

Special Issue Classroom Activities for Teaching Networks

Six degrees of separation: An interactive teaching activity for social networks

Research Article

Kyosuke Tanaka^{1*}, Neelam Modi Jain², Harshad Gado³, Noshir S. Contractor⁴

¹ Department of Management, Aarhus University, Universitetsbyen 61, Aarhus C, 8000, Denmark

² Management Division, Columbia Business School, New York, NY, USA

³ UnitedHealthcare, Chicago, IL, USA

⁴ Departments of Industrial Engineering, Communication, & Management & Organizations, Northwestern University, Chicago, IL, USA

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Abstract: The six degrees of separation (6-DoS) activity is an interactive web-based exercise that enables participants to experience a key concept in social network analysis: cognitive social structures (CSS). Our perception of who knows whom in a network is a powerful enabler of leveraging and contributing to it. In this 3–5-min network-routing activity (30–60 min from setup to debrief), each participant selects a set of contacts and delivers a message to a designated target to whom they are indirectly connected. The message is relayed through intermediaries, mirroring Milgram's (1967) small-world experiment, which surprisingly showed that short chains of acquaintances connect most individuals. This process illustrates foundational network concepts beyond CSS, including indirect ties, network paths, and how structural positions shape information flow. By engaging in 6-DoS, participants gain an experiential understanding of how their choice of contacts and their network awareness – or lack of it – shapes efficient information seeking and dissemination. The debriefing extends these insights to broader concepts, including the small-world phenomenon, brokerage, redundancy, and communication strategies. 6-DoS is adaptable for diverse educational contexts, from undergraduate and graduate courses in social networks, management, and communication to professional development and corporate onboarding. Because it is easy to set up, requires no specialized equipment, and can be completed quickly, 6-DoS is well-suited to both in-person and virtual environments. By blending playful interaction with conceptual rigor, 6-DoS transforms abstract network concepts into a concrete, shared experience so that learners do not just understand how networks work – they feel it.

Keywords: Information sharing • Interactive exercise • Message routing • Network perceptions • Small-world experiment

1. Introduction

Social network concepts can sometimes be unintuitive. The six degrees of separation (6-DoS) – famously demonstrated by Milgram (1967) and later replicated by Dodds et al. (2003), often referred to as the “small world” phenomenon – is especially counterintuitive given the size of the global population and our limited ability to perceive large-scale networks. This ability to perceive large-scale networks led to the study of cognitive social structures (CSS; Krackhardt, 1987) as a way to measure and assess the consequences of our perception of the networks of those in our (in)direct network. Interactive exercises

help address this challenge by enabling experiential learning and closing knowledge gaps (Kolb, 1984). With this goal in mind, we developed the 6-DoS.

6-DoS (pronounced *six-doss*) is designed by the Science of Networks in Communities Research Group at Northwestern University to help participants directly experience key concepts in social network analysis, including the 6-DoS and network perceptions. In this 3–5-min network-routing activity, each participant chooses a limited set of contacts and must relay a message to a designated target with whom they have no direct tie. The message can only reach the target by strategically forwarding it through intermediaries – mirroring the logic of the original small-world experiment (Milgram, 1967; Travers & Milgram, 1969).

* E-mail: kyosuke@mgmt.au.dk

6-DoS is a web-based application that requires participants to use computers, tablets, or smartphones with stable internet access. To support instructors, we provide setup and instructional videos on YouTube. The platform also generates a comprehensive set of results, including network visualizations, message completion rates, message paths, centrality measures, and individual network awareness scores, to facilitate reflection and discussion.

The activity is suitable for social network courses at the undergraduate and graduate levels across most social science disciplines, as well as for executive training and professional graduate programs in management, communication, and information science (Monge & Contractor, 2003). A typical session lasts about 30–60 min and includes instructions, gameplay, reflection, and discussion. Instructors commonly run two 3–5-min rounds for 10–600 participants. It is most effective when participants already know at least a few of the others.

2. Goals

The goal of 6-DoS is to enable participants to learn about the 6-DoS and the power of CSS through experience. Depending on the setting and teaching goals, we typically assign minimal or no pre-reading. If desired, the study by Milgram (1967) or Dodds et al. (2003) works well for 6-DoS, and that by Krackhardt (1987) or Marineau et al. (2018) for CSS. We have not observed any differences in how the activity unfolds when participants complete these readings beforehand. The debrief, however, can be more participant-led and substantive when participants are already familiar with relevant concepts and terminology. The activity fits well into a social network course, can be productively integrated into a course on management and teams, or can serve as a building block for an executive module on networking.

Importantly, 6-DoS demonstrates a *navigational* perspective of the 6-DoS. It is important to clarify this perspective before instructors conduct the activity. 6-DoS can be interpreted from two perspectives: topological and navigational (Adamic & Adar, 2005; Goel et al., 2009; Tanaka, 2021).

The *topological* perspective examines structural properties of social networks, emphasizing how individuals are connected through a small number of intermediaries. Rooted in graph theory, this view is directly related to the discovery by Watts and Strogatz (1998) that the small-world phenomenon arises from social networks with high clustering and short average path lengths, enabling any two individuals to be connected in relatively

few steps. From this perspective, the 6-DoS is a property of the network topology, independent of how people actually navigate it. A well-known example is Facebook's finding that the DoS in its friend graph have shrunk to four (Backstrom et al., 2012).

The *navigational* perspective, in contrast, examines how individuals use local information to find paths through a network. Goel et al. (2009) showed that although short paths exist, people rarely possess global knowledge and instead rely on heuristics based on cues such as geography, profession, or shared interests. This emphasis on local perception aligns with Krackhardt's (1987) concept of CSS, which captures individuals' mental models of who knows whom. Research shows that the accuracy of these perceptions has real consequences; for example, Marineau et al. (2018) found that individuals with more accurate CSS representations experience more positive outcomes (e.g., promotion) in organizations. Together, these insights suggest that efficient social navigation depends on both network structure and the accuracy of the local information people use.

Differentiating between these two perspectives is crucial because they reflect distinct social processes. The spread of a sexually transmitted disease through a sexual network, for instance, depends solely on topological connections, not on individuals' awareness. By contrast, purposeful networking, such as job seeking or finding a service provider, requires navigating the network based on one's own perceptions and heuristics, reflecting navigation rather than structure alone.

The 6-DoS activity highlights this gap in social navigation: participants may understand their immediate connections but fail to recognize the broader structural pathways they occupy. As Mehra et al. (2014, p. 317) note, "seeing the trees (i.e., ties) does not mean that one sees the forest." This experiential activity forces participants to move beyond dyadic thinking and instead perceive the "underlying patterns" of the larger network necessary for efficient message routing. We introduce the activity through examples that illustrate the need to efficiently search for or disseminate information to specific others with whom one is not directly connected. This highlights the importance – and difficulty – of identifying who is connected to whom and which heuristics or signals participants use to make sense of who knows whom in a social network. We offer examples of people making errors of omission, assuming two people are not connected when, in fact, they are. This might overload the network with redundant information that could have been disseminated through ties people omitted to recognize. In other instances, people make errors of commission, assuming

two people are connected when they are not. This might prevent crucial information from reaching a person because people assume they would have received it through a network tie that did not exist. The post-mortem on the Challenger space shuttle disaster suggests that this error of commission might have kept key decision-makers unaware of the risks during launch.

Depending on the integration of learning modules, instructors can add the following learning objectives: (1) experiential learning of information overload and breakdown, (2) experiential learning of strong and weak ties, and (3) experiential learning of CSS.

2.1 Recommended readings

Milgram (1967) offered a brief introduction to the small-world problem. Dodds *et al.* (2003) provided a short report on a global-scale replication by Travers and Milgram (1969). Watts (2004) is a popular science book on the small-world phenomenon. Marineau *et al.* (2018) and Krackhardt (1987) introduced the concept of CSS. Monge and Contractor (2003) offered insights into the theoretical motivations for why people choose their contacts and the consequences of those choices.

2.2 Related activities

The Oracle of Bacon (<https://www.oracleofbacon.org/>) lets users check six degrees of Kevin Bacon. Six Degrees of Wikipedia (<https://www.sixdegreesofwikipedia.com/>) finds the shortest link paths between Wikipedia pages, such as from Denzel Washington to Albert Einstein.

3. Setup

Running 6-DoS requires only a few minutes of preparation. The instructor accesses the application at bit.ly/networktask, selects “Administer” (not “Participate”), and creates a new session. Default settings work for most instructors, though there is an option to add a short intake questionnaire that collects background information about participants (e.g., department, major, country of origin), which can enrich the debrief. Upon launching the session, the system generates a unique session key that must be shared with participants before the activity begins. A setup tutorial is also available on YouTube (<https://youtu.be/Alq7-rhRBRs>). A detailed instructor manual with annotated screenshots is available at <https://sonic.northwestern.edu/home/>

software/6-dos/. Instructors are strongly encouraged to run the application a few times on a small group before using it in class, both to catch any setup hiccups and to develop a feel for the pacing.

4. Procedure

The activity unfolds across four phases.

4.1 Phase 1: Introduction (5–10 min)

Before participants log in, the instructor briefly explains the concept of indirect connections and the challenge of reaching a target person by relaying messages only through direct intermediaries. This frames the intuition behind Milgram’s (1967) small-world problem without giving away too much. Participants then visit the 6-DoS webpage, select “Participate,” and create accounts using their full names so that others can identify them.

4.2 Phase 2: Running the activity (10–20 min)

As participants log in, their names appear on the administrator’s screen. Once everyone has joined, the instructor specifies the number of direct contacts each participant may select: a reasonable guide is 2–3 contacts for groups of 15–30, and 4–5 for groups of 30–60. Participants then freely choose their contacts, and the instructor monitors completion progress in real time. Sharing the admin screen can gently nudge slower participants along.

Once contact selection is complete, the instructor sets the degrees of separation between each participant and their intended target (a fixed degree is recommended to ensure a level playing field), specifies the activity duration (3–5 min is typical), and sets how frequently the system issues new relay messages (every 60 s works well). The instructor then clicks “Start Relay.” During the relay, participants see their target, their available contacts, an inbox for receiving and forwarding messages, a tutorial button, and a help icon in the lower-right corner. The admin screen displays routing progress and time remaining and flags participants who need assistance.

4.3 Phase 3: Debrief (10–20 min)

The debrief is where the activity comes alive intellectually. The results interface provides four tabs. The first offers a

session summary: group size, number of contacts, messages generated, and the percentage of messages that reached their targets. The completion rate is a useful anchor for discussion. For reference, Travers and Milgram (1969) reported a completion rate of 22% in their original study, though rates in 6-DoS vary considerably with group size, contact density, and degrees of separation.

The next two tabs present network visualizations of two kinds: a “choose” network of the contacts participants selected, and a “use” network of the ties they actually used to relay messages, with thicker links indicating heavily used contacts. The clustered layout is usually best for spotting structure. Worth pointing out are large nodes – participants chosen by many others, signaling both popularity and potential overload – and pairs who chose each other, creating mutual loops that limit their routing options. Both networks can be downloaded as CSV files for further analysis.

The third tab lists message paths, comparing each message’s actual route and distance against the theoretically shortest one, along with its travel time and completion status. Sorting by actual distance is a quick way to surface the most inefficient or looping paths for discussion.

The final tab reports participant metrics, led by network awareness: the percentage of times a participant selected a contact on the shortest path to the target (Tanaka, 2021; Tanaka et al., 2020). We recommend highlighting top scorers rather than scrolling down to a “wall of shame.” Clicking a participant’s name opens standard centrality measures (indegree, outdegree, betweenness, closeness) for those curious about how position relates to awareness.

4.4 Phase 4: Another round (5–10 min)

If time permits and – as is almost always the case – participants are eager to go again, the instructor can either “Rerun” with the existing group (previous participants stay enrolled, and new ones can join using the auto-generated key) or “Create New Session” if the specifications need to change. Keeping the same duration and degrees of separation as the first round makes cross-round comparison cleaner. The second debrief layers a comparative dimension onto the first: how did completion rates shift, who changed their contacts and why, and did message paths come closer to the theoretically shortest routes? The discussion of the contact selection strategy is often the richest part. Whereas some participants shift toward weaker ties to reach farther pockets of the network, others avoid close ties to dodge the penalty of mutual connections, and others gravitate toward the previous round’s high scorers on network awareness (sometimes

overloading them in the process). The Network Awareness leaderboard almost always reshuffles, indicating that the trait is not fixed. Tanaka et al. (2020) attributed it to a mix of conscientiousness, one’s centrality in the network, and the capacity to monitor and encode ties among one’s contacts’ networks. The interface quietly provides participants with the routing paths of incoming messages – a stream of information about the surrounding network that some learn to read and others overlook entirely.

4.5 Debrief insights from the activity

After debriefing the specific results, the next pedagogical goal is to debrief the general insights about networking from this activity.

In Round 1, participants rely on intuitive contact-selection and routing strategies. During the debrief, the instructor highlights the system’s “optimal route” feature, comparing actual message paths against the theoretically shortest paths. This comparison reveals a gap between participants’ perceptions of who their contacts’ contacts are and the actual network of their contacts’ contacts. The visualization of closed loops and inefficient pathways serves a critical role in their initial routing choices, demonstrating how a lack of network awareness hampers information flow. This highlights the notion of network awareness as a “muscle” to be exercised through repetition, typically involving two rounds.

Reflecting on contact selection is just as instructive. When asked, “How did you decide whom to choose as your contacts?” participants often mention that in the first round, they selected strong ties or friends. The result creates mutual ties among many and overlaps among three or more, leading to redundant clusters that limit the ability to navigate the network effectively. By Round 2, having observed the inefficiencies of these contact selection strategies, participants shift to selecting weak or diverse ties – contacts who bridge silos or connect to different pockets within the network. This shift demonstrates a practical understanding that effective navigation requires diverse connections rather than close ones. In short, participants learn how to “game” the system’s network. Next stop? Game the network in the real world.

In a recent cohort of 30 executives, message completion increased from 47% in Round 1 to 78% in Round 2. Similar improvements occur across cohorts. These gains provide participants with objective evidence that network awareness is a learnable skill that directly affects the speed and accuracy of information dissemination. The

general insight: Network awareness is a “muscle” to be exercised through repetition and practice. This entails actively encoding information about your direct network contacts’ contacts. This can be accomplished by observing their networks, paying attention when they mention people in their network, and paying attention to third parties who mention network connections, among other things.

5. Lessons

The 6-DoS activity illustrates that networks function not only as structures but also as cognitive and behavioral phenomena. Three lessons come up again and again.

A key takeaway is that network awareness functions like a muscle. Across rounds, participants’ sensitivity to the structure around them – who is connected to whom, which ties are congested, where opportunities lie – tends to fluctuate. This fluctuation provides an entry point into discussing positional (e.g., centrality) and dispositional factors (e.g., conscientiousness) that shape network awareness (Tanaka *et al.*, 2020; Tanaka, 2021). Instructors can highlight that individuals in central positions often assume they have better visibility, while peripheral individuals sometimes identify pathway patterns more quickly because they face less information overload. Network advantage is not solely a matter of position but also of awareness – and awareness itself is not static.

After experiencing bottlenecks firsthand, many participants express a desire to reorganize their contacts, especially clusters of strong ties that are densely interconnected. They come to see that whereas strong ties provide trust and support, they may be redundant when everyone knows the same people, overloading channels. In contrast, participants often rediscover the strategic value of weak and diverse ties, which provide unique access to different parts of the network. Instructors can draw attention to instances in which a seemingly peripheral tie proves instrumental in unlocking new routes. The value of a relationship lies not only in its closeness but in the unique access it provides.

A powerful lesson emerges when comparing participants’ actual and perceived network positions. Many build tight clusters of direct contacts yet underperform by overlooking indirect pathways. This sets up discussions about what matters is not just whom you know, but whom your contacts know, and how accurately you can map those second- and third-degree connections. This reflects the reality that “social networks exist both as interactional patterns in the real world and as cognitive maps in our

heads ... we make maps not just of the physical world, but also of our social worlds” (Mehra *et al.*, 2014, pp. 325–326). The 6-DoS activity reinforces the notion that people are “map-makers” of their social worlds, and the key “aha” moment occurs when participants realize that the goal is to improve those maps to identify pathways they previously overlooked. Network effectiveness comes from perceiving structure, not merely occupying it.

Together, these insights offer instructors multiple points for debriefing: (1) fluctuating awareness reveals that network perception requires deliberate practice; (2) congested, high-load contacts illustrate the risks of redundant clusters; (3) weak ties repeatedly emerge as structurally powerful; and (4) participants face the gap between having a network and seeing it, opening discussion on social capital, indirect influence, and cognitive accuracy. By highlighting these patterns, instructors help participants see that networks are not static maps but dynamic processes requiring awareness and strategy to navigate effectively.

6. Reflections

Our experience of running 6-DoS over 10 years shows that participants benefit from repetition. The first round focuses on mechanics, and when left to their own intuition, participants default to comfortable, tightly clustered choices that produce inefficiencies. By the second round, they learn from those experiences and develop more strategic thinking about how to select and navigate their networks – anticipating congestion, experimenting with contract-selection strategies, and shifting toward more intentionally structured connections. Network visualization often challenges assumptions that those embedded in a tightly knit “inner circle” are frequently surprised to find themselves at a disadvantage, lacking the diverse, short pathways needed to reach the rest of the network. Perhaps the most powerful lesson occurs when participants compare their chosen paths to the actual shortest routes and realize that more efficient paths existed yet were overlooked. This shifts reflection from strategic critique to cognitive insight, revealing the blind spots and habits that shape how participants perceive and act within networks, prompting reflection that often continues well after the debrief ends.

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Author contributions

N.C. conceptualized and created the activity. K.T., N.M.J., H.G., and N.C. designed the activity's interface and features. H.G. implemented the web application. K.T., N.M.J., and N.C. wrote the manuscript.

Conflict of interest statement

The authors have no competing interests to disclose.

Data availability statement

All materials necessary for this activity are available at <https://sonic.northwestern.edu/home/software/6-dos/>. The webpage includes an Introduction Video (<https://youtu.be/doRe8PTi11k>), a Participant Instruction Video (<https://youtu.be/koE2Vp3RKdk>), and an Admin Walkthrough Video (<https://youtu.be/Alq7-rhRBRs>). It also includes additional AI-generated videos and slide decks specifically targeted to promote the activity, provide instructions to administrators of the activity, and provide instructions and debrief materials for users of the activity.

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