Still, we need to know more to be able to fully understand this complex issue. Future SIOP Income and Employment surveys could include additional questions regarding relevant employment-related data (e.g., area of specialization) that may be helpful in further addressing the issues raised in the focal article. However, as noted by Gardner et al. (2018), there are limitations to our data, one of which is low response rates for the Income and Employment Survey. For example, for the 2016 survey, only 24.0% of members responded. We believe that if we want to know more about the differences that exist in our field, we as members of SIOP should all own part of the responsibility to make it happen. Providing responses through SIOP-sponsored data collection efforts like the Income and Employment Survey is one way to do that. We ask all SIOP members, regardless of membership type, to participate in our next survey, which will be conducted in 2019, in order to make sure that SIOP has sound data to address questions like those posed by Gardner et al. (2018) and other issues of importance to our membership.

References

Gardner, D. M., Ryan, A. M., & Snoeyink, M. (2018). How are we doing? An examination of gender representation in I-O psychology. *Industrial and Organizational Psychology: Perspectives on Science and Practice, 11*(3), 369–388.

Richard, E., Wright, N., Thomas, S., Wiggins, A., DuVernet, A., Parker, B., & Davison, K. (2018). Revisiting the 2016 SIOP Income & Employment Survey: Gender pay gap. *The Industrial-Organizational Psychologist, 55*(3). http://my.siop.org/tip/jan18/editor/ArtMID/13745/ArticleID/249/Revisiting-the-2016-SIOP-Income-Employment-Survey-Gender-Pay-Gap⟨/BI⟩

How We Are Doing What We Are Doing: Network Mechanisms of Gender Representation in I-O Psychology

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The field of psychology has a long history of tracing the lineage of modern day psychologists back to their academic roots (Benjamin, Durkin, Link,

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Vestal, & Accord, 1992), and industrial and organizational (I-O) psychology is no exception (Culbertson, 2016). Why do we do it? Well, it is intriguing to see how our initial training may be linked back to some of the pioneers of our field. Perhaps it also represents how we are connected with one another—through our extended family relationships. But of course an academic family tree only reflects a portion of how we might be interconnected with one another—certainly our networks go much further than our dissertation chairs. Indeed, they might include our collaborators, coworkers and former coworkers, fellow former graduate students, and a host of people with whom we have connected at conferences or through other professional and personal relationships, and the composition of these networks, arguably, matters.

We argue the composition of our networks has important implications for gender representation in our field. We echo Gardner, Ryan, and Snoeyink's (2018) call for the use of social network analysis to explore the relational mechanisms that may contribute to the underrepresentation of women they describe, particularly as such knowledge could ultimately lead to the identification of solutions. Applying a social network perspective to the examination of gender representation will be particularly beneficial (a) to better understand mechanisms responsible for social homogeneity (how salary, performance, and role expectations are formed) and (b) to consider explanations for outcomes that have not yet been discussed, such as social capital explanations for performance and social dynamics of power and influence. The purpose of this commentary is to (a) introduce basic concepts of social network analysis (SNA) that may be critical to examining these issues, (b) identify how related research has used SNA to examine gender representation, and (c) present a research agenda/plan for how SNA could be used to examine some of the issues raised by Gardner et al. (2018).

Network Basics

A social network analysis would focus on relationships among I-O psychologist—our *nodes* of interest. The focal *node* is often referred to as *ego* and the relationship partners as *alters*. Social network studies have measured many different types of relationships (Borgatti, Mehra, Brass, & Labianca, 2009), but ones likely to be of particular interest in this research context include academic lineage (chairs and members of committees), coauthorship, mentorship, nominating relationships, and referents.

Network *position* is an individual's contribution to or involvement in the network (Borgatti & Everett, 1992). Two of the most commonly used measures of position are (a) *degree centrality*: the number of direct relationships, a measure of prominence within the network; and (b) *betweenness centrality*: the number of times an actor serves as a bridge along the shortest path

between two others actors, a measure associated with occupying *structural holes* and performing a brokerage function (Burt, 2009; Freeman, 1978). Both of these measures offer strategic advantage to individuals and are often associated with power and influence.

Networks often comprise smaller groups known as subgroups. The pattern of connections is different in subgroups when compared to the broader network. For example, certain areas of the network may be more cohesive or "clumped" together. Subgroups often arise informally, and *membership* in certain subgroups provides strategic advantages. For example, many networks exhibit a *core–periphery* structure where the core group is a small tightly connected group whose members interact frequently. Members of the periphery group have fewer connections, typically to a subset of the core. The core periphery has been associated with the dominant coalition (Balkundi & Harrison, 2006), and members of the core typically have greater influence and status than members of the periphery.

There are two basic social network research designs. A *whole network approach* examines all of the potential relationships between actors in a particular bounded set, such as an entire organization, or a specific group within an organization such as the advice network between members of the Executive Board and committee chairs of SIOP. A *personal network approach*, often referred to as an *ego network*, uses open-ended data collection techniques asking participants about their relationships to others and (possibly) perceived characteristics about these others. For example, we may ask I-O psychologists to list all of the people they go to for career-related advice; characteristics about these individuals, such as gender or years of experience; and whether or not the participant perceives that these individuals also seek out each other for career related advice. Importantly, either design can examine individual-level outcomes. A *whole network* approach may study the influence of an individual's *position* within an organizational network or his/her *membership* in a subgroup within that network on such outcomes, whereas a *personal network* approach may examine the influence of the *composition* of individuals' networks on such outcomes across a variety of cases.

What We Know: Networks and Gender Representation

The use of social network theory to examine gender representation has been part of a broader conversation around representation and advancement of women holding terminal degrees, focusing on the level of integration of women in professional social networks through representation and position. Some explore field-based variation, such as Cain and Leahy's (2014) finding that some disciplines, such as psychology, more fully integrate women within the field compared to others, such as engineering and physics, which have lower levels of representation. Similarly, in a nonacademic setting, Joshi's

(2014) work examined advice seeking within science and engineering teams and found gender and gender identification of the advice seeker, along with the gender composition of both the team and the embedding discipline, affected the recognition and utilization of expertise of female scientists and engineers (i.e., their centrality in the advice network).

One very important manifestation of this conversation focusing specifically on the representation of women in science, technology, engineering, and mathematics (STEM) fields is the work done through the National Science Foundation (NSF) and its ADVANCE Institutional Transformation program. Through this program, universities have explored the issue of gender representation with a particular focus on understanding the mechanisms that contribute to underrepresentation of women and minorities, and the so-called "leaky pipeline." Across ADVANCE institutions, there have been many distinct initiatives that aim to improve the professional and career development opportunities for women, and others have focused on the design and implementation of organizational change efforts to remove systemic and structural factors that hinder the advancement of women in STEM fields.

One review of various "pipeline initiatives" identified efforts to both "improve institutional structures and processes related to transition points" and "to equip women to successfully progress in the pipeline" by employing network mechanisms (Bilimoria, Joy, & Liang, 2008, p. 457), but other reviews detail initiatives that focus explicitly on access to networks and mentoring (e.g., Laursen, Austin, Soto, & Martinez, 2015; Morimoto, Zajicek, Hunt, & Lisnic, 2013). These initiatives target the exclusion or isolation of women from the informal networks instrumental to the flow of information and other tangible and intangible resources that enable advancement. Although mentoring is inherently a network concept, other ADVANCE initiatives target improved access to networks through grant programs with specific requirements for collaboration or focused networking events. One of the most explicit initiatives is the work by Nancy Steffen-Fluhr and her colleagues who have developed tools that allow faculty to visualize their position in the faculty research network and identify colleagues who can broker introductions to potential collaborators (Steffen-Fluhr, Gruzd, Collins, & Osatuyi, 2010). Such visualizations and tools can be very useful in identifying potentially insulating or isolating patterns that may arise insidiously, even in the face of apparent progress in gender representation. For example, Feeney and Bernal (2010) examined STEM advice networks and found that, even as representation of women increased in certain disciplines, they were still isolated, clustering together on the periphery rather than being integrated into the core. Through these and other initiatives, the ADVANCE program has improved our understanding of the challenges facing women in not only STEM fields,

but across a broad range of academic and practitioner contexts building on network theory and mechanisms (Borgatti & Halgin, 2011).

Network Mechanisms and Research Agenda

As a starting point for those who may be new to the social network perspective, we offer three distinct network mechanisms from prior work (Borgatti & Halgin, 2011) that can help us understand gender representation within the field of I-O psychology. *Capitalization* explains individual differences in performance-related outcomes as a function of an individual's position in the network. Positions differ in potential access to information, opportunities, and resources. *Contagion* explains the social homogeneity that occurs as a function of the composition of our networks, as connected individuals are influenced to adopt similar expectations and beliefs. *Cooperation* explains how particular configurations of actors result in differences in achievement at the group level. The following discussion offers a few different examples of this network application and briefly describes how a social network approach can complement and extend the suggestions offered by the focal article.

Application 1: Gender Equity in Pay

Gardner et al. (2018) identify differences in pay expectations as antecedent to gender differences in salary and recommend surveying new psychologists on pay expectations to measure gender differences. We agree and further suggest that SNA could serve to reveal the underlying mechanisms responsible for expectation formation. Social network studies have identified a *contagion* mechanism, where connected individuals are likely to influence the beliefs and behaviors of one another. Social network scholars have shown evidence for this contagion process in several different areas, including emotions (Cacioppo, Fowler & Christakis, 2009), innovation adoption (Valente, 1996), and attitudes (Rice & Aydin, 1991). This homogenizing process, a result of social comparison, occurs through direct communication, direct attention, third party gossip, and imitation (Shah, 1998). We propose studying possible gender differences in these social comparison networks by surveying I-O psychologists' pay referent others: "Who do you compare yourself to when trying to understand whether or not you are fairly paid by your organization? This could be an individual you directly communicate with or someone with whom you have a general idea about their level of pay." This study could use a whole network or personal network approach and could use network measures of *composition* to understand the contagion process underlying the formation of pay expectations. There may be inherent differences in *size* and gender *heterogeneity* (as measured by the relative percentage of men and women comprising the referent network), as there is some evidence that women primarily rely on same-sex comparisons (Kulik &

Ambrose, 1992). Are women primarily comparing themselves to other women, and could this reinforce and propagate the disparity in pay expectations? Are women less likely to seek out multiple other referents? If the referent networks of women are indeed smaller and more gender skewed, a network perspective may suggest practical implications that go beyond the advice of increasing pay expectations to strategically seeking out more and different referents.

Application 2: Status and Influence

Gardner et al.'s (2018) focal article also explores the underlying dynamics of status and influence by examining differences in award recognition and editorial appointments. These formal indicators certainly distinguish prominent individuals within the field but may not indicate relevant thought leaders who influence the work of others. We propose conducting a co-authorship network analysis within the field of I-O psychology (see Acedo, Barroso, Casanueva, & Galán, 2006 for an excellent example in the field of management) across a broad range of dissemination outlets including presentations (e.g., SIOP Annual Conference and Leading Edge Consortium), workshops, chapters (e.g., Professional Practice Series and Frontiers Series), and journals. Examining this whole network data will allow us to study potential gender differences in the patterns of influence within the field. Those with higher *degree centrality* are typically more prominent in the field and will be pursued more often by other potential collaborators through preferential attachment (Rivera, Soderstrom, & Uzzi, 2010). Those with higher *betweeness centrality* act as *brokers* connecting authors from different subdisciplines and theoretical perspectives who are not typically connected. Looking at gender comparisons in centrality and brokerage can give us an indication of the relative status of women in the field and allows us to explore changes in influential positions over time. Are women more or less likely to occupy central positions and act as brokers? The work of Herminia Ibarra (1997) indicates that high-potential women rely more on external relationships than their male counterparts, suggesting that women may be acting as brokers in the field, connecting different parts of the network. Is this the case in coauthorship networks, and if so could this be an alternative route for increasing the status and influence of women in the field?

Finally, can we identify a *core–periphery* structure within the coauthorship network and examine an author's membership in each of these subgroups. The *core* members being more central and densely connected would indicate authors of greater influence and status—a dominant coalition. Examining the changes of the inclusion rate for women in the *core* of the coauthorship network would indicate whether the influence of women within the field is increasing. The identification of the *core* within I-O psychology

should also be important in directing career advice for junior women I-O psychologists, as some work has suggested it is differentially more important for early-career women to form relationships with high status others (Burt, 1998). Certainly some initiatives should aim towards equity from network access. Until that is the case, choosing a mentor or thesis advisor who is part of the *core* may be particularly crucial for women in the field.

Application 3: Performance and Publications

We can also examine the impact of the coauthorship network on achievement-related outcomes. Some early studies on gender differences in social networks (e.g., Ibarra, 1997; McPherson, Smith-Lovin, & Cook, 2001) suggest that women have a tendency to build close circles of contacts, constructing small, densely connected networks that are strongly homophilous (i.e., with strong tendencies to connect to other women). However, more recent research suggests a "closure penalty," as women experience career disadvantages when working in highly cohesive teams. This study found that women benefit more from open and diverse networks (Lutter, 2015). We can examine this network mechanism of *cooperation* by extracting the ego network from the whole coauthorship network. First, we could examine gender differences in the *density* and *composition* of coauthorship *ego* networks. As density measures the extent to which an ego's alters are also connected to each other, if women in fact have *denser* coauthorship networks, their coauthors would also tend to work together. *Composition* measures attributes of ego's alters, such as gender, so if women have more homophilous networks, they will consist to a higher degree of other women coauthors. With these points, we might ask: How does co-authorship network density and homophily affect achievement-related outcomes such as citation rate, impact factor, and advancement? If in fact we do see the "closure penalty" affecting women's co-authorship networks, we should further direct women to act as brokers in the field who seek out unconnected and diverse coauthors. It is important to note that this line of inquiry could be equally applied to the examination of professional advice and expertise networks among I-O psychologists across the various practitioner, scientist, and academic distinctions. Performance, achievement, and advancement should be equally influenced by this "closure penalty," and women could benefit from seeking out more diverse and distant sources of advice and expertise.

Conclusion

Our professional networks are far more complex and likely exert powerful and nuanced effects on gender representation in I-O psychology than our academic lineage family trees might suggest. Examining the network mechanisms of capitalization, contagion, and cooperation can illuminate the

precursors to gender disparity in our field as well as offer potential solutions. As such, including social network analysis could play a key complimentary roll in heeding Gardner et al.'s (2018) call to "initiate conversation and suggest next steps appropriate to achieving equity in representation." First, social network analysis provides a set of metrics that broaden this conversation. Formal measures of inclusion such as board membership, awards and recognition, and equitable salaries are certainly indicative of greater gender inclusion, but they only tell us part of the story. Social network analysis allows us to uncover the social mechanisms responsible for underlying gender differences in status attainment and access to social capital. True inclusion would also consider whether or not women are equally represented and strategically positioned in informal advice and collaboration networks.

Second, a social network perspective can provide specific next steps to compliment approaches that focus on organizational rules and target setting to encourage inclusion. Organizations can do more to promote relationship building by creating conditions that encourage the formation of broad, diverse, and efficient networks. Utilizing mentorship programs to provide buy-in ties and measuring networks to provide feedback and training for personal network development could be an important way to promote inclusion. Finally, a social network perspective can potentially offer better tailored career advice for women to overcome barriers associated with a lack of inclusion: (a) Seek out more and diverse referent others to form salary expectations, (b) seek out high status mentors and collaboration partners early in one's career, and (c) strategically maintain a brokerage position and enact a brokerage role by connecting to diverse and unconnected others. Clearly there is more to be done as we work to make I-O psychology a more inclusive field. Encouraging more research on social networks and gender provides important additional perspectives and potential solutions as we work toward this goal.

References

Acedo, F. J., Barroso, C., Casanueva, C., & Galán, J. L. (2006). Co-authorship in management and organizational studies: An empirical and network analysis. *Journal of Management Studies*, *43*(5), 957–983.

Balkundi, P., & Harrison, D. A. (2006). Ties, leaders, and time in teams: Strong inference about network structure's effects on team viability and performance. *Academy of Management Journal*, *49*(1), 49–68.

Benjamin, L. T. Jr., Durkin, M., Link, M., Vestal, M., & Accord, J. (1992). Wundt's American doctoral students. *American Psychologist, 47*, 123–131.

Bilimoria, D., Joy, S., & Liang, X. (2008). Breaking barriers and creating inclusiveness: Lessons of organizational transformation to advance women faculty in academic science and engineering. *Human Resource Management, 47*(3), 423–441.

Borgatti, S. P., & Everett, M. G. (1992). Notions of position in social network analysis. *Sociological Methodology, 22*, 1–35.

Borgatti, S. P., & Halgin, D. S. (2011). On network theory. *Organization Science, 22*(5), 1168–1181.

Borgatti, S. P., Mehra, A., Brass, D. J., & Labianca, G. (2009). Network analysis in the social sciences. *Science*, *323*(5916), 892–895.

Burt, R. S. (1998). The gender of social capital. *Rationality and Society*, *10*(1), 5–46.

Burt, R. S. (2009). *Structural holes: The social structure of competition*. Boston, MA: Harvard University Press.

Cacioppo, J. T., Fowler, J. H., & Christakis, N. A. (2009). Alone in the crowd: The structure and spread of loneliness in a large social network. *Journal of Personality and Social Psychology*, *97*(6), 977–991.

Cain, C. L., & Leahey, E. (2014). Cultural correlates of gender integration in science. *Gender, Work & Organization, 21*(6), 516–530.

Culbertson, S. S. (2010). The Academics' Forum: Fun with family trees (tracing your academic lineage). *The Industrial-Organizational Psychologist*, *48*(1). http://www.siop.org/tip/july10/12culbertson.aspx

Feeney, M. K., & Bernal, M. (2010). Women in STEM networks: Who seeks advice and support from women scientists? *Scientometrics, 85*(3), 767–790.

Freeman, L. C. (1978). Centrality in social networks conceptual clarification. *Social Networks, 1*(3), 215–239.

Gardner, D. M., Ryan, A. M., & Snoeyink, M. (2018). How are we doing? An examination of gender representation in I-O psychology. *Industrial and Organizational Psychology: Perspectives on Science and Practice, 11*(3), 369–388.

Ibarra, H. (1997). Paving an alternative route: Gender differences in managerial networks. *Social Psychology Quarterly, 60*(1), 91–102.

Joshi, A. (2014). By whom and when is women's expertise recognized? The interactive effects of gender and education in science and engineering teams. *Administrative Science Quarterly, 59*(2), 202–239.

Kulik, C. T., & Ambrose, M. L. (1992). Personal and situational determinants of referent choice. *Academy of Management Review, 17*(2), 212–237.

Laursen, S. L., Austin, A. E., Soto, M., & Martinez, D. (2015). ADVANCing the agenda for gender equity. *Change: The Magazine of Higher Learning, 47*(4), 16–24.

Lutter, M. (2015). Do women suffer from network closure? The moderating effect of social capital on gender inequality in a project-based labor market, 1929 to 2010. *American Sociological Review*, *80*(2), 329–358.

McPherson, M., Smith-Lovin, L., & Cook, J. M. (2001). Birds of a feather: Homophily in social networks. *Annual Review of Sociology*, *27*(1), 415–444.

Morimoto, S. A., Zajicek, A. M., Hunt, V. H., & Lisnic, R. (2013). Beyond binders full of women: NSF ADVANCE and initiatives for institutional transformation. *Sociological Spectrum, 33*(5), 397–415.

Rice, R. E., & Aydin, C. (1991). Attitudes toward new organizational technology: Network proximity as a mechanism for social information processing. *Administrative Science Quarterly, 36*(2), 219–244.

Rivera, M. T., Soderstrom, S. B., & Uzzi, B. (2010). Dynamics of dyads in social networks: Assortative, relational, and proximity mechanisms. *Annual Review of Sociology, 36*, 91–115.

Shah, P. P. (1998). Who are employees' social referents? Using a network perspective to determine referent others. *Academy of Management Journal*, *41*(3), 249–268.

Steffen-Fluhr, N., Gruzd, A., Collins, R., & Osatuyi, B. (2010, April). N is for network: new tools for mapping organizational change. Presented at the National Association of Multicultural Engineering Program Advocates (NAMEPA)/Women in Engineering Program Advocates Network (WEPAN) 4th Joint Conference.

Valente, T. W. (1996). Social network thresholds in the diffusion of innovations. *Social Networks*, *18*(1), 69–89.