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The weakness of tie strength☆

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ABSTRACT

The relationship between network structure and access to novel information has fascinated social scientists for decades, culminating in the recent identification of the bandwidth-diversity tradeoff. Yet, existing work focuses on a unidimensional conception of network ties that leaves many important sources of novel information unexplored. We unpack bandwidth, identifying three factors that govern the transmission behavior of network ties: capacity (the ability of a tie to transmit content), frequency (the average time between tie activations), and redundancy (the extent to which a tie reaches persons who are connected to each other). Empirical analyses and simulation models reveal new types of ties, as well as the conventional variety, that open promising research avenues.

Introduction

In 1973 Mark Granovetter argued that “weak” ties are actually strong (i.e., important) because they can provide access to novel resources; since we share no associates with our “weak” ties, they connect us to parts of the social world that we otherwise could not reach. The importance of Granovetter’s contribution rests on three key insights: first, ties vary in terms of strength, with that strength conceived as a linear combination of multiple elements. Second, tie strength is related to triadic configurations, with strong ties embedded in closed triads. Third, the strength of a tie helps determine access to novel information via embedding in open or closed triads. Building on these insights, Burt (1992) emphasized the conceptual distinction between tie strength and closed triads, arguing that novelty is related to triadic closure, irrespective of tie strength. More recently, Aral and Van Alstyne (2011) reexamined the association between tie strength (which they relabeled bandwidth), triadic closure and novelty. Contrary to Burt and Granovetter’s insights, Aral and Van Alstyne demonstrated that the bandwidth of a tie often matters more in providing novel information than its ability to act as a bridge to new parts of the network, such that ties with higher bandwidth enable access to more novel information. More specifically, they show that the greater volume of information flowing down high bandwidth ties often provides more novelty, even if the proportion of the information that is novel is smaller. This stream of research has produced critically important insights, but remains wedded to a pair of core assumptions: that tie strength is essentially unidimensional and that it is robustly connected to triadic closure. But are these assumptions really correct? And if they’re not, how might our understanding of networks be improved by abandoning them?

Our goal in this paper is to provide a systematic understanding of the relationship between tie strength, triadic configuration and access to novel information by questioning these two key assumptions. First, while tie strength was seen as a multidimensional concept by Granovetter, he assumed that the different dimensions are highly correlated and he operationalized tie strength as a single dimension based on the frequency of interaction. Since then, most researchers have continued to conceive of tie strength as a single dimension, operationalizing it as either the frequency of interaction (e.g., Burt, 2004; Cannella and McFayden, 2013) or the closeness of the relationship (e.g., Yakubovich, 2005; Perry-Smith, 2006) between two individuals. Even when researchers capture both frequency and emotional closeness in the data, they tend to aggregate these two dimensions into one variable, defaulting back to a unidimensional view of tie strength (e.g., Reagans, 2005, 2011; Levin and Cross, 2004). Second, researchers have long assumed that tie strength and triadic closure are positively related (i.e., a strong tie will be part of a closed triad). While most researchers accept this assumption, there is actually very little empirical evidence to support it.

We argue that the common model of tie strength rooted in these assumptions is incomplete and leads researchers to focus on a limited

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subset of the ties that actually exist, in the process ignoring potentially important sources of novelty. To correct this oversight, we build on the extant literature in order to identify two dimensions of tie strength: *capacity*, the ability of a tie to transfer information; and *frequency*, the inverse of the average length of time between uses of a tie. Further, in order to understand the information transmission behavior of ties we also explore the *redundancy* of ties: the extent to which the two participants in a tie share common third-parties. These three dimensions together more precisely describe the information transmission properties of network ties and unpack the constituent elements of bandwidth.

Our analytical strategy prosecutes two lines of evidence. First, we offer an empirical exploration of the relationships between the three properties of ties. The main goal of this empirical exercise is to assess whether the three elements, frequency, capacity, and redundancy, combine into a single dimension of tie strength, or are substantially independent properties whose combinations generate distinct types of ties. We analyze the emails exchanged between employees in the corporate headquarters of a medium size company, showing that frequency and capacity are not highly correlated and that many observed dyads fall outside the traditional strong/weak tie continuum. We also show that while ties with low frequency and low capacity tend to be less redundant than ties with high frequency and high capacity, the least redundant ties do not obey this simple relationship. Second, in order to understand how the three properties of ties provide access to novel information, we use a simulation. Our simulation builds on Aral and Van Alstyne's (2011) model by allowing the three properties of ties to vary independently of each other. The simulation results validate the usefulness of our approach, enabling us to identify new categories of ties that provide access to novel information while reproducing prior theoretical insights and empirical results.

Background

The strength of weak ties

According to Granovetter (1973) "weak" ties are strong (i.e., useful) because they are better sources of novelty than "strong" ties. Because your strong ties involve more of your time, it is likely that those persons you are strongly tied to will come into contact with each other and develop a relationship of their own (Granovetter, 1973: 1362). This limits your access to novel information because you, and your alter (i.e., associate), likely learn the same things from the same people at roughly the same time. The alternative, where two of your strong tie partners lack a relationship with each other, is less likely to occur naturally[1] and was described by Granovetter (in a deliberate exaggeration) as a "forbidden triad" (1973: 1363).

The importance of this logic depends on the concept of a *network bridge*, or a connection that provides the only path between two points in a network (see also Wasserman and Faust, 1994: 114-6). At a global level, bridges allow information to diffuse throughout a network and at the individual level they provide access to novelty. If the "forbidden triad" is truly forbidden, it follows that, "…*no strong tie is a bridge,* [emphasis original]" and that, "…all bridges are weak ties," (Granovetter, 1973: 1364).[2] Thus, the strength of weak ties is that they can bridge between different portions of the network and make the world seem small (Watts and Strogatz, 1998), while strong ties cannot.

Two decades following Granovetter's key insight, Ronald Burt (1992) returned to the core argument, noting that while strong ties cannot be bridges, and thus all bridges are weak ties, it does not follow that all weak ties are bridges. Tie strength thus focuses on a correlate of bridging, but not on bridging itself. In response, he introduced the concept of a "structural hole", or the void between two sections of a network that prevents information or resources from flowing between them. When an individual has a relationship to each of these network sections, he or she acts as a local or global bridge over the structural hole. Ties that connect to different network regions are thus non-redundant and ties connecting to the same region are redundant.

Burt's reformulation of the weak tie argument adds to our grasp of tie dynamics; whereas tie weakness is a necessary but not sufficient condition for bridging, bridges are by definition non-redundant. Additionally, Burt focuses more on the "control benefits" available from a tie (Burt, 1992: 28), or the ability to, for example, play others off of each other. The structural holes argument thus sensitizes us to the active use of ties to achieve goals, while the weak ties argument focuses on a passive mode where content is received in the course of normal interaction.[3]

Although Burt claims that the strength of a bridging tie is irrelevant to his argument (1992: 30), he observes that benefits are maximized when the network is composed of "trusted contacts" (1992: 47), and that trust is a component of "strong relationships" (1992: 16). Thus, while redundancy is a separate concept from tie strength, the benefits of non-redundancy require strong ties to fully materialize.

The benefits of non-redundant ties have been broadly supported (e.g., Burt, 1992, 2004), but there have nevertheless been indications that a focus on redundancy does not tell the whole story. For example, Bian (1997) found that in China, jobs are more reliably obtained via strong ties than weak ties, suggesting that bridges are not universally useful. Tugging at this loose end leads directly to the concept of bandwidth, introduced by Sinan Aral and Marshall Van Alstyne, and to which we now turn.

Bandwidth:

The literature reviewed above suggests that novel information comes mainly from non-redundant ties, but Aral and Van Alstyne (2011) disagree. The reason is that stronger, and typically more redundant, ties have more "bandwidth," or larger flows of information.[4] Even though a lower proportion of what we get from our strong, redundant contacts is novel, the greater bandwidth those relations enjoy allows them to deliver more total content and thus more total novelty (2011: 91).[5]

Aral and Van Alstyne do not provide a formal definition of bandwidth, but explain that redundant connections have greater frequency of interaction and richer information flows (2011: 93). In contrast, non-redundant connections are used less often and support less complex information flows (ibid). Additionally, they assert that stronger ties imply greater bandwidth, and that bandwidth should be calculated using observed communications (2011: fn. 3). Therefore, bandwidth is the product of the frequency of tie use and the volume/complexity of the information flow, calculated over realized communication events.

Bandwidth is a key insight, but suffers from three issues: the assumption that the components of bandwidth are positively associated, the focus on realized communication, and the assumption that bandwidth and redundancy are correlated. First, bandwidth is a product of frequency of contact and the volume of information transferred. High bandwidth connections are said to include, "greater frequency of interaction and richer information flows," while communication through low bandwidth connections occurs, "less frequently, with lower complexity and detail" (Aral and Van Alstyne, 2011: 93). In some

[1] Forbidden triads can result from deliberate effort. For example, a man (woman) may expend considerable energy in ensuring that his (her) wife (husband) and mistress (lover) do not develop a relationship.

[2] This conclusion also holds for local bridges (i.e. the most efficient route between two distant points in the network).

[3] The distinction between active and passive use of ties was also present in Granovetter's (1995) book-length treatment of tie strength, though he and subsequent scholars have not focused on it.

[4] This idea, albeit in reduced form, can be traced to earlier work by Joel Podolny (2001: 34).

[5] More recent (2017) work by Jennifer Larson appears to have independently reached the same conclusion, as well as identified additional empirical support.