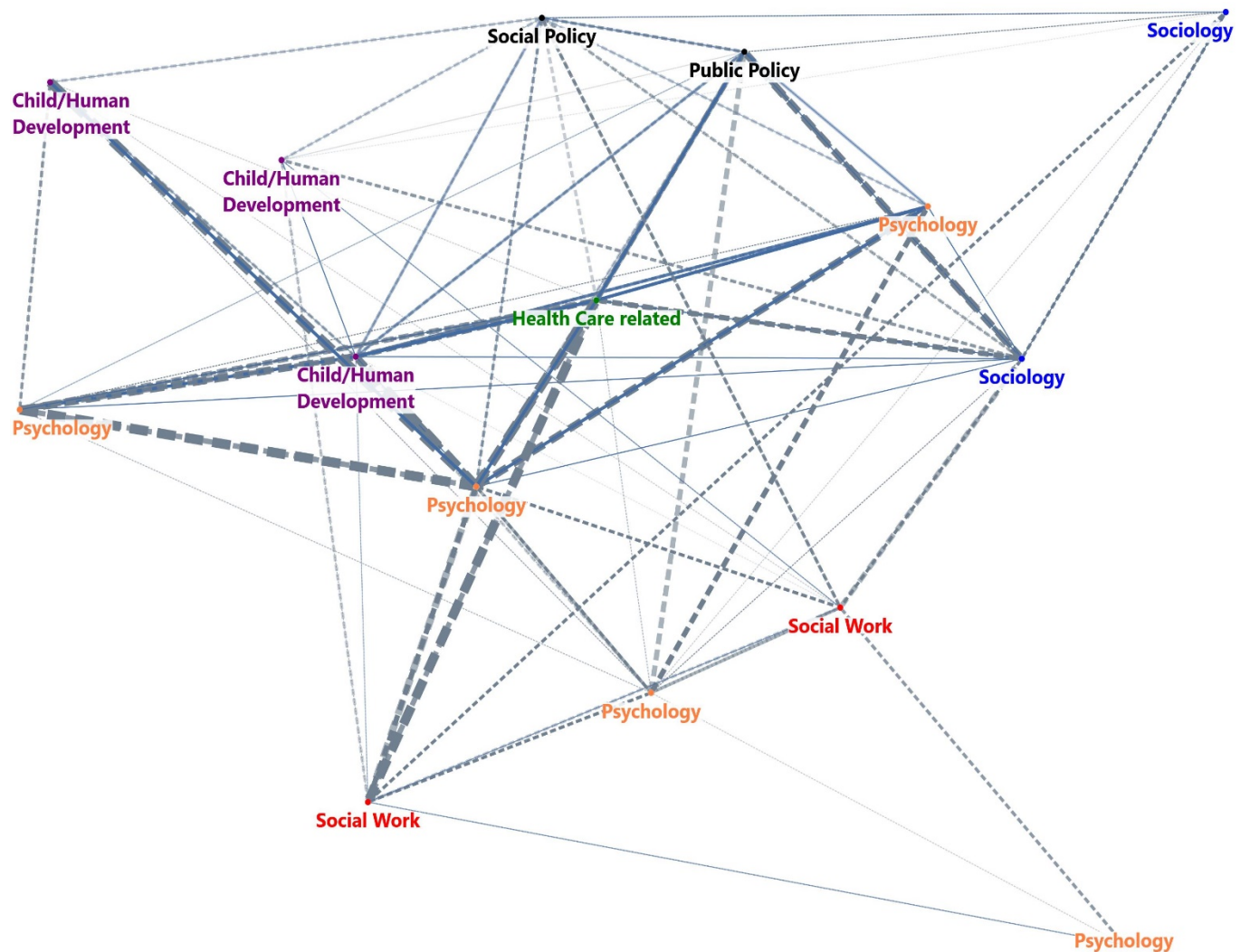
Figure 12. Cohort Six Network: Small Group Assignment



Notes:

- Dashed, grey lines represent virtual interactions; solid, steel blue lines indicate in-person interactions.
- The width of the line shows the total number of in-person and virtual interactions between two fellows. The broader the line, the greater the number of interactions.
- The darkness of the line shows the average reported quality of all interactions between two fellows. The darker the line, the higher the reported quality.

Figure 13. Cohort Six Network: Discipline



Notes:

- Dashed, grey lines represent virtual interactions; solid, steel blue lines indicate in-person interactions.
- The width of the line shows the total number of in-person and virtual interactions between two fellows. The broader the line, the greater the number of interactions.
- The darkness of the line shows the average reported quality of all interactions between two fellows. The darker the line, the higher the reported quality.

Table 7. Cohort Six Descriptive Statistics

Fellow	Degree	Change from Prior Year	Betweenness Centrality
Fellow 610	12	2	9.712
Fellow 601	12	2	4.066
Fellow 612	11	5	3.430
Fellow 609	11	0	2.616
Fellow 615	10	1	3.452
Fellow 614	10	-4	1.906
Fellow 605	10	0	2.521
Fellow 602	9	1	4.597
Fellow 613	8	-6	3.610
Fellow 611	8	0	0.254
Fellow 604	8	1	0.476
Fellow 606	7	-4	0.597
Fellow 608	7	-2	1.010
Fellow 607	6	-2	0.754
Fellow 603	3	-4	0.000
	This year	Prior Year	
Network Average	8.800	9.467	
Network Median	9	9	
Network Density	0.629	0.68	
Discipline Density			
Psychology		0.70	
Child/Human Development		0.67	
Social Work		1.0	
Sociology		1.0	
Public/Social Policy		1.0	
Health Care related		N/A	
Small Group Density			
Risk and Protective Factors		1.00	
Parenting in Poverty		1.00	
Policies and Interventions		0.60	

Notes:

- *Degree*: Number of connections attached to that fellow.
- *Betweenness*: How important each node/fellow is in providing a “bridge” between different parts of the network.

Cohort Seven

By the numbers

Network Density: 0.76 (76%)

Average Degree: 10.7

Retention Rate: 1.0 (100%)

Most connected cohort this year

Cohort Seven was selected in 2017 and graduated from the fellowships in 2019; this survey covers their second active year in the fellowships. Cohort Seven had 15 active fellows, who exhibited a high graph density of 76% and an average degree of 10.7 (described in more detail below). Figure 14 documents the interactions among the 15 Cohort Seven fellows, with the fellows' nodes color-coded to reflect their small group assignment. For this cohort, small groups were formed around parenting stress and resilience, adverse childhood experiences and instruments to measure risk, and early childhood and the systems that serve young children.

Figure 15 presents the same data with respect to interactions among the fellows but highlights each fellow's specific discipline. As noted in Figure 15, the 15 fellows represent five disciplines. Four fellows identified both psychology (orange) and child/human development (purple) as their discipline. Additionally, three fellows are in public policy (black), and two in both health care related fields (green) and social work (red).

Description of the Network

Cohort Seven had the highest graph density among any cohort this year. It was .762, meaning over three-quarters (76%) of all possible connections between Cohort Seven fellows occurred outside of mandatory fellowships functions. The average degree of 10.7 is also the highest in this year's analysis, and indicated on average, a Cohort Seven fellow connected with three-quarter of his or her peers. This level of interaction outside the mandatory fellowships meetings and small group projects is higher than what we typically observe in other cohorts at this same stage with the program.

Because this cohort is so well connected, there is no clear center of the network structure. There is a very small range of betweenness centrality scores, and all scored are relatively low (see Table 8). No fellow is responsible for keeping others engaged, and no fellow is in danger of dropping from the network. Two fellows in this network connected with every other member, and one-third had a degree of 13 (connected with all but one cohort peer). These three fellows fall near the center of the network as they connect to every other fellow. Although there is a high number of connections for a new cohort, the reported quality of these connections was quite mixed. Among all reported Cohort Seven connections with quality ratings (94% of connections), 56% were rated high quality. However, as shown in Table 10, Cohort Seven boasts the highest number of connections, network density, average degree and retention rate during this survey year among all eight cohorts.

Small Group Affiliation

Within this cohort, small group assignments play a role in the shape of the network. Figure 14 shows the fellows in the ACES/CAN small group clustered together with strong, high frequency connections reported among them (as indicated by the wide and dark lines). This small group had a network density of 1.0. Again, these interactions occurred outside of meetings held to complete the mandatory small group project. The other two small groups had strong graph densities of 0.8. While small group connections are strong, given the highly connected nature of this cohort, network connectivity transcends small group boundaries as well.

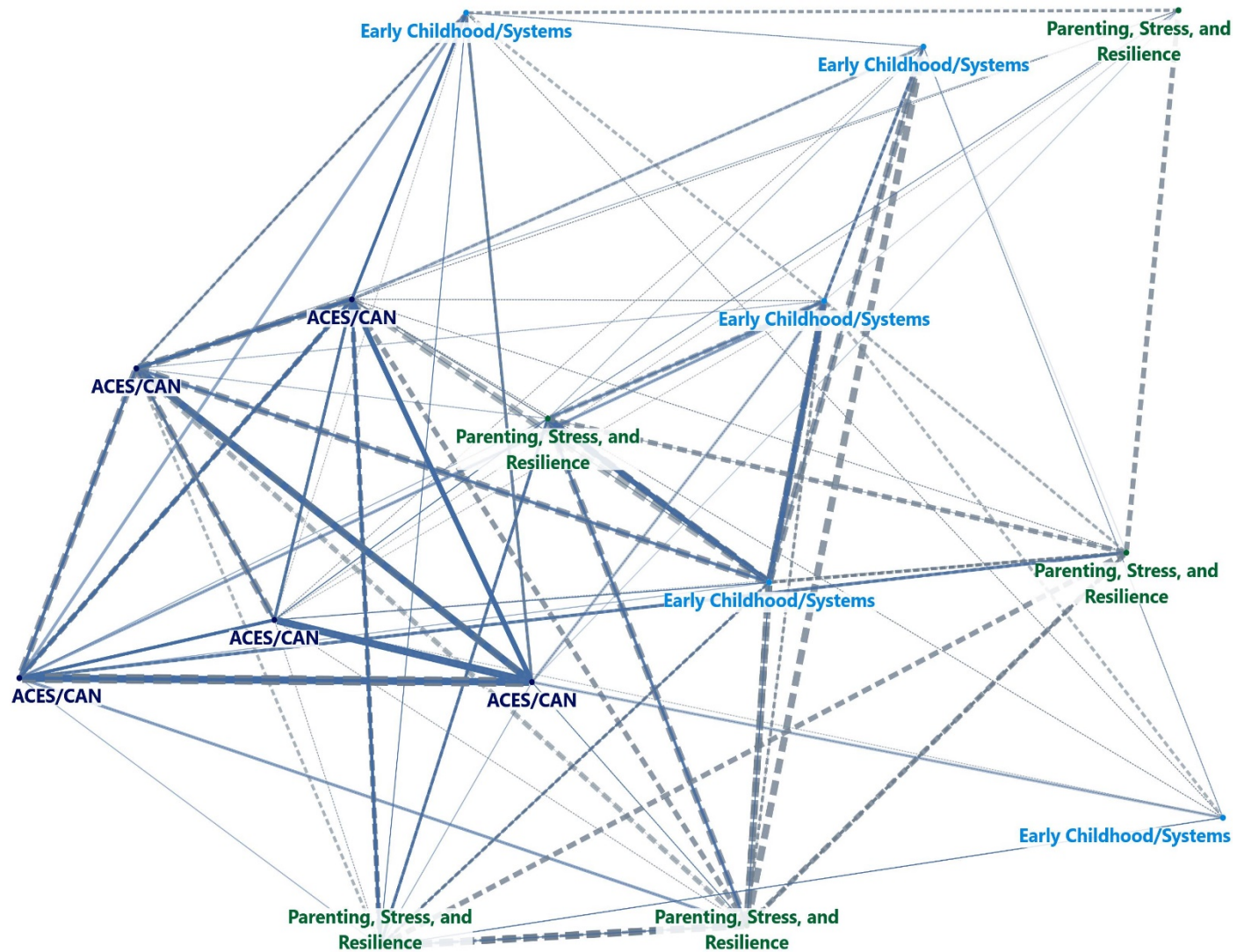
Disciplines

Cohort Seven Fellows are from a diverse group of disciplines. While fellows connect with their discipline peers in Cohort Seven, because the overall network connectivity is so high, disciplines do not play as critical of a role as it does in other cohorts (see Figure 15). Fellows are connecting with everyone else in their discipline, except for psychology (density=0.83), but also making many cross-disciplinary connections. Among all within-cohort connections in Cohort Seven, 81% were interdisciplinary. This shows that while disciplines play a strong role in establishing connections, the fellows in Cohort Seven also connect over other similarities, perhaps in approaches related to their dissertation work, career paths, and other shared interests.

Retention

All Cohort Seven fellows connected with more than half of the other fellows in their cohort, for a 100% retention rate, the highest of any cohort ever recorded. This is a significant jump from the previous year's retention rate (53%). This increase is not entirely unexpected; previous data has showed the second year of the fellowships program reveals a more connected cohort network. It reflects the increased familiarity fellows have with their cohort peers and their openness to both seeking advice from other cohort members as well as offering assistance. Additionally, every fellow either increased the number of cohort peers they connected with or connected with the same number. Keeping in mind that these interactions do not include fellowships-sponsored events, such as annual and mid-year meetings or small group interactions, this level of connectivity is impressive and speaks to the value Cohort Seven fellows place on the network.

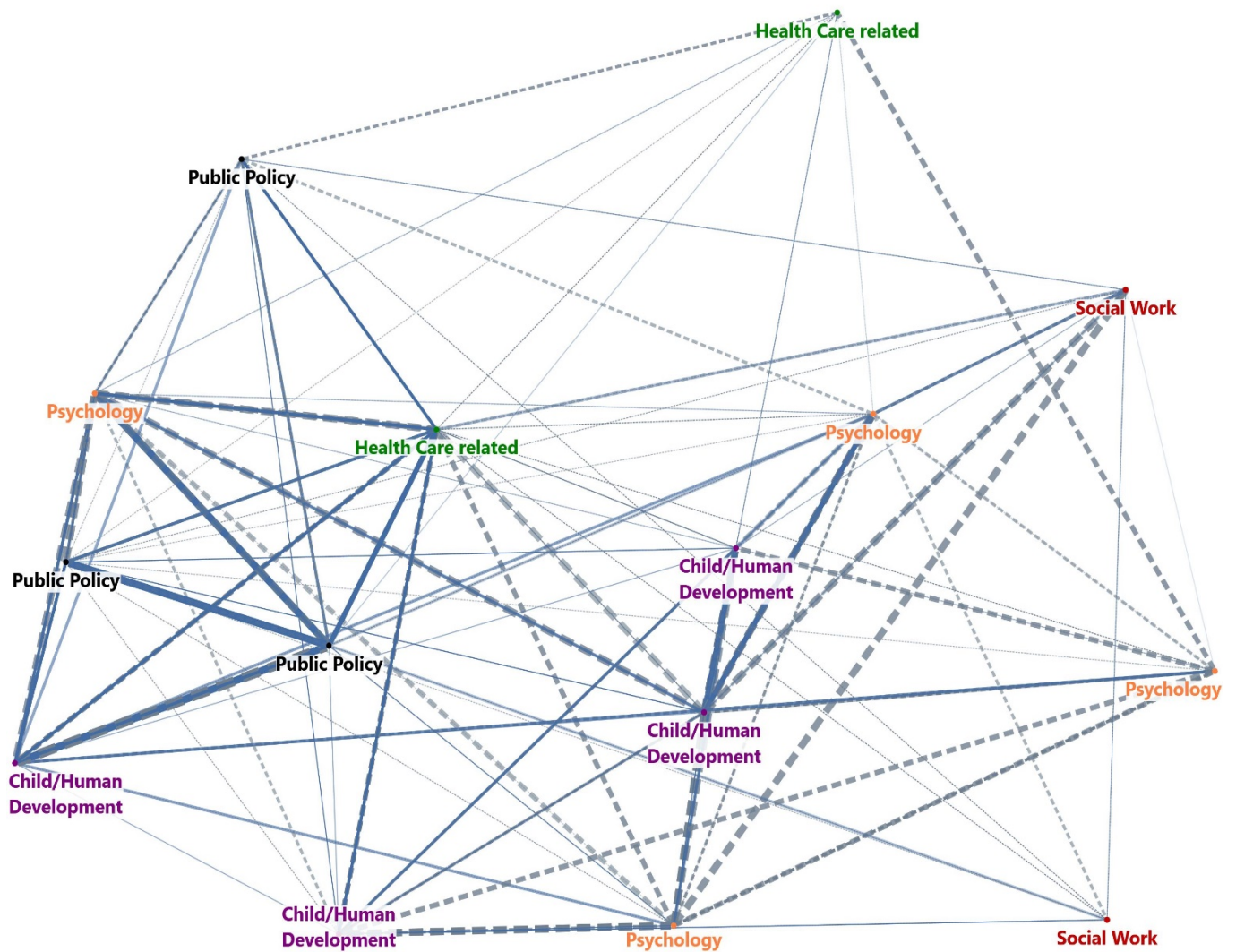
Figure 14. Cohort Seven Network: Small Group Affiliation



Notes:

- Dashed, grey lines represent virtual interactions; solid, steel blue lines indicate in-person interactions.
- The width of the line shows the total number of in-person and virtual interactions between two fellows. The broader the line, the greater the number of interactions.
- The darkness of the line shows the average reported quality of all interactions between two fellows. The darker the line, the higher the reported quality.

Figure 15. Cohort Seven Network: Discipline



Notes:

- Dashed, grey lines represent virtual interactions; solid, steel blue lines indicate in-person interactions.
- The width of the line shows the total number of in-person and virtual interactions between two fellows. The broader the line, the greater the number of interactions.
- The darkness of the line shows the average reported quality of all interactions between two fellows. The darker the line, the higher the reported quality.

Table 8. Cohort Seven Descriptive Statistics

Fellow	Degree	Change from Prior Year	Betweenness Centrality
Fellow 715	14	0	3.752
Fellow 714	14	9	3.752
Fellow 707	13	3	3.393
Fellow 703	11	2	1.339
Fellow 702	11	1	1.172
Fellow 706	11	6	1.148
Fellow 713	11	5	2.157
Fellow 710	11	1	1.329
Fellow 708	10	4	1.085
Fellow 712	10	1	0.595
Fellow 709	10	4	1.618
Fellow 701	10	2	1.327
Fellow 704	9	1	1.302
Fellow 711	8	0	0.647
Fellow 705	7	3	0.383
	This year	Prior Year	
Network Average	10.667	7.867	
Network Median	11	8.000	
Network Density	0.762	0.562	
Discipline Density			
Psychology			0.833
Child/Human Development			1.00
Health Care related			1.00
Social Work			1.00
Public Policy			1.00
Small Group			
Parenting, Stress, and Resilience			0.80
ACES/CAN			1.00
Early Childhood/Systems			0.80

Notes:

- *Degree*: Number of connections attached to that fellow.
- *Betweenness*: How important each node/fellow is in providing a “bridge” between different parts of the network.

Cohort Eight

By the numbers

Network Density: 0.30 (30%)

Average Degree: 4.1

Retention Rate: 0.13 (13%)

Still establishing connections with peers; high connectivity across network

Cohort Eight was selected in 2018 and will graduate from the fellowships in 2020. Cohort Eight had 15 active fellows, exhibited a low graph density of 0.295, and an average degree of 4.1 (described in more detail below). Figure 16 documents the interactions among the 15 Cohort Eight fellows, with the fellows' nodes color-coded to reflect their small group assignment. For this cohort, small groups were formed around the intergenerational transmission of child maltreatment and parenting challenges, children and youth, and early childhood systems and settings.

Figure 17 presents the same data with respect to interactions among the fellows but highlights each fellow's specific discipline. As noted in Figure 17, nearly half of the 15 fellows (7) are in various psychology disciplines (shown in orange), four are in social work (red), three fellows in child/human development (purple), and one fellow in sociology (blue).

Description of the Network

Cohort Eight had a graph density of 0.295, meaning that only 30% of all possible connections between Cohort Eight fellows occurred outside of mandatory fellowships functions. This graph density is the lowest of all the cohorts, and the lowest among any cohort since network analysis began tracking density four years ago. The Cohort Eight network also exhibited an average degree of 4.1, indicating that, on average, the Cohort Eight fellows interacted with just over one-quarter of their cohort outside planned fellowships meetings and work on their small group projects. As Table 10 shows, this cohort also had the lowest number of total connections (62) within their cohort of any cohort, although only slightly behind Cohorts Two and Four (66 and 67, respectively).

In this cohort, one fellow is the clear core of the network; this fellow connected with every other fellow in the cohort and therefore has the highest betweenness centrality ranking by a wide margin (see Table 9). However, despite the low number of connections for a new cohort, the reported quality of these connections was fairly high. Among all reported Cohort Eight connections with quality ratings (94% of connections), 62% were rated high quality.

Small Group Affiliation

Within this cohort, some early patterns of connections are influenced by small group assignments, as shown in Figure 16. One small group seems to be well connected, while others are not connecting outside of their project work very often. The intergenerational/parenting group had a strong graph density of 0.9, meaning 90% of possible connections between these

five fellows occurred outside of connections made towards working on their group project. We see the fellows in this group clustered together in Figure 16.

Beyond that group, small groups did not seem to drive connections during their first year of the fellowship. The systems and setting small group had a graph density of 0.3, while no connections occurred among the members of the children and youth small group outside of their work on their group project (network density=0.0).

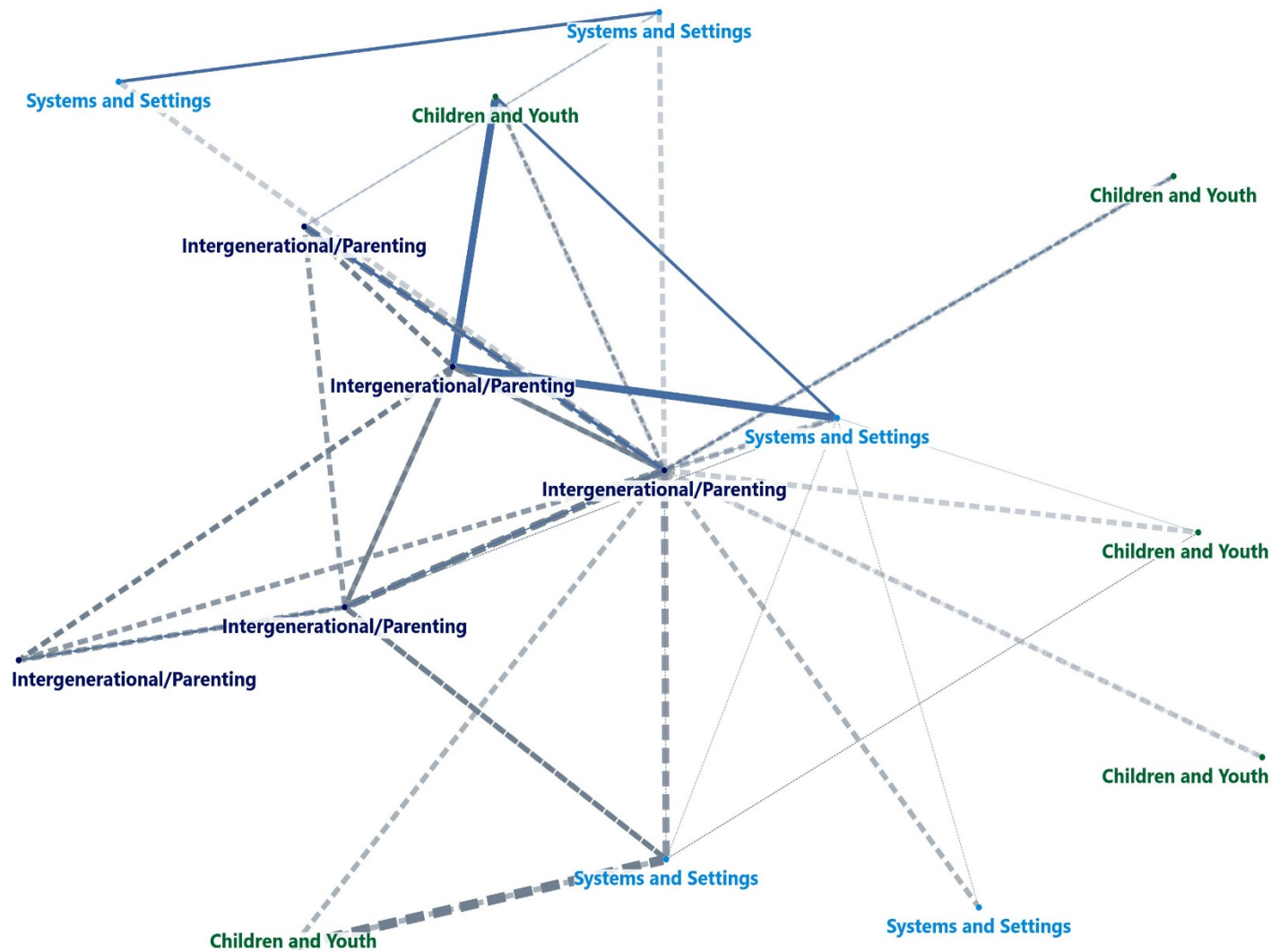
Disciplines

Cohort Eight Fellows fall into four discipline groups, and all disciplines were weakly connected during their first year in the fellowships. Each discipline with more than one fellow presented a 0.33 network density, indicating a third of the possible connections among fellows in the same disciplines took place. We can see from Figure 17 that discipline does not play a strong role in the structure of this network, which may be a result of the newness of the relationships and the cohort. Among all within-cohort connections in Cohort Eight, 63% were interdisciplinary.

Retention

Among the Cohort Eight fellows, only two fellows connected with more than half of the other fellows in their cohort, for a retention rate of 13%, the lowest of any cohort. The reporting period is during the cohort's first year as fellows and precludes connections made at fellowship meetings and work on small group projects. This is the lowest retention rate of a new cohort since the survey began. While the low numbers for this cohort cause some concern, it is not indicative of their connection with the full fellowships network. Analysis in the next section will shed light on whether the Cohort Eight fellows became connected with fellows outside of their network with more frequency or quality than they did with their cohort peers.

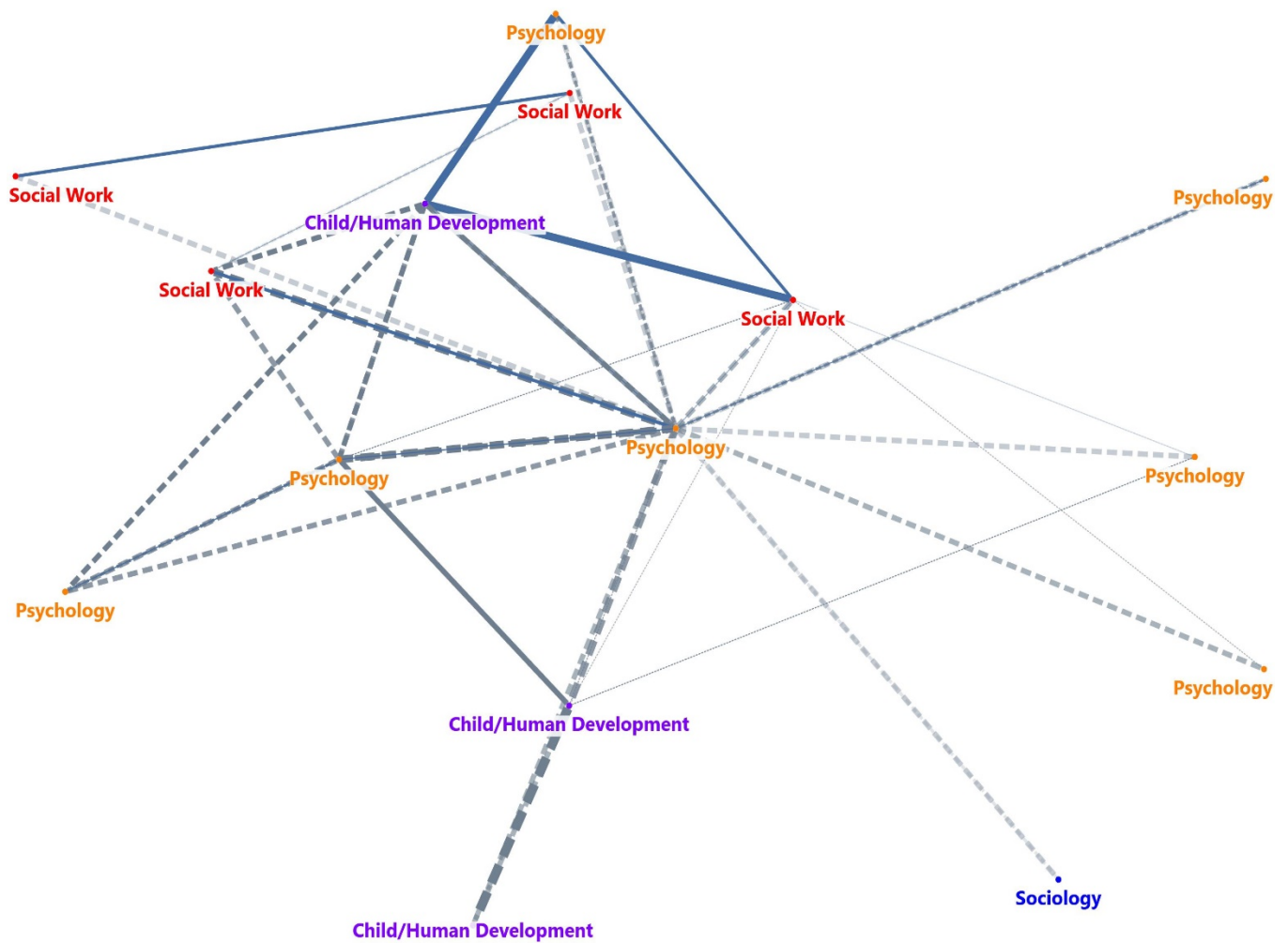
Figure 16. Cohort Eight Network: Small Group Assignment



Notes:

- Dashed, grey lines represent virtual interactions; solid, steel blue lines indicate in-person interactions.
- The width of the line shows the total number of in-person and virtual interactions between two fellows. The broader the line, the greater the number of interactions.
- The darkness of the line shows the average reported quality of all interactions between two fellows. The darker the line, the higher the reported quality.

Figure 17. Cohort Eight Network: Discipline



Notes:

- Dashed, grey lines represent virtual interactions; solid, steel blue lines indicate in-person interactions.
- The width of the line shows the total number of in-person and virtual interactions between two fellows. The broader the line, the greater the number of interactions.
- The darkness of the line shows the average reported quality of all interactions between two fellows. The darker the line, the higher the reported quality.

Table 9. Cohort Eight Descriptive Statistics

Fellow	Degree	Betweenness Centrality
Fellow 810	14	61.000
Fellow 807	7	5.000
Fellow 809	6	2.333
Fellow 814	6	2.333
Fellow 805	5	1.833
Fellow 811	4	1.000
Fellow 801	3	0.000
Fellow 808	3	0.500
Fellow 812	3	0.000
Fellow 815	3	0.000
Fellow 804	2	0.000
Fellow 813	2	0.000
Fellow 802	2	0.000
Fellow 803	1	0.000
Fellow 806	1	0.000
	This year	
Network Average	4.133	
Network Median	3	
Network Density	0.295	
Discipline Density		
Psychology		0.33
Child/Human Development		0.33
Social Work		0.33
Sociology		N/A
Small Group		
Intergenerational/Parenting		0.90
Systems and Settings		0.30
Children and Youth		0.00

Notes:

- *Degree*: Number of connections attached to that fellow.
- *Betweenness*: How important each node/fellow is in providing a “bridge” between different parts of the network.

Within-Cohort Summary

Table 10 summarizes the connectivity of each cohort as reported in the current survey and in the previous year, if available. As these data illustrate, variation exists across the eight cohorts and, in many cases, within cohorts over time. Some key points:

- In the past year, all but one cohort increased their within-cohort connections.
- Cohorts Two and Four had substantially lower within-cohort connections than other cohorts (approximately half the reported connections), although Cohort Two increased those connections this year compared to the previous year.
- Network density varied across all cohorts, with four increasing and three decreasing.
- The average number of individuals each fellow connected with in their cohort (average density) increased in four of the cohorts and decreased in three cohorts.
- The proportion of individuals who connected with at least half of the fellows in their cohort (retention rate) either stayed the same or increased for five cohorts while it dropped for two cohorts.

Table 10. Summary of Within-Cohort Network Data, by Cohort

	Cohort One	Cohort Two	Cohort Three	Cohort Four	Cohort Five	Cohort Six	Cohort Seven	Cohort Eight
	prior year	prior year	prior year	prior year	prior year	prior year	prior year	
Cohort-Specific Statistics								
Number of within-cohort connections	161 143	66 48	117 103	67 91	153 105	143 142	184 124	62
<i>Network Density</i>	0.52 0.60	0.35 0.30	0.60 0.48	0.46 0.50	0.64 0.39	0.63 0.68	0.76 0.56	0.3
<i>Average Degree</i>	7.3 7.9	4.6 3.3	8.4 6.7	6.4 6.9	8.9 5.5	8.8 9.5	10.7 7.9	4.1
<i>Retention Rate</i>	0.67 0.67	0.27 0.07	0.67 0.47	0.33 0.67	0.80 0.40	0.87 0.93	1.00 0.60	0.13

Summary of Full Fellowships Network Connections

Overall Interactions

In FY 2019 (July 2018-June 2019), fellows reported a total of 3,493 connections across the full fellowships network, which is 40% more than the total number of connections reported in FY 2018. This is the largest percentage jump in reported connections over the past four years. Overall, the number of fellows that each fellow connected with ranges between 2 and 119, indicating that at least one person connected with every single fellow in the network. Once again, slightly more than half of the 3,493 connections (1,816, or 52%) were in-person connections, while the other 48% were virtual (by email, Google hangouts, Zoom, etc.). The majority of these 3,493 connections (2,032, or 58%) were reciprocated connections, meaning that both fellows recorded the same type of connection. Our best estimate of the number of unduplicated connections is 2,477, which is 48% more unique connections this year than reported in the prior year.⁷

Quality of Connections

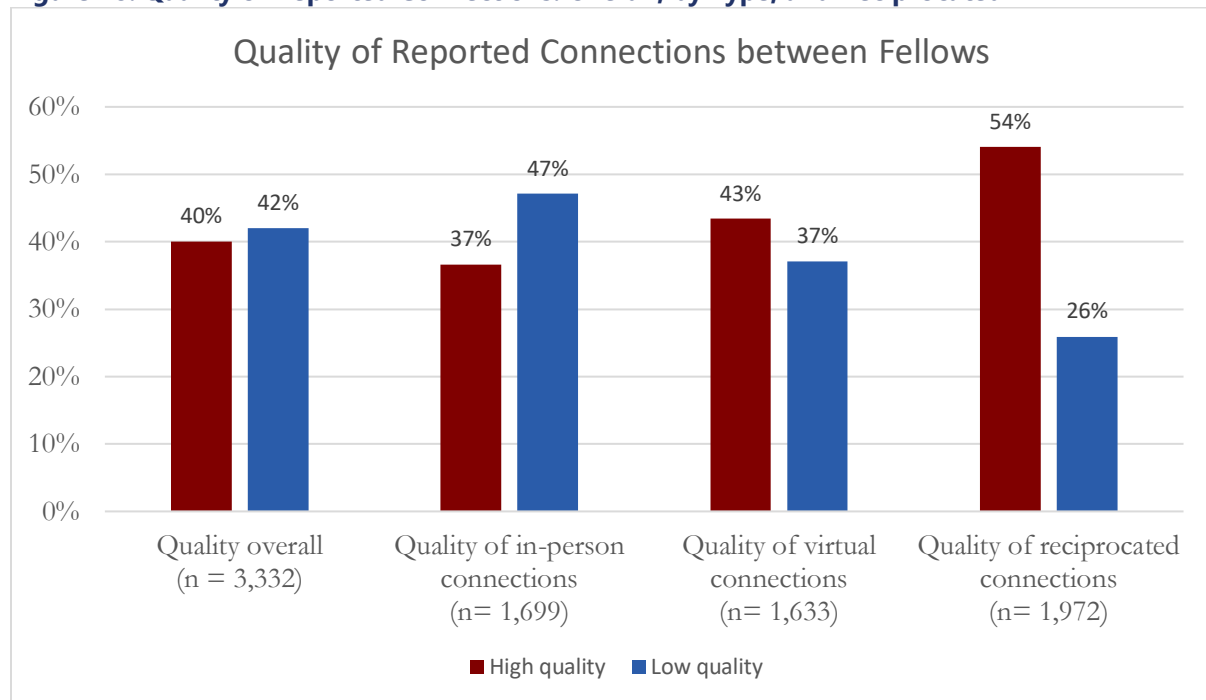
Using a 5-point Likert scale, fellows rated the quality of 95% of all the connections they reported.⁸ Nearly 40% of all rated connections received a rating of 4 or 5, suggesting that the connections were of high quality. Overall, this represents a 12% decline in the proportion of interactions rated as high quality. However, the mean score for all rated interactions was 3.0, which is only slightly lower than last year's mean of 3.2.

Surprisingly, fellows gave virtual connections slightly higher quality ratings than in-person interactions (43% of virtual connections in contrast to 37% of in-person connection were given a rating of 4 or 5). This may speak to the quality of the virtual connection events fellows sponsor such as writing retreats and utilizing communication platforms such as Google Hangouts and Zoom, all which lead to more interactive virtual engagements. Additionally, among the reciprocal connections that had a quality rating, 54% were rated as high quality, while only 20% of the connections reported by only one of the fellows received this rating. Looking at it a different way, 79% of the high-quality in-person connections and 81% of the high-quality virtual connections were reciprocated relationships. Predictably, the higher quality connections are more likely to be recalled than those of lower quality, where one fellow may have failed to recall the connection when completing their survey if it was a short, weak connection. Figure 18 shows the quality of connections as reported across several domains.

⁷ As discussed in the introduction, reciprocal connections are counted twice, one for each respondent, resulting in some duplication in our count. To understand the number of unique connections, where both fellows reporting the connection only counts as one unique connection, we divide the number of reciprocated connections in half, and add that number to the non-reciprocated connections: $(2032/2)+1461= 2,477$ unique reported connections.

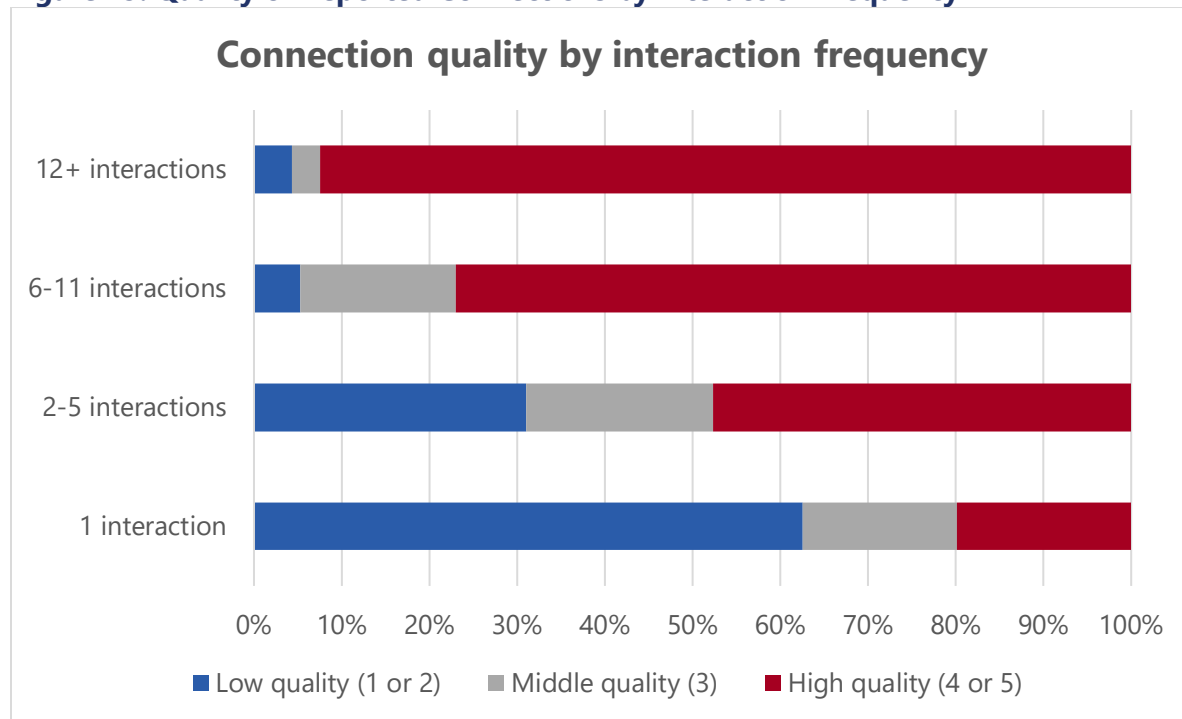
⁸ Fellows provided ratings on over 95% of the 3,493 connections they reported having with their colleagues.

Figure 18. Quality of Reported Connections: Overall, by Type, and Reciprocated



We examined the quality of the connections by the frequency with which they occur. Not surprisingly, fellows tended to view connections involving multiple interactions with a fellow to be of higher quality than those involving fewer interactions. During the year, nearly half of reported connections occurred only one time and of these, over 60% received low quality ratings. As demonstrated in Figure 19, the overwhelming majority of connections with 6 or more interactions are rated high quality. We found connection quality is strongly correlated with the interaction frequency ($r=0.49$, $p<.001$).

Figure 19. Quality of Reported Connections by Interaction Frequency



Within vs. Cross-Cohort Analysis

Table 11 reports total connections for each cohort and for the full fellowship network, as well as the proportions of connections that occurred within a fellow's cohort as opposed to connections outside the cohort. Overall, 72% of all connections involved fellows from different cohorts, representing a 3% increase over the previous year. Strategies such as increased graduated fellow attendance at the mid-year meeting, staff-driven connections between current and former fellows, network-wide communication on behalf of the Leadership Committee,⁹ writing retreats, and peer mentors created greater opportunities for connections and relationships among fellows from different cohorts.

The majority of connections reported by fellows in each cohort involved interactions with fellows outside the cohort, but this proportion varied across the eight cohorts. As we observed in the past, the total number of connections reported by fellows in a specific cohort generally increase the longer that cohort has been engaged in the program. Unsurprisingly, the newest cohort reported fewer total contacts than the other cohorts, although length of time in the program is not fully predictive of the number of connections an individual fellow might make over the year. Across the eight cohorts, the majority of all connections were cross-cohort connections, ranging

⁹ The Leadership Committee, comprised of one representative from each cohort and three at-large members, met routinely throughout this year to discuss the sustainability of the fellowships network. Committee members sought input and provided updates to the cohort on a regular basis.

from 58% (Cohort Seven) to 83% (Cohort Four).¹⁰ It is not surprising to see Cohort Seven with the lowest cross-cohort percentages—more recent cohorts have had limited opportunities to meet and interact with their peers from the program’s initial cohorts. Additionally, in the few cases where the fellowship has sponsored meetings for all fellows, such as the mid-year meeting, those who were currently enrolled in the program during the data collection period (Cohorts Seven and Eight) were asked not to include these “program initiated” interactions in their survey. This limitation makes the relatively high proportion of cross-cohort interactions reported by Cohort Eight fellows encouraging. This final cohort of fellows engaged in and utilized the resources from the entire network during their first year.

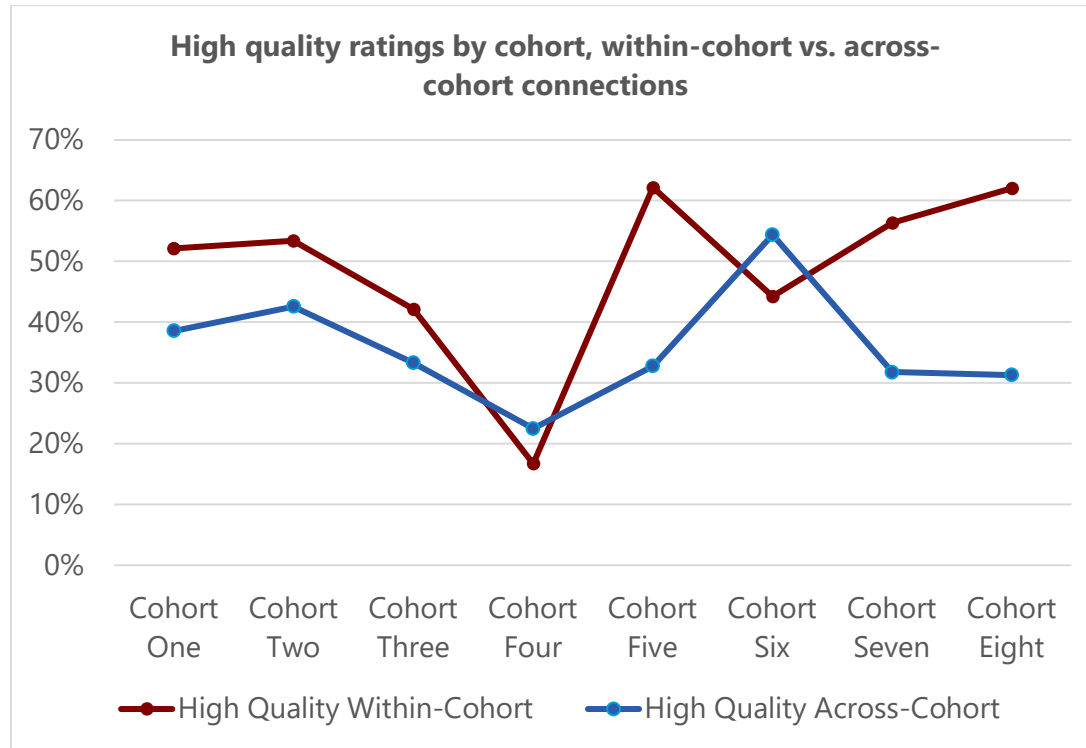
Table 11. Full Fellowships Connections

2018-2019 2017-2018	Cohort One prior yr	Cohort Two prior yr	Cohort Three prior yr	Cohort Four prior yr	Cohort Five prior yr	Cohort Six prior yr	Cohort Seven prior yr	Cohort Eight	Full Fellowships Network
Total Reported Connections	580 477	377 289	517 364	384 304	540 414	409 386	435 264	251	3,493 2,498
% Within-cohort	28% 30%	18% 17%	23% 28%	17% 31%	28% 25%	35% 37%	42% 47%	25%	28% 30%
% Across-cohort	72% 70%	83% 83%	77% 72%	83% 70%	72% 75%	65% 63%	58% 53%	75%	72% 70%

When we compare how fellows rate their connections within their cohort compared to the network as a whole, we see wide discrepancies across the eight cohorts. Six of the eight cohorts rated connections with their cohort peers as higher quality than their connections with fellows outside their cohort (Figure 20).

¹⁰ When considering cohort-specific analysis of these reports, it is important to remember that the numbers only include the fellow reporting the interaction. For example, if a Cohort Four fellow reported a connection with a Cohort One fellow but that Cohort One fellow did not report the same interaction, then that connection would not be counted in the Cohort One numbers. It would, however, be included as a cross-cohort interaction in the Cohort Four calculations.

Figure 20. Cohort Quality Ratings



Academic Discipline

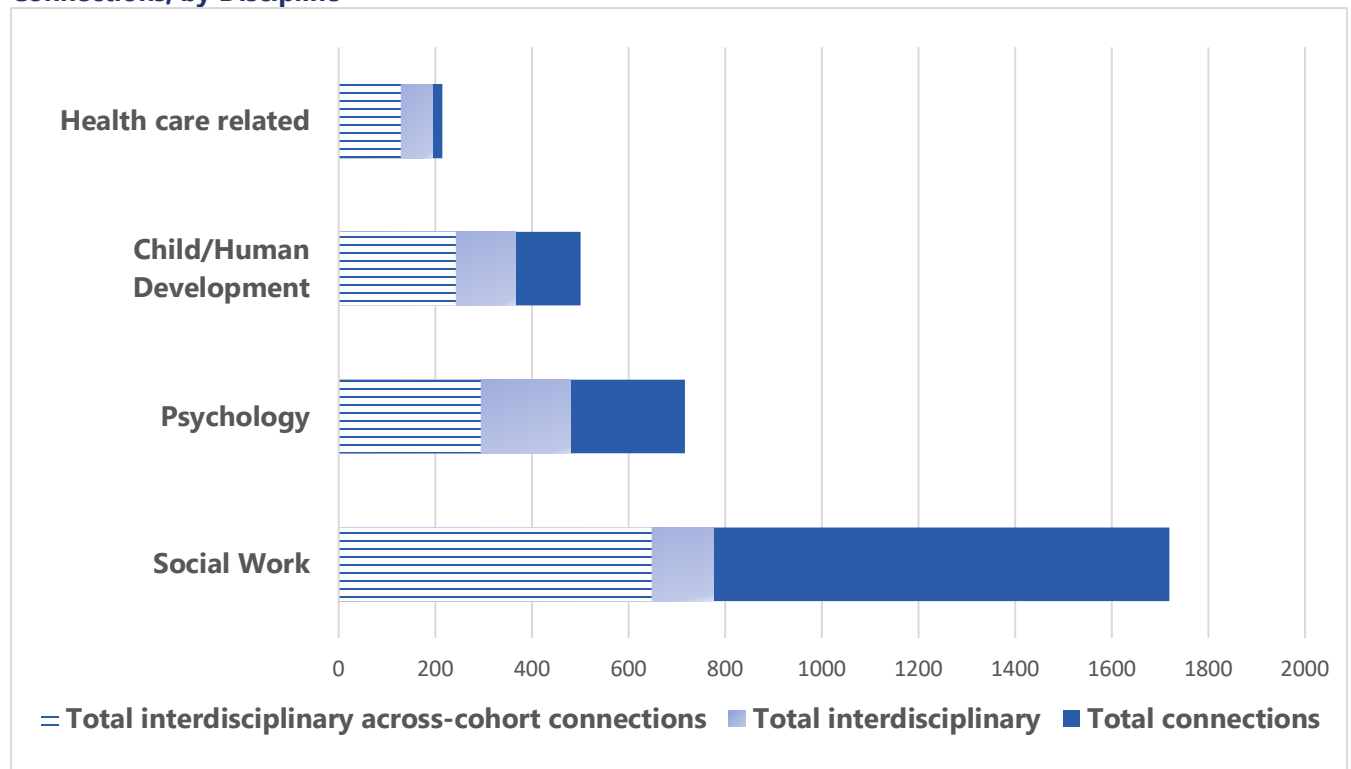
In order to look at how discipline might factor into how fellows connect, we developed a typology consisting of nine broad academic disciplines allowing fellows to self-identify which category best fit their situation.¹¹ These categories listed in our typology vary in their specificity. For example, some disciplines, such as psychology, are captured in several categories (clinical, developmental, school, etc.). Similarly, the healthcare related field is broken down into several individual categories including MD/PhDs, public health fellows, epidemiologists and nursing PhDs. There is reason to believe in both cases that there may be little overlap in research interests or projects among fellows self-identifying in each of these subcategories even though all share a broader common discipline. Among the disciplines with 10 or more fellows, social work and child/human development both have relatively high graph densities of 0.40 and 0.44 respectively, as these disciplines have high discipline identity. Psychology (0.25) and health care related (0.24) disciplines exhibit lower graph densities, for reasons explained above.

While we know people are connecting by their disciplines, we also know they are talking to fellows from other disciplines. Over half (61%) of all reported connections cross these discipline boundaries. Additionally, while we know that the majority of all connections for each cohort were connections crossing cohort boundaries, those connecting outside of their cohorts are

¹¹ Survey discipline categories are Child/Human Development, Criminal Justice, Education, Health Care/Public Health/Health Policy/Epidemiology (i.e. "Health care related"), Psychology, Public Policy, Social Policy, Social Work, and Sociology. For analysis, Public Policy and Social Policy were combined into one category.

largely doing so across discipline. Among the 2,529 cross-cohort connections reported, 59% (1,489) were also interdisciplinary. Figure 21 shows the total connections, proportion that are interdisciplinary, and proportion of the interdisciplinary connections that are across cohort boundaries, by discipline for the four most populous disciplines in the network. The majority of connections for most disciplines are with fellows outside of their own discipline category (except social work), and the large majority of these interdisciplinary connections occur with fellows in other cohorts. Cohort and discipline boundaries no longer define the network connectivity.

Figure 21. Total Interdisciplinary and Cross-Cohort Interdisciplinary Connections as Subset of Total Connections, by Discipline



Geography

Fellows listed their current geographic location in the survey. We examined connections by US Census regions and did not find any patterns to indicate that geography was influencing fellow connectivity. Corroborating this finding, fellows rated a number of factors that motivated their connections (see next section), and geographic proximity was ranked lowest among all factors.

We took a micro lens to the geographic analysis to understand whether local clusters of fellows indicated more or stronger connections relative to the fellowship network as a whole. We considered metro areas where more than five fellows reside,¹² and found Chicago (n=6), Boston (n=6), and Washington, D.C. (n=10) are home to the largest clusters of fellows. The six Chicago metro area fellows have a high graph density of 0.87, meaning 87% of all possible connections between the six fellows occurred. These six fellows also, on average, rated geographic proximity

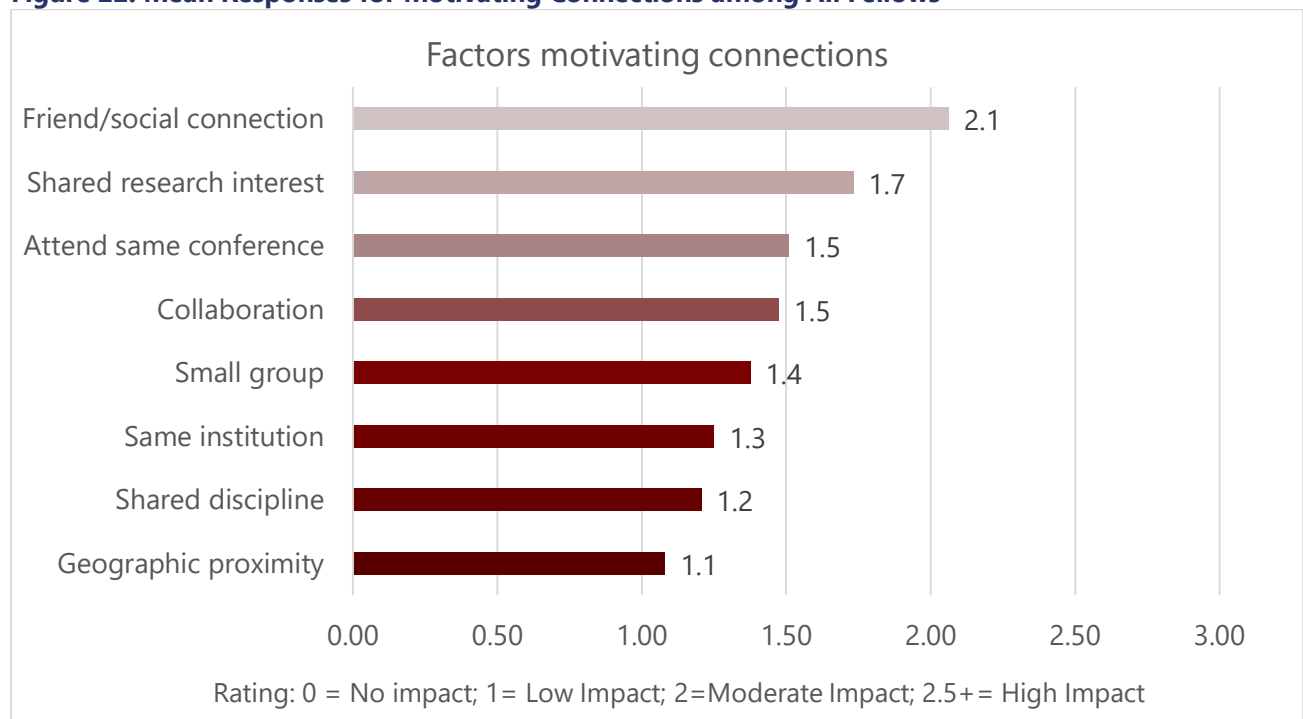
¹² Among those that completed the survey, at the time of the survey.

as having considerable impact in determining which fellows they were most likely to interact with. Fellows from the two other regions we examined, however, did not report comparable levels of connectivity, suggesting geographic proximity is at best a partial explanation for the frequency with which fellows interact.

Motivating Connections

We asked fellows about the relative importance of 13 different factors that motivated their connections with one another (e.g., shared research interests, social relationship, and collaboration). The scale ranged from 0 (no impact) to 3 (highly significant impact). While some fellows considered none of these factors important in influencing their interactions with their peers, others found all or most of the factors relevant. Friendship or social connection received the highest average impact factor from the fellows (mean=2.1), with 42% of fellows rating this as having a moderately significant impact on who they interacted with during the year. Following this, fellows report that having a shared research interest with another fellow was the second most significant factor in making connections with their colleagues (mean=1.7). Nearly one-third of the fellows in the survey (30%) reported active collaborations as having a highly significant impact on their connections. Ratings for the factors are summarized in Figure 22.

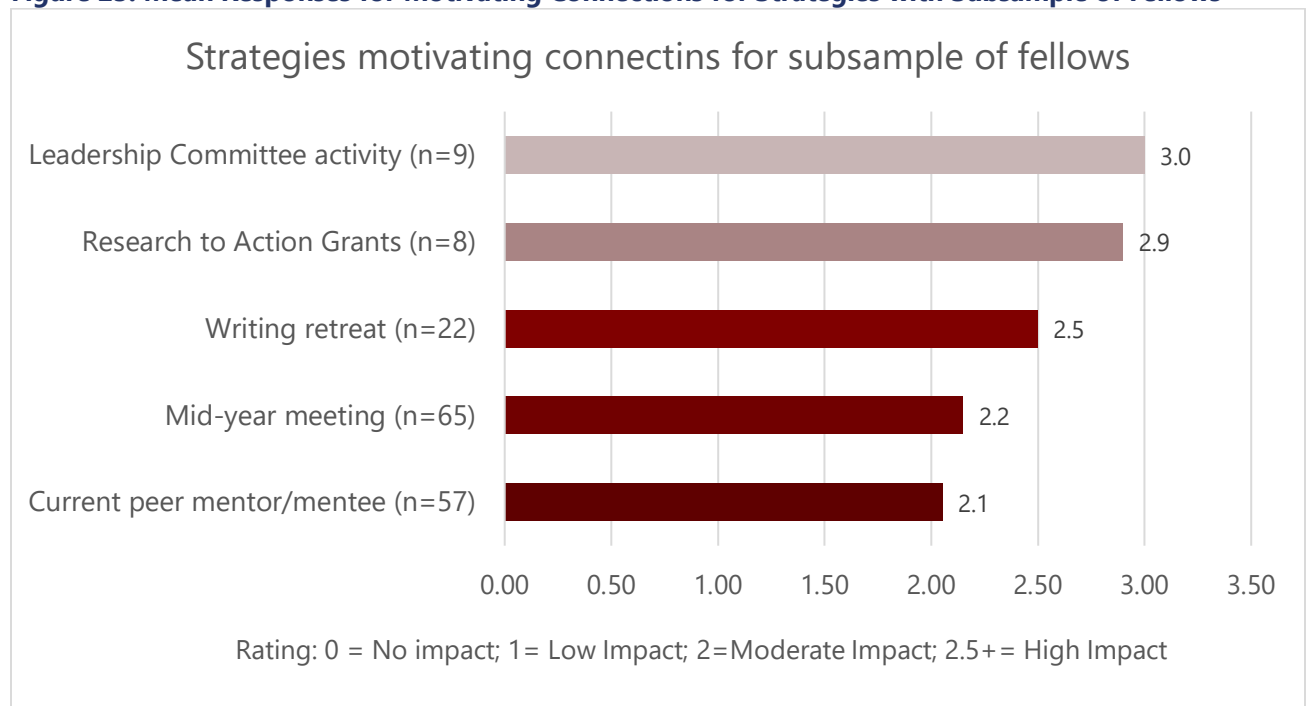
Figure 22. Mean Responses for Motivating Connections among All Fellows



Some strategies that received relatively low ratings across the full sample are ones that only a subsample of fellows participated in during the survey year. These include participation on the Leadership Committee, Research to Action Grants, mid-year meeting, writing retreats and peer mentoring programs. To more accurately discern the impact of these activities on a fellow's connections, we used the rating scores only of these fellows who participated in each opportunity. Figure 23 summarizes these results. Nine of the 11 fellows on the Leadership

Committee completed the survey, and all nine rated the Leadership Committee activities as having a highly significant impact on their engagements. Similarly, seven of the eight Research to Action Grant recipients gave the grants the highest rating for motivating connections (mean=2.9). Examining the relative impact of the writing retreats (a strategy organized by fellows, for fellows), we found the 22 fellows who attended at least one writing retreat rated this activity as having a significant impact on who they engage with from the network (mean=2.5). Finally, fellows involved in a peer mentoring relationship during the reporting period (all Cohort Seven and Eight fellows and their peer mentors) rated these partnerships as moderately important in promoting network connections (mean=2.1).

Figure 23. Mean Responses for Motivating Connections for Strategies with Subsample of Fellows



Multivariate Analysis

We conducted hierarchical multiple regression analysis to identify the most salient factors in explaining variation in the number of connections fellows reported with other fellows, which was the dependent variable. Our independent variables included:

- Small group density: We calculated the mean density of each small group; the value is between 0 and 1 and indicates the proportion of possible connections between the five group members over the past four surveys.
- Discipline density: We calculated the number of fellows who shared the same discipline; the value is between two and 43.
- Length in fellowships: We calculated the number of years each fellow had been in the fellowships; values ranged from one year for Cohort Eight to eight years for Cohort One.

- Geographic proximity: We counted the number of fellows in the same metro area; the values were between 1 and 15.

Regression results are presented in Table 12.

Table 12. Doris Duke Fellowships Covariates Predicting Total Connections in Hierarchical Regression Analysis

		ΔR^2	Final model β
Total Connections ($N = 112$)			
Step 1	Small Group Density	.116*	.402*
Step 2	Discipline Density	.070*	.267*
Step 3	Length in Fellowships	.001	.031
Step 4	Geographic Proximity	.001	.028
		Total $R^2 = .171^*$	

* $p < .005$

The final model, with all four independent variables, explained 15.7% (adjusted R squared) of the variance in the new total connections, yet the third and fourth steps did not result in a significant change in R squared. Thus, the best fitting model for predicting new total connections was the second model with the predictors *small group density* and *discipline density*, which explained 17.1% (adjusted R squared) of the variance in the total number of connections.

As we expected, fellows who were in small groups that maintained higher connectivity reported a larger number of total network connections this year. From the beginning of the fellowships program, we provided fellows a concrete opportunity to collaborate across disciplines with a smaller number of colleagues on a joint project. As such, we assigned each fellow at the time of enrollment to one of three small groups. While not all small groups developed similar patterns, regression results suggest that the small group connections and the strength of these connections over the past four years had a meaningful impact on a fellow's total connections across the network. When small groups maintained relatively strong connections across time, individual group members were more likely to connect with additional fellows.

Fellows from disciplines who were more broadly represented in the fellowship network (e.g. social work, psychology) were more likely to report a larger number of total connections than those who had fewer colleagues in the program sharing their academic discipline (e.g., criminal justice, sociology). On one hand, it is intuitive to assume fellows would find greater common ground with people enrolled in similar programs and sharing a similar disciplinary focus. Professional organizations are typically structured around single disciplines; academic departments are usually discipline specific; and many journals continue to focus on a sole

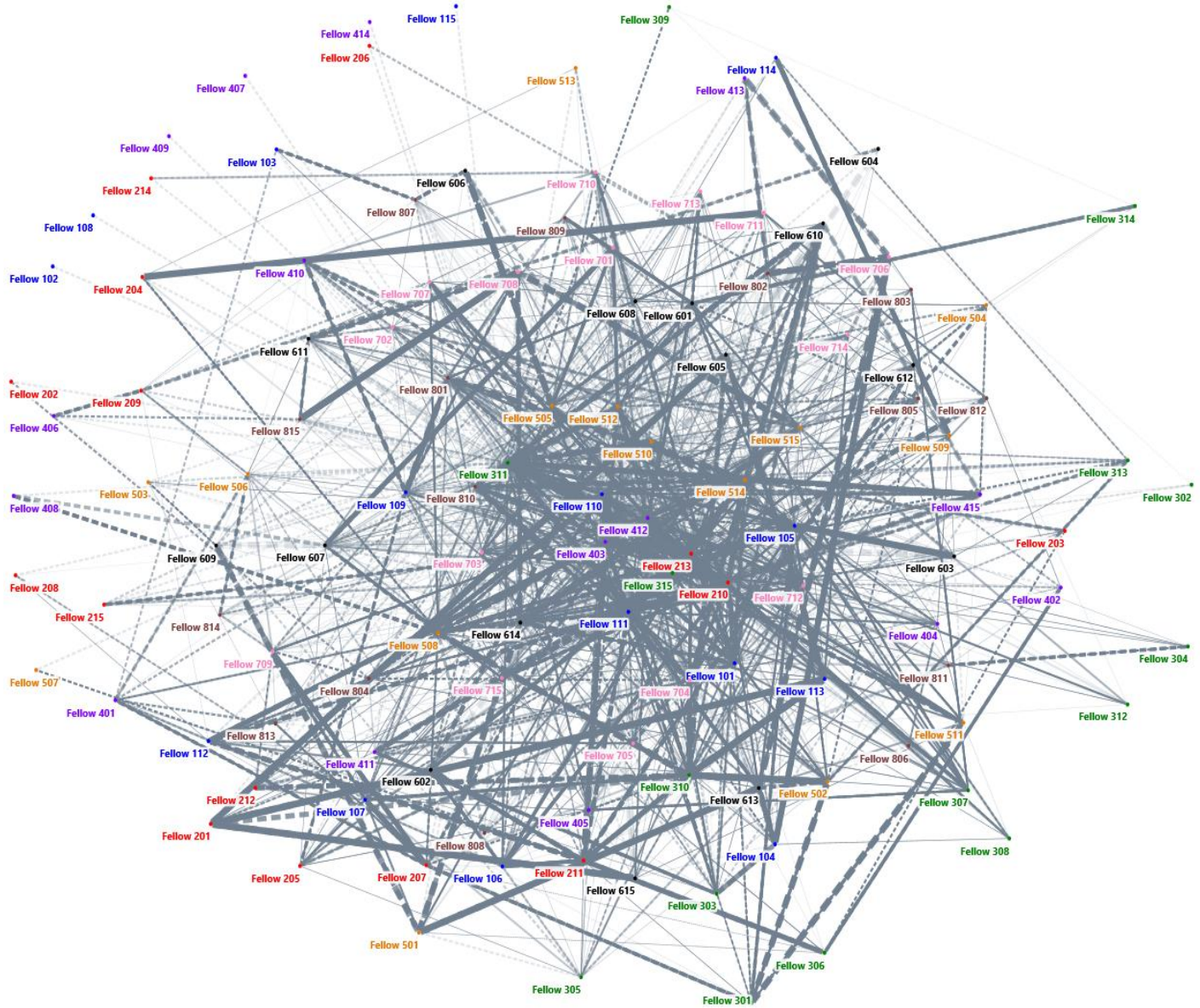
discipline. The fellowships program has been challenging this structure since its inception, forming cohorts that reflect greater discipline diversity and creating opportunities for interdisciplinary connections. Although the overall number of interdisciplinary connections continue to be strong and is growing (as evidenced by overall survey results discussed elsewhere), having a critical mass of colleagues in your discipline within the network may provide fellows greater initial comfort in forming connections within this peer group.

Neither of the other two independent variables in our model (geographic proximity and program duration) contributed additional explanatory power with respect to a fellow's total number of connections. Even before the COVID pandemic, fellows routinely communicated with their peers across the country based on shared interests and research opportunities. Although we had assumed that fellows living in close proximity or working in similar institutions might report a higher number of connections, the data does not support this pattern. Similarly, the length of time in the program did not, in and of itself, result in a greater number of contacts.

Full Network Graphs

Figures 24 and 25 display the graphs of the full fellowships network. Figure 24 shows all 3,493 connections with colors designated for each cohort, and each fellow's node as well as connections to their cohort peers are highlighted in their cohort's color. Cross-cohort connections are displayed by a grey line. Figure 25 shows the network's cross-cohort connections, thus all edges are shown in grey. The width, style, and opacity of each line still represents the frequency, type, and quality of the connection, respectively. Table 13 lists each fellow in the network organized by their betweenness centrality score (how critical a fellow is to keeping other fellows engaged in the network), along with their degree (number of fellows they connected with in the network), how that number changed from the prior year, and their discipline.

Figure 25. Full Fellowships Network: Cross-Cohort Interactions



Notes:

- Dashed lines represent virtual interactions; solid lines indicate in-person interactions.
- The width of the line shows the total number of in-person and virtual interactions between two fellows. The broader the line, the greater the number of interactions.
- Blue discs indicate a Cohort One fellow.
- Red discs indicate a Cohort Two fellow.
- Green discs indicate a Cohort Three fellow.
- Purple discs indicate a Cohort Four fellow.
- Orange discs indicate a Cohort Five fellow.
- Black discs indicate a Cohort Six fellow.
- Pink discs indicate a Cohort Seven fellow.
- Brown discs indicate a Cohort Eight fellow
- Grey lines show cross-cohort interactions.

Table 13. Full Fellowships Network: Descriptive Statistics

Fellow	<i>Betweenness Centrality</i>	<i>Degree</i>	<i>Change from Prior Year</i>	<i>Discipline</i>
Fellow 311	1436.249	119	65	Social Work
Fellow 213	356.789	89	35	Social Work
Fellow 403	329.417	87	36	Social Work
Fellow 111	329.144	81	20	Social Work
Fellow 210	305.968	82	32	Social Work
Fellow 412	276.785	80	41	Child/Human Development
Fellow 315	262.386	80	21	Social Work
Fellow 514	258.178	81	33	Psychology
Fellow 110	197.833	77	14	Social Work
Fellow 105	92.706	59	3	Social Work
Fellow 508	90.763	49	9	Social Work
Fellow 505	86.689	59	17	Child/Human Development
Fellow 510	81.914	61	40	Health Care related
Fellow 101	66.286	45	5	Social Work
Fellow 515	64.519	50	8	Social Work
Fellow 810	57.754	47	N/A	Psychology
Fellow 109	55.775	44	-1	Psychology
Fellow 310	50.315	44	5	Social Work
Fellow 614	48.856	46	-4	Health Care related
Fellow 512	39.883	48	-4	Psychology
Fellow 211	37.515	30	-10	Social Work
Fellow 601	33.386	41	18	Child/Human Development
Fellow 405	29.995	30	11	Social Work
Fellow 306	29.672	23	5	Health Care related
Fellow 107	29.433	34	-9	Social Work
Fellow 704	26.469	41	22	Social Work
Fellow 605	21.949	36	9	Public Policy

Fellow	<i>Betweenness Centrality</i>	<i>Degree</i>	<i>Change from Prior Year</i>	<i>Discipline</i>
Fellow 113	21.859	32	-1	Public Policy
Fellow 411	21.086	25	3	Education
Fellow 609	20.805	26	3	Psychology
Fellow 207	20.618	25	0	Social Work
Fellow 506	20.395	31	17	Psychology
Fellow 509	19.942	28	16	Psychology
Fellow 715	19.778	41	0	Health Care related
Fellow 712	19.535	38	10	Child/Human Development
Fellow 613	19.229	30	-9	Social Work
Fellow 607	18.669	27	-5	Sociology
Fellow 404	18.572	25	-9	Social Work
Fellow 410	16.928	26	2	Psychology
Fellow 612	16.204	33	13	Sociology
Fellow 503	15.763	22	18	Psychology
Fellow 710	15.549	30	10	Psychology
Fellow 303	15.237	28	3	Education
Fellow 707	15.185	34	9	Psychology
Fellow 106	15.049	29	6	Social Work
Fellow 406	14.172	15	2	Psychology
Fellow 711	13.764	27	6	Health Care related
Fellow 112	13.763	21	-3	Social Work
Fellow 703	13.706	37	12	Child/Human Development
Fellow 708	13.461	37	18	Psychology
Fellow 615	12.754	26	-5	Social Policy
Fellow 807	12.627	24	N/A	Psychology
Fellow 415	12.070	22	-5	Social Work
Fellow 313	11.559	20	7	Social Policy
Fellow 709	11.012	29	13	Public Policy

Fellow	<i>Betweenness Centrality</i>	<i>Degree</i>	<i>Change from Prior Year</i>	<i>Discipline</i>
Fellow 812	10.606	21	N/A	Psychology
Fellow 305	10.597	22	1	Social Work
Fellow 714	10.492	34	16	Public Policy
Fellow 502	10.464	28	0	Social Work
Fellow 608	10.432	30	-1	Child/Human Development
Fellow 610	10.380	28	12	Psychology
Fellow 602	9.428	26	-2	Social Work
Fellow 809	9.421	27	N/A	Psychology
Fellow 706	9.095	29	18	Child/Human Development
Fellow 307	8.994	25	14	Child/Human Development
Fellow 702	8.938	35	13	Psychology
Fellow 611	8.936	28	6	Psychology
Fellow 401	8.826	15	-1	Social Work
Fellow 302	8.777	17	5	Psychology
Fellow 804	8.374	21	N/A	Social Work
Fellow 511	7.972	24	5	Social Work
Fellow 802	7.778	24	N/A	Child/Human Development
Fellow 209	7.247	14	2	Psychology
Fellow 701	7.183	30	0	Public Policy
Fellow 205	6.081	15	5	Psychology
Fellow 811	5.745	20	N/A	Social Work
Fellow 308	5.655	15	3	Social Work
Fellow 705	5.290	25	6	Social Work
Fellow 801	5.266	28	N/A	Psychology
Fellow 815	5.043	21	N/A	Psychology
Fellow 402	5.020	12	4	Health Care related
Fellow 813	4.757	18	N/A	Psychology
Fellow 713	4.612	30	16	Child/Human Development

Fellow	<i>Betweenness Centrality</i>	<i>Degree</i>	<i>Change from Prior Year</i>	<i>Discipline</i>
Fellow 104	4.599	23	13	Criminal Justice
Fellow 805	4.415	25	N/A	Child/Human Development
Fellow 606	4.176	18	-7	Child/Human Development
Fellow 413	3.941	11	6	Child/Human Development
Fellow 504	3.780	21	6	Social Work
Fellow 301	3.530	16	-1	Social Work
Fellow 603	3.401	20	-6	Psychology
Fellow 803	3.375	20	N/A	Psychology
Fellow 312	3.045	14	0	Child/Human Development
Fellow 604	2.836	14	0	Psychology
Fellow 814	2.376	18	N/A	Child/Human Development
Fellow 212	2.047	16	-5	Social Work
Fellow 314	1.796	8	3	Child/Human Development
Fellow 513	1.703	10	-2	Psychology
Fellow 808	1.539	15	N/A	Social Work
Fellow 501	1.485	10	-5	Health Care related
Fellow 414	1.233	6	3	Criminal Justice
Fellow 408	1.094	7	1	Social Work
Fellow 201	1.003	8	-3	Social Work
Fellow 304	0.983	11	0	Health Care related
Fellow 202	0.961	6	4	Social Work
Fellow 203	0.957	9	7	Health Care related
Fellow 103	0.937	6	-1	Psychology
Fellow 204	0.802	6	-3	Health Care related
Fellow 806	0.564	12	N/A	Sociology
Fellow 206	0.500	5	4	Psychology
Fellow 409	0.486	7	-1	Sociology
Fellow 215	0.381	10	6	Social Work

Fellow	<i>Betweenness Centrality</i>	<i>Degree</i>	<i>Change from Prior Year</i>	<i>Discipline</i>
Fellow 114	0.319	6	-1	Social Work
Fellow 507	0.250	4	-1	Sociology
Fellow 208	0.165	6	1	Social Work
Fellow 108	0.000	6	-2	Social Work
Fellow 407	0.000	6	-3	Social Policy
Fellow 309	0.000	5	2	Psychology
Fellow 115	0.000	4	3	Psychology
Fellow 214	0.000	4	-1	Sociology
Fellow 102	0.000	2	-1	Social Work

DISCUSSION

The eight cohorts in the Doris Duke Fellowships for the Promotion of Child Well-Being represent a diverse group of emerging scholars. Through participation in fellowships activities during their two-year fellowships term and through access to the full fellowships network, these scholars have the opportunity to collaborate within and across disciplines. These collaborations have an intentional focus on promoting child well-being. The network survey found that substantial interactions occur between the fellows, both within and across cohorts, beyond interactions at fellowships events. The following themes emerged from this year's social network analysis of the Doris Duke Fellowships Network.

100% of all fellows are connected to the network. Every cohort had more overall connections this year compared to last year – increases ranged from 6% to 65% for each cohort, with a 32% average increase for the seven cohorts that had last year's numbers with which to compare. While 15 new fellows are added to the network each year, fellows this year increased their average number of other fellows with whom they connected by 26%. Fellows are increasing the number of fellows they connect with, expanding across cohort boundaries, and are remaining engaged with the entire network after their time in the program.

Cohorts of fellows remain strongly connected. Within-cohort engagement remains strong for nearly every cohort, regardless of how many years have lapsed since they were an active cohort. Additionally, fellows rate their connections among cohort peers as high quality, indicating that these interactions are meaningful and additive to their development as a leader in the field.

Fellows connect across cohorts. The majority of the 3,493 interactions (72%) are occurring across cohort boundaries, which is a 3% increase over the previous year's data. In the survey's first administration four years ago (2015-2016), cross-cohort connections made up only 55% of all connections. Every year, fellows increasingly collaborate on a wide range of activities and engage fellows across the network. These include journal articles and professional presentations as well as efforts to influence public policy and reform practice.

Interdisciplinary collaborations are increasing. Aligning with one of the four primary goals of the fellowships—to increase interdisciplinary knowledge and research—the majority (61%) of all reported connections are ones that crossed disciplinary boundaries, which is an 11% increase from the prior year.

Geographic boundaries do not define the network shape. At the time of the survey, fellows completing the survey resided and worked in 40 states and two international countries. While some metro areas are home to different clusters of fellows, analysis shows geographic proximity does not predict strong connections, nor is it a motivating factor for fellows to reach out and connect with their network peers.

Multiple factors motivate connections. Reasons for connecting differ for individuals, but many factors we identified have some impact on their connections, with the most fellows providing a

rating for 10 factors. The fellowships and fellow-created opportunities appear to play a meaningful role in influencing connections, especially for those who participated in those activities. Continuing to create opportunities for engagement will help maintain connections as the program transitions.

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