

1
3
5
7
9
11

IMAGINARY WORLDS: USING VISUAL NETWORK SCALES TO CAPTURE PERCEPTIONS OF SOCIAL NETWORKS

13 Ajay Mehra, Stephen P. Borgatti, Scott Soltis,
15 Theresa Floyd, Daniel S. Halgin, Brandon Ofem and
17 Virginie Lopez-Kidwell

AU:13

19

ABSTRACT

21
23 *Social networks are not just patterns of interaction and sentiment in the*
25 *real world; they are also cognitive (re)constructions of social relations,*
27 *some real, some imagined. Focusing on networks as mental entities, our*
29 *essay describes a new method that relies on stylized network images to*
31 *gather quantitative data on how people “see” specific aspects of their*
social worlds. We discuss the logic of our approach, present several
examples of “visual network scales,” discuss some preliminary findings,
and identify some of the problems and prospects in this nascent line of
work on the phenomenology of social networks.

AU:2

33
35
37
39

Contemporary Perspectives on Organizational Social Networks
Research in the Sociology of Organizations, Volume 40, 311–332
Copyright © 2014 by Emerald Group Publishing Limited
All rights of reproduction in any form reserved
ISSN: 0733-558X/doi:10.1108/S0733-558X(2014)0000040016

1 Social networks lead a double life. They are, on the one hand, recurring and
2 relatively stable patterns of interaction and sentiment connecting indi-
3 viduals to each other. The study of social networks in this realist guise is well
4 established and easily makes up the bulk of network research. On the other
5 hand, social networks are also phenomenal constructs. In this cognitive
6 guise, they are mental (re)constructions of social relations, some real, some
7 imagined. Now it is true that, as a matter of practice, researchers often learn
8 about interaction and sentiment patterns by asking respondents to tell them
9 about their relations with others. If people are poor at recalling the interper-
10 sonal ties around them (e.g., Bernard, Killworth, & Sailer, 1984), then this
11 may call into question the use of subjective report as a basis of collecting
12 data about networks in the real world. Or it could be that the biases of
13 perception and recall that creep into people's reports of the networks
14 around them are systematic and predictable, suggesting that subjective
15 reports of social networks, corrected for these biases, can still be useful for
16 researchers trying to learn about networks as concrete patterns in the world **AU:3**

17 (Freeman & Romney, 1986; cf. Krackhardt, 2014; McEvily, 2014). But
18 there is more that follows from recognizing the dual nature of social net-
19 works. First, we can develop and test theories about the antecedents and
20 consequences of the accuracy with which the structure of social networks
21 are cognitively represented in human minds. For example, one study of 36
22 members of a high-tech company showed that, controlling for formal and
23 informal bases of power the accuracy with which an individual perceived
24 the informal network was positively correlated with individual power in
25 the organization (Krackhardt, 1990). And a different multi-sample study
26 theorized and found that the accuracy with which individuals perceive
27 social ties in workplace networks is a function of the social distance between
28 the perceiver and the tie being perceived (Krackhardt & Kilduff, 1999).

29 An alternative approach is to focus directly on social networks as
30 mental creations, "apart from any relation they may have to behavior"
31 (Krackhardt, 1987, p. 110). Such an approach would seek to explore and
32 explain the structure of the social networks that exist in the mind, imagin-
33 ary worlds that people create and then endeavor to live in. This cognitive
34 approach might strike some as regressive, a retreat back into the mind
35 from the (inter-subjective) concreteness that some see as a distinguishing
36 characteristic of the network approach to the study of social structure (e.g.,
37 Mayhew, 1980; Wellman, 1988, p. 3). But there is rich precedent both
38 classic (e.g., Heider, 1958) and contemporary (see the review in Kilduff &
39 Krackhardt, 2008) to suggest the fruitfulness of such a stance. Which
brings us to the question: Why are social networks less studied in their **AU:4**

1 cognitive incarnation? There may be more than one answer to this ques-
3 tions, but one is surely that the collection of quantifiable data on indivi-
duals' perceptions of social networks can be, to put it mildly, "a formidable
5 task" (Krackhardt, 1987, p. 114). Indeed, the method that is considered the
gold standard for collecting cognitive social network data – i.e., the cogni-
7 tive social structures (CSS) approach pioneered by Krackhardt (1987) – is
extremely taxing on respondents because it requires each person to report
on her perceptions of every possible pair in the sample.

9 The purpose of this brief essay is to introduce a method that makes it
feasible to efficiently collect readily quantifiable data about individuals'
11 perceptions of their social worlds. Two insights prompted us to initiate the
development of this method. First, we know that pictorial representations
13 of relationships help researchers make sense of complex social network data
(Freeman, 2000). Indeed, the use of graphic imagery to represent relational
15 information was key to the birth of sociometry (Moreno, 1953) and is a core
feature of contemporary network analysis (Freeman, 2004). And yet we
17 rarely use network visuals to collect data from respondents (cf. Hogan,
Carrasco, & Wellman, 2007). Second, we were interested in developing an
19 approach that would allow us to ask respondents directly about the particu-
lar network characteristic that a researcher is interested in rather than
21 soliciting responses at the level of dyadic ties and then inferring the network
characteristic of interest. For example, Robert may, when prompted, report
23 that he is connected with A, B, and C and that there are no ties between A,
B, and C. A researcher could infer from this information that Robert
25 perceives himself to be a structural bridge connecting A, B, and C.
However, it could be the case that, despite perceiving the set of dyadic ties
27 connecting himself to A, B, and C, Robert may have never recognized that
he is a bridge between the others in the network. Similarly, a respondent
29 could provide tie-level information that indicates that he sees ties between
most people in his group and yet he may never come to the realization that
31 his is a densely connected group. Seeing the trees (i.e., ties) does not mean
that one sees the forest (i.e., larger network configurations, such as bridging
33 positions). Evidence from psychology suggests that attention is selective;
people do not record individual stimuli, they record underlying patterns
35 (Neisser, 1976). Rather than asking about trees and then inferring which
features of the forest the respondent sees, our approach would ask respon-
37 dents directly about the forest they see (or fail to see).

Although we have been developing, refining, and testing this pictorially
39 based method for collecting network perceptions for a couple of years, this
line of work is very much in its infancy. We describe below the basic logic

1 and share several examples of our nascent approach, initiate a discussion of
 3 its advantages and disadvantages as a method for learning about people's
 5 network perceptions, note some preliminary findings from empirical studies
 7 we have underway, take stock of opportunities and challenges, and invite
 9 readers to join us in the work that lies ahead.

9 PICTURING NETWORK PERCEPTIONS

11 The idea that perceived interpersonal relations can differ from real ones **AU:5**
 13 and that this difference can be seen not as error in need of mitigation but
 15 as a substantive phenomenon to be theorized and investigated can be
 17 traced to Heider (1958); cf. Sartre (1936). Recognizing the active, construc-
 19 tive role played by perception in helping us cognize the world around us,
 21 Heider's phenomenal theory focused on the "nature of the contact between
 23 the person and his environment as directly experienced by the person"
 25 (1958, p. 22). Heider was interested in understanding not just how the
 27 person sees the people in her social environment but also how the person is
 29 directed toward seeing how the people in her social environment, as percei-
 31 vers themselves, see others. Although there are parallels between how peo-
 ple perceive relations among objects and how people perceive relations
 among people, Heider recognized that the sentiments and attitudes that
 people hold toward others are psychological entities, "mentalist concepts"
 that cannot be "weighed by a scale, nor examined by a light meter" (1958,
 p. 32). Even if one focuses exclusively on the perception of interpersonal
 behaviors, social relationships have to be inferred from some observed
 sequence of acts. To perceive a relationship between two people requires
 that one "abstract from ... varying modes of behavior an invariant
 relational aspect" (Nadel, 1958, p. 10).

31 Krackhardt's (1987) cognitive social structure method builds directly on
 33 these phenomenological insights. While the standard sociometric approach
 35 has defined network structure in terms of a set of R matrices (one matrix
 37 for each relation) of the form R_{ij} , where R is the relation on which the
 structure is defined, i is the sender of the relation, and j is the receiver of
 the relation; CSS represents network structure in the form $R_{i,j,k}$ where i is
 the sender of the relation, j is the receiver, and k is the perceiver. Thus, if
 the relation R were friendship, then $R_{1,4,9}$ would mean that person 9 thinks
 39 that person 1 sees person 4 as a friend. This means that if there were N
 actors in a system, then the CSS representation of the system would require

1 $N \times N \times N$ matrices. This cognitively oriented approach has advantages
2 over the standard approach for representing network data but a disadvan-
3 tage is that the amount of information that respondents have to provide
4 is so extensive and time-consuming as to make it “virtually impossible”
5 to study networks made up of more than about 50 people (Krackhardt,
6 1987, p. 114).

7 The visual network scale (VNS) approach also seeks to uncover the
8 perceived social world that respondents see. It does so, however, not by
9 going through the laborious procedure of asking people to report on the
10 relations between every possible pair of people in a system but by present-
11 ing respondents with stylized depictions of social network structures and
12 asking them to judge, using a numeric scale, the extent to which their
13 perceptions of the structure of the social world match the stylized network.

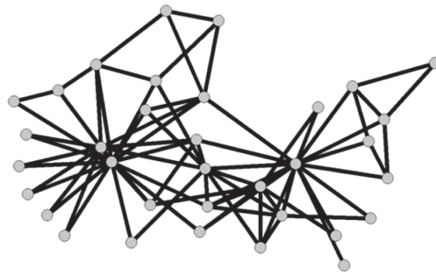
14 Our approach builds on previous work on the use of visual scales in
15 social science research, which recognize the ability of the human mind to
16 make sense of complex information when it is presented as a picture (see
17 Freeman, 2000). The translation of data into images can allow people to
18 readily grasp patterns and anomalies in complex relational data, perhaps
19 because visual data allows humans to use the right hemisphere of the brain
20 (which handles visual imagery) in addition to the left hemisphere (which
21 handles analysis). In the 1700s, William Playfair, a Scottish engineer,
22 created the bar chart, pie chart, and the line graph – visual innovations
23 that enabled people to detect patterns they would be unlikely to spot by
24 staring at long lists of numbers (The Economist, 2013, p. 77). Einstein
25 famously struck upon his theory of special relativity in the form of an
26 image (he imagined the world from the perspective of someone travelling
27 on a beam of light) not an equation (Podolny, 2003, p. 169). Perhaps the
28 most widely used image choice scale in the social sciences is the faces scale,
29 first developed by Kunin (1955) for work on the reliability and validity of
30 the scale; see, for example, Garra et al. (2010) to assess workplace attitudes.
31 The faces scale presents respondents with a series of images of faces drawn
32 to express emotion along a continuum from extremely positive to extremely
33 negative. The respondent chooses the image that best represents his or her
34 current feeling, sensation or attitude. Kunin originally developed the faces
35 scale to solve an issue of distortion he perceived when complex feelings
36 had to be translated into words. He claimed that the use of facial visuals
37 provided a more accurate measurement of attitudes that were otherwise too
38 complex for respondents to summarize and assess. This very idea – that
39 the human mind can readily use pictures to make sense of otherwise com-
plex relational data – is, of course, what led Moreno, arguably the father

AU:6

1 of sociometry, to develop the sociogram in the first place, which he saw not
 3 merely as a method of visual representation but also as a method of
 5 exploration (Moreno, 1953, pp. 95, 96). Building on Moreno's insight, we
 7 have developed a number of picture-based scales to learn about how
 9 respondents perceive/imagine their social worlds. In developing these visual
 11 network scales, we have tried to be mindful of the fact that although network
 13 visualization is a powerful tool for making sense of complex data, it
 15 can be easily misused – poorly laid out network diagrams convey little
 17 information and can lead to errors in the interpretation of networks
 19 (McGrath, Blythe, & Krackhardt, 1997).

13 VISUAL NETWORK SCALES

15 Before presenting respondents with our stylized visual network scales,
 17 we first introduce them (Fig. 1) to the general idea that social networks
 19 can be depicted in two-dimensions using nodes to represent people and lines
 21 to represent some relation (e.g., close friendship) that we happen to be
 23 interested in. In creating the stylized depictions of various structural configurations,
 25 we were mindful of three criteria – correspondence between point distance and path
 27 distance; avoidance of placement of nodes in such proximity that they obscure one another;
 29 and a preference for equal-length ties – that one could use to optimize the physical layout of the diagrams



35 *Fig. 1.* Explaining Network Images. In this section of the questionnaire, we ask
 37 about your perceptions of the overall pattern of close friendships in [the
 39 organization]. As you are probably aware, we can represent the structure of close
 friendships in [the organization] as a network in which a small circle is used to
 represent a person, and a line between two circles indicates that those two people
 are close friends. Here is a made-up example to illustrate what we mean:

1 (see Borgatti, Everett, & Johnson, 2013, pp. 104–106). In addition to
 2 producing readable and aesthetically pleasing renderings, our goal was to
 3 create diagrams that emphasized only one feature of the network at a time.
 4 So, for example, when creating a network diagram to capture respondents’
 5 perceptions of two-step network reach (see below), we chose instantiations
 6 of the graph, at each level of the scale, that excluded ties among friends of
 7 friends – otherwise, it would be less clear whether we were asking about the
 8 extent to which friends have many friends or the extent to which friends’
 9 friends tend to be themselves interconnected. Extensive pretesting with
 10 network experts and, separately, subjects who had no prior exposure to
 11 network theory or network visualization suggested the scales had high face-
 12 validity. The feedback from these individuals helped us refine our network
 13 images (and the text-based instructions that accompany them) and shore up
 14 their content validity.

15

17

Ego-Network Structure

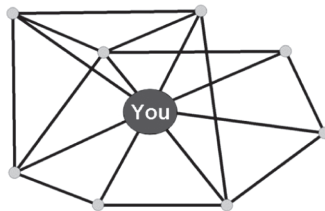
19 The first set of visual network scales we developed focused on an indivi-
 20 dual’s perceptions of her “ego network,” which consists of the individual’s
 21 direct relations and the relations among those to whom she is directly
 22 related. We begin by sensitizing (Fig. 2) the respondent to the idea of their
 23 “personal network” (respondents, unsurprisingly, did not like the technical
 24 label “ego network”). We next asked respondents to indicate, using a

25

27

29

31



33

35

37

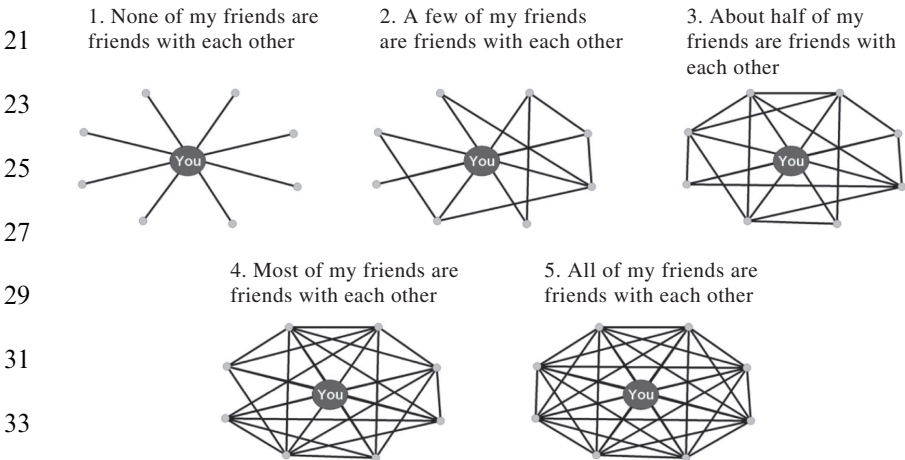
39

Fig. 2. Explaining Personal Network Images. In this section, we are going to show you some stylized pictures of your personal network of close friendships in [the organization]. By personal network we mean the set of relations among you, your close friends, and the relations among your close friends. In each diagram, the larger circle in the center is you; the other circles represent your close friends, and the lines between the circles represent close friendships. Please take a look at the pictures and their verbal descriptions, and then tell us which network YOU think looks most like your personal network of close friends in [the organization].

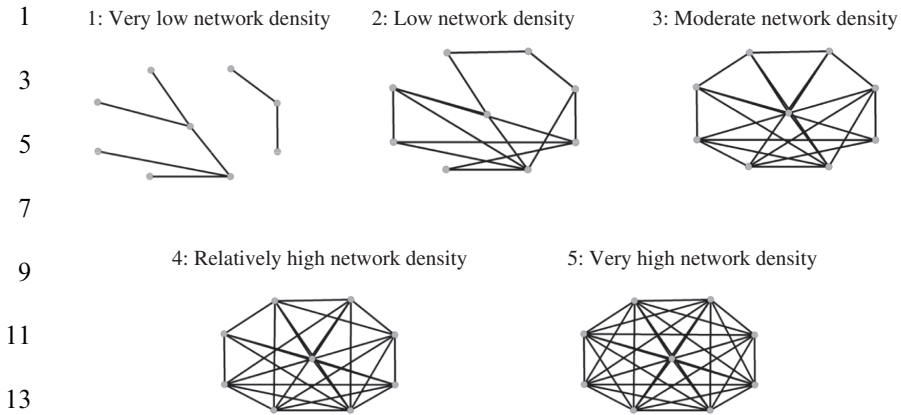
1 Likert scale, the density of their ego network (Fig. 3), the extent to which
 3 they perceived themselves as occupying a bridging position in their ego
 5 network (Fig. 4), and the extent to which their friends themselves had
 7 many friends (Fig. 5).

7 *Whole-Network Structure*

9 To learn how a respondent perceived the structure of her overall or
 11 “whole” social network, we modified the wording of the question about
 13 ego network structure so that the question now asked individuals about
 15 their perceptions of the structure of relations within the organization as a
 17 whole. This allowed us to use the stylized network images to learn how the
 19 respondent perceived the density of the whole network (Fig. 6), and
 whether the respondent perceived the structure of the overall network of
 the organization as best resembling one structured in terms of (a) a core-
 periphery structure; (b) a clique structure; (c) a sparse network; or (d) a
 densely connected network (Fig. 7).



35 *Fig. 3. Visual Scale to Capture Perception of Ego Network Density.* This question
 37 focuses on your perceptions of the degree of interconnectedness among your close
 39 friends in [the organization]. In your opinion, which of the network diagrams below
 best approximates the degree of interconnectedness in your personal network of
 close friendships in [the organization]? Please make your selection by clicking one of
 the pictures below. Please select one choice.



15 *Fig. 6. Visual Scale to Capture Perception of Whole Network Density.* This
 17 question focuses on your perceptions of the degree of interconnectedness of close
 19 friendships within [the organization]. The more interconnected the network, the
 21 more dense the pattern of relations within the network is. In your opinion, which of
 the network diagrams below best approximates the density of the network of close
 friendships in [the organization] as a whole. Please make your selection by clicking
 one of the pictures below. Please select one choice.

23 that visual network scales can play a role in advancing our understanding
 25 of the perception of network change by providing a picture-based tool for
 27 directing respondents' attention to the specific network characteristic
 29 changes in which are the objects of interest. Fig. 8 depicts a visual scale
 31 designed to capture respondents' perceptions of changes in the density of
 their ego network, and Fig. 9 depicts a visual scale designed to capture
 respondents' perceptions of changes in the degree to which they occupy
 bridging positions in their ego networks. Fig. 10 shows a visual scale that
 attempts to capture respondents' perceptions of changes in their relative
 centrality in the overall network over time.

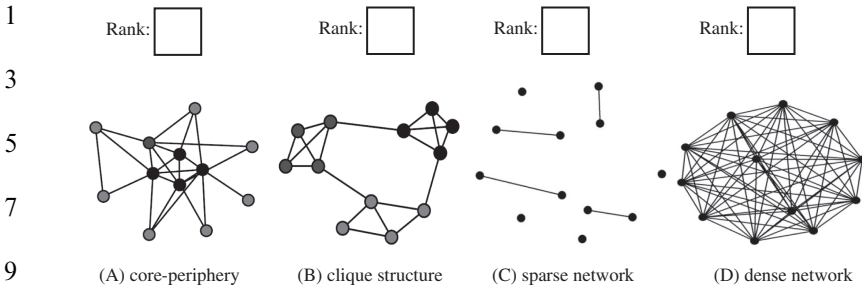
33

35

Retrospective and Prospective Trajectories

37

39 Human beings are imaginative creatures oriented toward the past and the
 future even as they negotiate the present (Emirbayer & Mische, 1998).
 People like to tell stories about how their various relationships have waxed

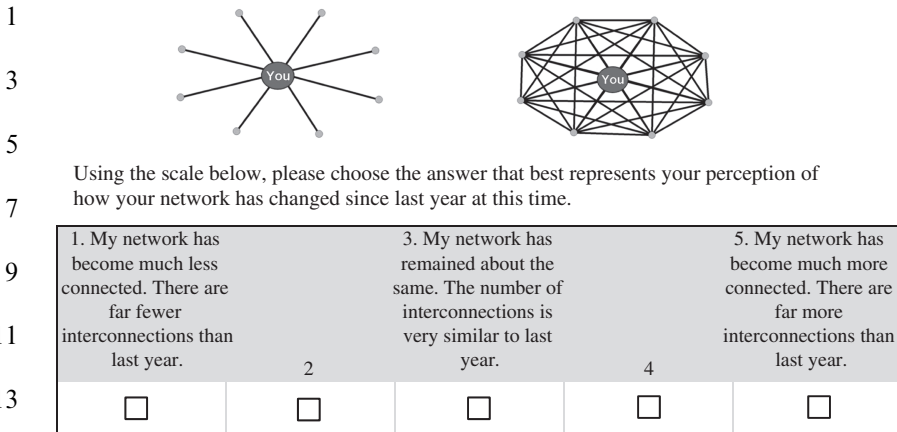


11 *Fig. 7. Visual Scale to Capture Perceived Structure of Whole Network.* In this
 12 part of the questionnaire, you will be asked to indicate how you see the overall
 13 network structure among all student participants of the SNA course. There are four
 14 diagrams below.

- 15 (A) **Core-periphery**: in this network, there is a core of well-connected people, and
 16 most people are on the poorly connected margins of the network.
- 17 (B) **Clique structure**: this is a network composed of distinct cliques; members of a
 18 clique have lots of ties to each other and very few ties to people outside their
 19 own clique.
- 20 (C) **Sparse network**: this is a sparsely connected network; members have ties to
 21 only a few of the many people in the network.
- 22 (D) **Dense network**: this is a densely connected network; people have many ties to
 23 each other.

24 *Notes:* Please rank the four diagrams representing the overall structure of the
 25 **friendship network** by using numbers 1, 2, 3, and 4 (meaning: 1=most likely to
 26 4=most unlikely).

27 and waned over time and they construct imaginative narratives about
 28 the course their relationships might follow in the future. How we act in a
 29 current relationship may be conditioned both by how we see its past and
 30 how we envision its future. Alfred Schutz, a sociologist who was keenly
 31 attuned to this sadly neglected aspect of human agency, sought to under-
 32 stand action from the perspective of the actor temporally embedded in the
 33 stream of experience. Life – and perhaps social life in particular – is only
 34 rendered sensible, he argued, in retrospect (1967, p. 47; cf. Schutz, 1978).
 35 There is promising new work in social psychology on how people think
 36 about their relationships over time (e.g., Karney & Frye, 2002), but network
 37 research has tended to engage in what Granovetter (1992) has called “tempo-
 38 ral reductionism ... treating relations and structures of relations as if
 39 they had no history that shapes the present situation. In ongoing social rela-
 40 tions, human beings do not start fresh each day, but carry the baggage of



15 *Fig. 8. Visual Scale to Capture Perceived Changes in Density. In this section, we ask you for your perceptions of the changes in your network of close friends in [the organization]. This question focuses on your perceptions of CHANGES in the degree of interconnectedness among your close friends in [the organization].*

17 The network diagram on the left represents a personal network with NO interconnectedness. The network diagram on the right represents a personal network that is completely interconnected.

19

21

23

25 previous interactions into each new one” (p. 34). And just as human action is oriented toward the past, so it is oriented toward the future: “immersed in a temporal flow, they [humans] move ‘beyond themselves’ into the future and construct changing images of where they think they are going” (Emirbayer & Mische, 1998, p. 984). To make sense of the social maneuverings of people building and breaking ties in the present it may therefore be valuable to account for how people imagine their social worlds unfolding in the future.

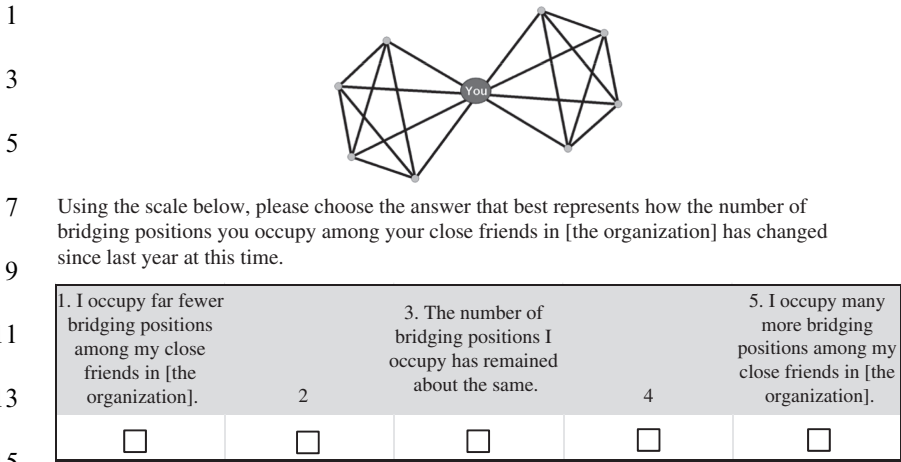
31 One way to efficiently capture how people retrospect and prospect about their interpersonal ties is to present them with stylized image-based trajectories that relationships commonly take (cf. Flora & Segrin, 2000) and then ask them how they perceive relationships with specific others in retrospect (Fig. 11) and prospect (Fig. 12). The arc of a human relationship can, of course, be charted along many dimensions. We focused here on the fundamental dimension of tie-valence (like/positive versus dislike/negative). Unlike the other visual network scales we have discussed, this one is focused at the level of specific dyadic ties rather than at the level of the ego

33

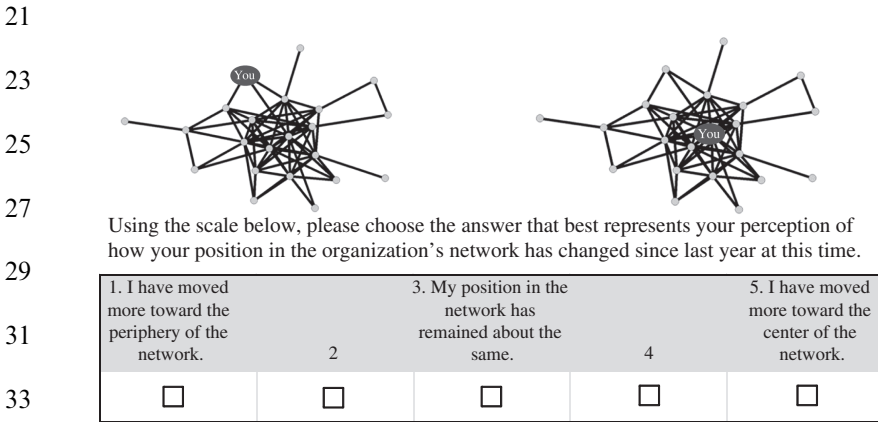
35

37

39



17 *Fig. 9. Visual Scale to Capture Perception Changes in Bridging in the Personal Network.* This question focuses on your perceptions of the CHANGE in the number of *bridging positions you occupy among your close friends in [the organization]*. In the diagram below, there are two groups/cliques of people. The large circle that connects the two groups/cliques can be thought of as a *bridge*.



35 *Fig. 10. Visual Scale to Capture Perception of Change in Network Position.* This question focuses on your perceptions of CHANGES in your *position in the network of close friends in [the organization]*. The network diagram on the left represents a person on the periphery of the network. This person has close friends who themselves are not connected to many others. The network diagram on the right represents a person in the center of the network. This person has close friends who themselves are connected to many others.

37

39

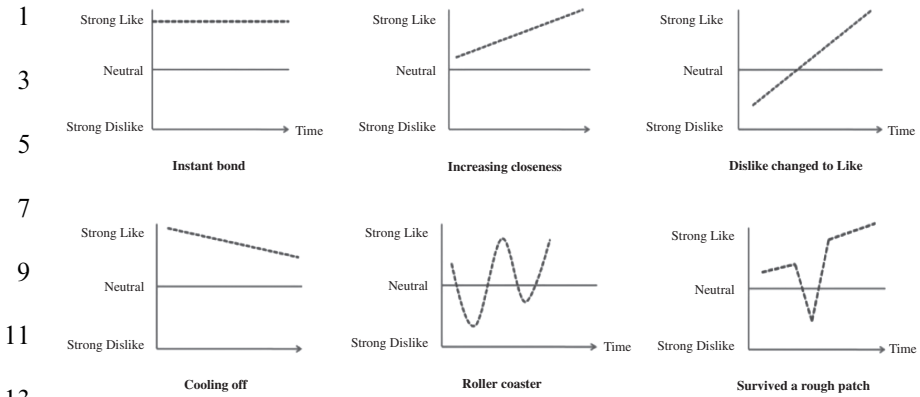


Fig. 11. Visual Scale to Capture Retrospective Perceptions of Friendship Tie Trajectories. Consider your relationships with your close friends. The way that each relationship progressed over time may be different from the others. You may have shared an instant bond with some friends, while for others, the friendship developed slowly over time. The images below represent different ways that relationships may progress over time. The horizontal axis represents the passage of time. The vertical axis represents the status of the relationship and ranges from Strong Like at the top to Strong Dislike on the bottom. Please enter FIVE of your *close* friends and select the image that best depicts the way that your friendship with each person has progressed over time.

network or the whole network. Extending our approach to these alternate levels of analysis should be relatively straightforward.

Network Preferences

When we observe that an individual has a sparse network, we cannot infer that the individual prefers sparse networks. The kind of agency at work in the construction and development of social networks is rarely unbounded. A person could have a preference for living in a densely connected world and yet end up with a sparsely connected network for myriad reasons not least of which is that the others who make up the network have their own preferences for structuring social worlds. One approach to understanding the social structures people prefer to inhabit is to present them with stylized networks and ask them for their preferences (Fig. 13–15). A related approach is to present respondents with stylized network diagrams and ask

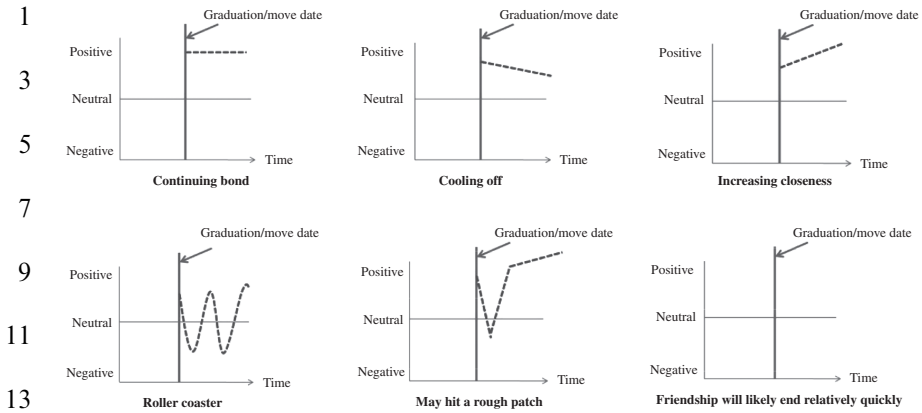


Fig. 12. Visual Scale to Capture Prospective Perceptions of Friendship Tie Trajectories. As you approach your graduation from [the university], there is a possibility that you will move away from your close friends. Imagine that after graduation, you move more than 100 miles away from each of the close friends listed below. Then, for each friend you named, please select the image that best depicts the way you expect the friendship will progress or change AFTER the move.

21
23
25
27
29
31
33
35

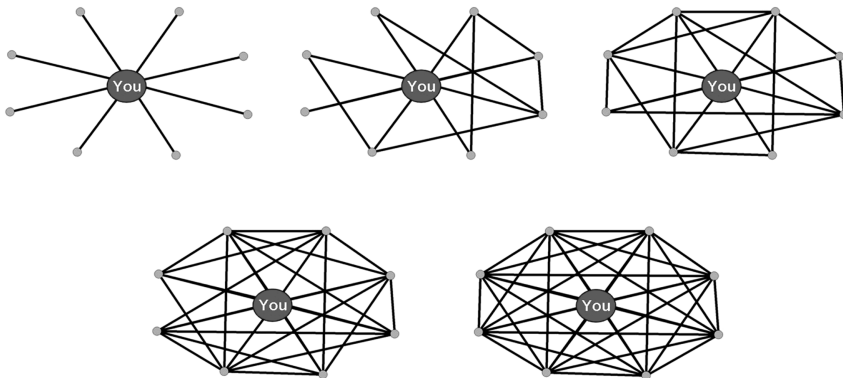
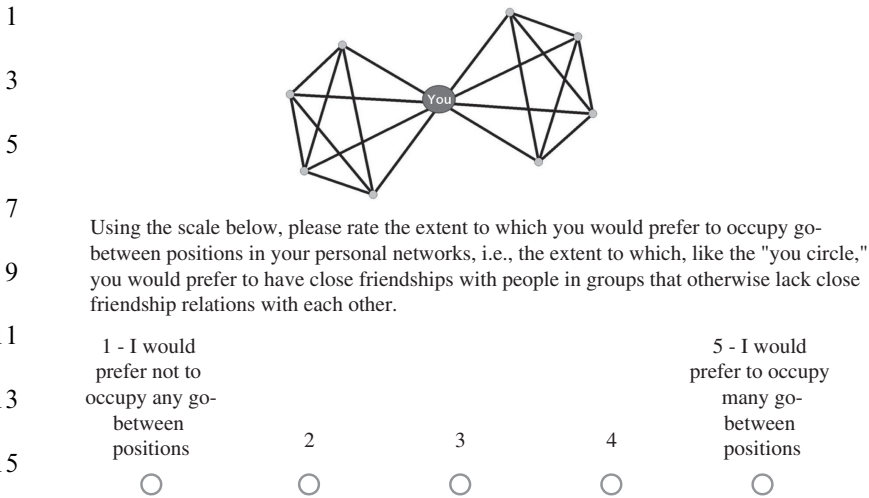


Fig. 13. Visual Scale to Capture Preference for Dense Networks. This question focuses on the degree of interconnectedness between a person and his or her close friends. If this were your network, which diagram represents the degree of interconnectedness that you would prefer?



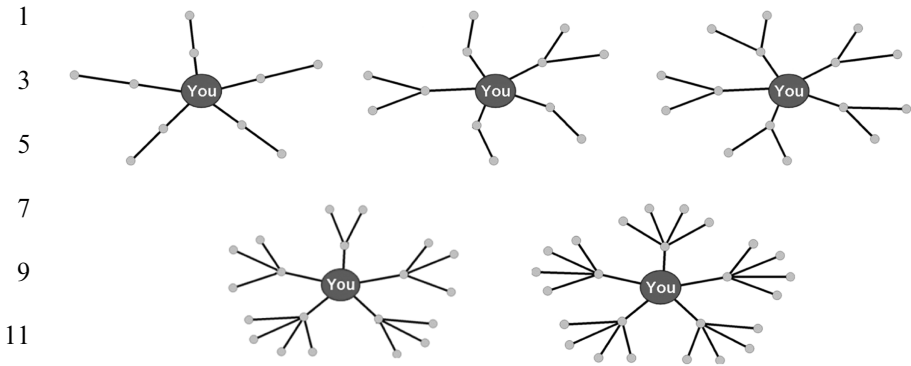
17 *Fig. 14.* Visual Scale to Capture Preference for Bridging Positions.

19 them how they have attempted to transform (or not) such situations in the
21 past (Fig. 16).

23 PRELIMINARY INVESTIGATIONS

25 Empirical research using visual network scales is in an early stage but
27 results are starting to trickle in from five separate studies – one of a college
29 sorority, another of a co-ed college fraternity, two lab studies, and a study
31 of a small manufacturing company. Preliminary results from the sorority
33 and the fraternity were reported in (Mehra, Borgatti, Soltis, Kidwell, &
35 Floyd, 2010). The data from the two lab studies have neither been pre-
sented nor published. Initial results from the small manufacturing plant
can be found in Soltis and Floyd (2013). Because the results of these studies
are unpublished and have not yet undergone peer review, they should be
treated with caution.

37 Perceptions of social networks do not have to match reality. However,
39 at this early stage it may be interesting to ask how network perceptions
measured using visual network scales correspond with traditional measures
of network reality. Evidence from the college sorority indicated that our
measures of perceived network density, bridging, and two-step reach were



13 *Fig. 15.* Visual Scale to Capture Preference for Network Reach. This question
15 focuses on the extent to which a person’s close friends have many other close
17 friends, or how well-connected the principal person’s close friends are. If this were
19 your network, which diagram represents how connected you would prefer your
21 close friends to be?

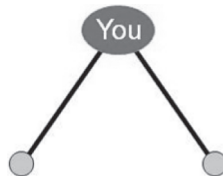
19

21

23

25

27



29

31

33

When you found yourself in this position, what has been your typical reaction?

- I did not attempt to change things
- I tried to arrange for the two people to meet
- I dropped one of the two people as a friend

35

37

39

Fig. 16. Visual Scale to Capture Approach to Transforming Networks. People
might occupy go-between positions for many different reasons. Sometimes, a
person acts as a go-between for two other people simply because the two others do
not know each other. Sometimes, a person acts as a go-between for two other
people because the two others actively dislike each other. The below image
represents a person acting as a go-between for two others who do not know each
other. Please think of times when you found yourself in this position.

1 each significantly and positively (but modestly) correlated with measures of
2 density, bridging, and two-step reach based on sociometric data that were
3 used to code ties as real if both parties agreed that the tie existed (correla-
4 tions ranged between .24 and .30, p values for all correlations were less
5 than .01). These correlations were in the same direction in the data from
6 the college fraternity, but only some of the correlations were significant
7 (i.e., perceived density and density were correlated at .22, $p < .01$). Using
8 data from the only sample that included both visual network scale data
9 and CSS data, we found that our measure of perceived bridging was posi-
10 tively and significantly correlated ($r = .40$, $p < .05$) with a measure of brid-
11 ging (betweenness centrality – Freeman, 1979), but our picture-based
12 measures of perceived density and two-step reach were not significantly
13 correlated with measures of density and two-step reach using the CSS data.
14 It is important to keep in mind that CSS and the visual scales may not cap-
15 ture the same cognitions. As we have noted, whereas CSS asks questions at
16 the level of dyads (trees) and infers the structural characteristics of interest
17 (the forest), the visual network scale approach asks directly about the struc-
18 tural characteristic of interest.

19 Do our measures of network perception predict outcomes that we would
20 expect them to predict on the basis of theory? Because our measures tap
21 network perceptions, we expected they would be especially likely to predict
22 subjective, personal outcomes. This is what we have found in the data from
23 the college sorority and fraternity. In both samples, the visual scale-based
24 measures of ego network characteristics were significant predictors of satis-
25 faction with the organization and a measure of how valuable respondents
26 believed their social networks were for career success and professional
27 development (Mehra et al., 2010). These results controlled for “real” ego
28 network characteristics based on traditional sociometric data, which treat-
29 ed a tie as real if both parties agreed that the tie existed. The satisfaction
30 people felt appeared to be less a function of things (real social networks)
31 than their thoughts of things (network perceptions).

It makes sense that how people perceived the networks around them
33 influenced how satisfied they felt. But did network perceptions, measured
34 using visual network scales, predict how others evaluated a person? The
35 answer is “yes.” We found that characteristics of ego networks captured
36 using visual network scales significantly predicted the number of leadership
37 nominations individuals received from others in both the sorority and
38 the fraternity (Mehra et al., 2010). Similarly, the visual network measure of
39 perceived bridging, controlling for the non-significant effects of a measure
of bridging based on CSS data, was a significant predictor of the

1 extent to which others evaluated the person's job performance positively
(Soltis & Floyd, 2013). Analysis of the data from the two lab studies is
3 ongoing. However, preliminary analysis showed some support for the con-
struct and predictive validity of our scales. In particular, we found that self-
5 monitoring, a measure of personality that reflects an individual's motivation
and ability to engage in impression management, was positively related ($p =$
7 $.22, p < .01$) to our visual scale measuring respondents' preference for occu-
pying bridging positions in their personal networks, a result that fits prior
9 evidence from the field (e.g., Sasovova, Mehra, Borgatti, & Schippers,
2010). Preliminary evidence also suggests that extroverts tend to be less
11 likely than introverts to see their relationships as "cooling off" over time
($r = -.26, p < .01$). Taken together, the results across these studies indicate
13 initial support for the idea that visual network scales tap peoples' percep-
tions of their social networks and they show reasonable predictive validity.
15 They also suggest that our measures and measures based on the CSS
approach while modestly related appear to be, as expected, capturing differ-
17 ent aspects of how people perceive their social networks.

19

21

SUMMARY AND CONCLUSION

23 Social networks exist both as interactional patterns in the real world and as
cognitive maps in our heads. Yet the vast majority of network research has
25 focused on networks in their realist guise rather than on networks in their
cognitive guise. One reason for this state of affairs may be that tools for
27 systematically studying how people see their social networks are limited
and cumbersome. The current gold standard for assessing network percep-
29 tions (Krackhardt's cognitive social structures method), for example, poses
such heavy burdens on respondents that it is infeasible to collect data about
31 perceptions of even modestly sized networks (Krackhardt, 1987).
Moreover, the CSS approach asks individuals to report their perceptions at
33 the level of individual ties and then infers from the data what people see in
terms of the underlying structural configurations one can detect in the
35 data. Although this procedure has strengths, one potential disadvantage is
that it is unclear whether people really perceive the structural configura-
37 tions of interest. We have introduced in this chapter an alternative
approach to gathering network perceptions, one that leverages the ability
39 of humans to understand complex relational data using pictures. Visual
network scales offer a way to study not just how people see their present

1 social networks but how they perceive their networks over time, in retro-
spect and in prospect. To the extent that people are the authors of their
3 own histories, people can reinterpret past social relationships and thereby
influence their current emotions and attitudes. Similarly, how people envi-
5 sion their social networks unfolding in the future can influence how they
react to their current circumstances. It may be that one reason that many
7 individuals seem not to capitalize on the full potential of their social net-
works is that they are too focused on the trees to see the forest. Visual net-
9 work scales could be adapted for use as a consciousness-raising and
training tool to help individuals to spot, leverage, and create social capital.
11 We also note that in designing the visual network scales discussed in this
essay we have largely restricted our focus to aspects of network structure.
13 But our general approach can be used to design visual network scales that
cover other important aspects of social networks, such as nodal attributes,
15 tie strength, and tie directionality.

We have summarized in this brief essay preliminary results from a hand-
17 ful of ongoing studies that together suggest that visual network scales may
offer a promising approach to understanding the phenomenology of net-
19 work perception. But there is clearly much work that remains to be done
before this promise can be more fully realized. Perhaps the most obvious
21 challenge involves getting a better handle on how the peculiarities of the
method/instrument used for capturing network perceptions shapes what
23 respondents tell us about the social networks in their minds. There is prob-
ably no perfectly neutral method for learning about social networks as men-
25 tal constructs. Visual network scales allow researchers to ask respondents
directly about specific network configurations (e.g., bridging, reach).
27 However, it may be that people do not think about their networks in terms
of such configurations – or at least they do not do so until researchers ask
29 them to. Perhaps people find it more natural to think about their social net-
works at the level of specific trees (dyads) rather than at the level of the for-
31 est (broader network configuration). We need to better understand the
reactivity of visual network scales and how these relate to the reactivity of
33 alternative approaches to the collection of network perceptions. The
approach a researcher should use to gather data on network perceptions in
35 any given study surely depends upon the hypothesis at hand. Nonetheless,
we suspect it will be a useful strategy to find ways of combining multiple
37 methods (across studies even if not in the same study) rather than relying
exclusively on any one single approach to understanding network cognition.
39 Human beings are map-makers (Turchi, 2004). We make maps not just
of the physical world but also of our social worlds. The maps we construct

1 may at times be horribly skewed and the worlds we envision largely imagin-
ary. Nonetheless, we live in the worlds our maps create. To take this point
3 seriously is not to dissolve the social world but to make it more directly
accessible to us.

7 9 ACKNOWLEDGMENTS

11 We thank Filip Agneessens, Dan Brass, Travis Grosser, Martin Kilduff,
David Krackhardt, Joe Labianca, Zuzana Sasovova, Patrizia Vecchi,
13 Michael Wise, and Meredith Woehler for their comments and criticisms.

15 17 REFERENCES


- 19 Bernard, H. R., Killworth, P., & Sailer, L. (1984). The problem of informant accuracy:
The validity of retrospective data. *Annual Review of Anthropology*, 13, 495–517.
- 21 Borgatti, S. P., Everett, M. G., & Johnson, J. C. (2013). *Analyzing social networks*. London:
Sage.
- 23 Emirbayer, M., & Mische, A. (1998). What is agency? *American Journal of Sociology*, 103,
962–1023.
- 25 Flora, J., & Segrin, C. (2000). Relationship development in dating couples: Implications for
relational satisfaction and loneliness. *Journal of Social and Personal Relationships*, 17,
811–825.
- 27 Freeman, L. C. (2000). Visualizing social networks. *Journal of Social Structure*, 1. **AU:9**
- Freeman, L. C., & Romney, K. A. (1987). Words, deeds, and social structures: A preliminary
study of the reliability of informants. *Human Organization*, 46, 330–334.
- 29 Freeman, L.C. (2004). *The development of social network analysis*. Vancouver: Empirical Press.
- Garra, G., Singer, A. J., Taira, B. R., Chohan, J., Cardoz, H., Chisena, E., & Thode, H. C.
(2010). Validation of the Wong-Baker FACES pain rating scale in pediatric emergency
31 department patients. *Academic Emergency Medicine*, 17, 50–54.
- 33 Granovetter, M. (1992). Problems of explanation in economic sociology. In N. Nohria &
R. J. Eccles (Eds.), *Networks and organizations: structure, form, and action* (pp. 25–57).
Boston, MA: Harvard Business School Press.
- 35 Heider, F. (1958). *The psychology of interpersonal relations*. Hillsdale, NJ: Lawrence Erlbaum.
- Hogan, B., Carrasco, J. A., & Wellman, B. (2007). Visualizing personal networks: Working
with participant-aided sociograms. *Field Methods*, 19, 116–144.
- 37 Karney, B. R., & Frye, N. E. (2002). But we've been getting better lately: Comparing prospec-
tive and retrospective views of relationship development. *Journal of Personality and Social
Psychology*, 82, 222–238.
- 39 Kilduff, M., & Krackhardt, D. (2008). *Interpersonal networks in organizations: Cognition,
personality, dynamics, and culture*. New York, NY: Cambridge University Press.

- 1 Kilduff, M., Tsai, W., & Hanke, R. (2006). A paradigm too far? A dynamic stability reconsideration of the social network research program. *Academy of Management Review*, *31*, 1031–1048.
- 3 Krackhardt, D. (1987). Cognitive social structures. *Social Networks*, *9*, 109–134.
- 5 Krackhardt, D. (1990). Assessing the political landscape: Structure, cognition, and power in organizations. *Administrative Science Quarterly*, *35*, 342–369.
- 7 Krackhardt, D., & Kilduff, M. (1999). Whether close or far: Social distance effects on perceived balance in friendship networks. *Journal of Personality and Social Psychology*, *76*, 770–782.
- 9 Kunin, T. (1955). The construction of a new type of attitude measure. *Personnel Psychology*, *8*, 65–77.
- 11 Mayhew, B. (1980). Structuralism versus individualism: I – shadowboxing in the dark. *Social Forces*, *59*, 335–75.
- 13 McGrath, C., Blythe, J., & Krackhardt, D. (1997). The effect of spatial arrangement on judgments and errors in interpreting graphs. *Social Networks*, *19*, 223–242.
- 15 Mehra, A., Borgatti, S. P., Soltis, S., Kidwell, G., & Floyd, T. (2010). Seeing networks in organizations: A novel approach to assessing the accuracy of network perceptions. Paper presented at the fourth ION conference, Lexington, KY.
- 17 Moreno, J. L. (1953) *Who shall survive?* Beacon: New York, NY.
- 19 Nadel, S. F. (1958). *The theory of social structure*. The Free Press of Glencoe.
- Neisser, U. (1976). *Cognition and reality: Principles and implications of cognitive psychology*. New York, NY: Freeman.
- 21 Podolny, J. M. (2003). A picture is worth a thousand symbols: A sociologist's view of the economic pursuit of truth. *The American Economic Review*, *93*(2), 169–174. **AU:10**
- 23 Sartre, J. P. (1936). *L'imagination*. Presses Universitaires de France.
- 25 Sasovova, Z., Mehra, A., Borgatti, S. P., & Schippers, M. (2010). Network churn: The effects of self-monitoring personality on brokerage dynamics. *Administrative Science Quarterly*, *55*, 639–670.
- 27 Schutz, A. (1967). *The phenomenology of the social world* (G. Walsh & F. Lehnert, Trans.). Evanston, IL: Northwestern University Press
- 29 Schutz, A. (1978). In R. Grathoff (Ed.), *The theory of social action: The correspondence of Alfred Schutz and Talcott Parsons*. Bloomington, IN: Indiana University Press. **AU:11**
- 31 Soltis, S. & Floyd, T. (2013). Network perceptions, contextual performance, and person-organization fit. Paper to be presented at the 2013 meeting of the Academy of Management. **AU:12**
- 33 The Economist. (2013). Infographics: Winds of change. *The Economist*, July 6.
- 35 Turchi, P. (2004). *Maps of the imagination*. San Antonio, TX: Trinity University Press.
- Wellman, B. (1988). Structural analysis: From metaphor to substance. In B. Wellman & S. D. Berkowitz (Eds.), *Social structures: A network approach* (pp. 19–61). New York, NY: Cambridge University Press.

UNCITED REFERENCES

- 39 Freeman and Romney (1987); Kilduff, Tsai, and Hanke (2006); **AU:8**

AUTHOR QUERY FORM

	Book: RSO-V040-3610843 Chapter: 16	Please e-mail or fax your responses and any corrections to: E-mail: Fax:
---	---	---

Dear Author,

During the preparation of your manuscript for typesetting, some questions may have arisen. These are listed below. Please check your typeset proof carefully and mark any corrections in the margin of the proof or compile them as a separate list.

Disk use

Sometimes we are unable to process the electronic file of your article and/or artwork. If this is the case, we have proceeded by:

- Scanning (parts of) your article Rekeying (parts of) your article
 Scanning the artwork

Bibliography

If discrepancies were noted between the literature list and the text references, the following may apply:

- The references listed below were noted in the text but appear to be missing from your literature list. Please complete the list or remove the references from the text.**

- UNCITED REFERENCES:* This section comprises references that occur in the reference list but not in the body of the text. Please position each reference in the text or delete it. Any reference not dealt with will be retained in this section.**

Queries and/or remarks

Location in Article	Query / remark	Response
AU:1	Please consider shortening chapter running head so that it fits to 65 character limit.	
AU:2	Please provide upto six keywords for this chapter.	
AU:3	References (Freeman & Romney, 1986; cf. Krackhardt, 2014, McEvily, 2014; Freeman, 1979;)	

	have not been provided in the list. Please provide the reference details.	
AU:4	Should "Which brings us" be in continuity with the previous sentence? If so, "w" should be lower cased and end punctuation of the previous sentence should be deleted. Please advise.	
AU:5	Please confirm the heading levels set for all the headings.	
AU:6	Should consequent spell out forms "visual network scale" and "visual network scales" be replaced with "VNS" and "VNSs", respectively? Please advise.	
AU:7	Please check the first two sentences of the paragraph "How social networks change and why ..." for clarity.	
AU:8	References "Freeman and Romney (1987); Kilduff et al. (2006)" have not been cited in the text. Please clarify as to where they should be cited.	
AU:9	Please provide page range in reference "Freeman (2000)".	
AU:10	Please provide publisher location in reference "Sartre (1936)".	
AU:11	Please provide chapter title in reference "Schutz (1978)".	
AU:12	Please update reference "Soltis & Floyd (2013)".	
AU:13	As per LOC and rest of the chapters we have changed as Stephen P. Borgatti instead of Steve Borgatti.	