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EMBEDDEDNESS, PROSOCIALITY, AND SOCIAL INFLUENCE: EVIDENCE FROM ONLINE CROWDFUNDING[1]

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This paper examines how (1) a crowdfunding campaign's prosociality (the production of a public versus private good), (2) the social network structure (embeddedness) among individuals advocating for the campaign on social media, and (3) the volume of social media activity around a campaign jointly determine fundraising from the crowd. Integrating the emerging literature on social media and crowdfunding with the literature on social networks and public goods, we theorize that prosocially, public-oriented crowdfunding campaigns will benefit disproportionately from social media activity when advocates' social media networks exhibit greater levels of embeddedness. Drawing on a panel dataset that combines campaign fundraising activity associated with more than 1,000 campaigns on Kickstarter with campaign-related social media activity on Twitter, we construct network-level measures of embeddedness between and amongst individuals initiating the latter, in terms of ***transitivity*** *and* ***topological overlap****. We demonstrate that Twitter activity drives a disproportionate increase in fundraising for prosocially oriented crowdfunding campaigns when posting users' networks exhibit greater embeddedness. We discuss the theoretical implications of our findings, highlighting how our work extends prior research on the role of embeddedness in peer influence by demonstrating the joint roles of message features and network structure in the peer influence process. Our work suggests that when a transmitter's message is prosocial or cause-oriented, embeddedness will play a stronger role in determining influence. We also discuss the broader theoretical implications for the literatures on social media, crowdfunding, crowdsourcing, and private contributions to public goods. Finally, we highlight the practical implications for marketers, campaign organizers, and crowdfunding platform operators.*

Keywords: Crowdfunding, social media, peer influence, social sharing, social marketing, public good, network embeddedness, prosocial campaigns

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The appendices for this paper are located in the "Online Supplements" section of the *MIS Quarterly*'s website (http://www.misq.org).

Introduction

Recently, there has been a keen interest among academics and practitioners in leveraging the crowd to gather ideas, support ventures, and further causes, a notion generally referred to as crowdsourcing (e.g., Lukyanenko et al. 2014; Majchrzak and Malhotra 2013). Crowdfunding is one type of crowdsourcing that enables entrepreneurs of all types—whether social, cultural, artistic, or for-profit—to raise capital from the crowd to pursue new ventures or causes (Mollick 2014). Successful campaigns engage the crowd early (Etter et al. 2013), establishing a large social media footprint before launch of the campaign, tapping into the social networks of the organizer and early campaign backers (Mollick 2014), and engaging throughout the course of fundraising (Lu et al. 2014). The resulting sustained social buzz helps to ensure fundraising success and increases demand for project output (Burtch et al. 2013). Most crowdfunding platforms now provide social media sharing features on campaign web pages to enable this process, most notably via Twitter and Facebook sharing buttons (Thies et al. 2016), and numerous industry best practices are available on the Internet that instruct organizers on how best to leverage social media and social networking services in fundraising.[2]

Given the apparent practical importance of social media in crowdfunding, there is a notable dearth of empirical research on the subject. Only a small body of work has explored the role of social media in crowdfunding campaign outcomes (Etter et al. 2013; Lu et al. 2014; Thies et al. 2016), establishing that social media activities correlate with fundraising outcomes; thus, a number of open theoretical questions remain. For example, past work has tended to treat various forms of social media as perfect substitutes, yet this assumption is likely invalid. Still, the two most prominent platforms—Facebook and Twitter—exhibit very distinct characteristics, in terms of platform design, which has led to different social network structures amongst users (Hughes et al. 2012; Kane et al. 2014).

The structural properties of social networks have been shown to play a significant role in determining the degree and extent of social influence. A prime example is network embeddedness, the extent to which the users in a network share mutual connections (Aral and Walker 2014; Centola 2010; Easley and Kleinberg 2010; Uzzi and Gillespie 2002). Thus, a social network characterized by low embeddedness exhibits fewer shared (mutual third-party) connections amongst nodes, whereas a social network characterized by high embeddedness exhibits more shared connections. Recent work has documented that peer influence is amplified in the presence of embeddedness (Aral and Walker 2014; Centola 2010), because embeddedness is associated with the manifestation of cooperative norms (Granovetter 1985; Nakashima et al. 2017) and trust (Bapna et al. 2017). Embeddedness elicits cooperation and trust because the presence of a shared audience simultaneously increases the potential upside from behaving "well" and the downside of behaving "badly" (Granovetter 1992).

Interestingly, the same notions of cooperation and social image have *also* been shown to play a central role in individuals' decisions to contribute toward a public good (Andreoni and Bernheim 2009; Benabou and Tirole 2006; Bernheim 1994; Sugden 1984), defined as goods that are non-excludable in supply and non-rival in demand (Samuelson 1954). The public good literature has long argued that individuals' public good contributions depend a great deal on their desire to conform, to appear fair, and to seem benevolent to social peers (Andreoni and Bernheim 2009; Benabou and Tirole 2006).

We integrate these two disparate literatures, hypothesizing that when the objectives of a crowdfunding campaign (or marketing solicitation more broadly) tap into the crowd's prosocial motivations (e.g., Burtch et al. 2013; Pietraszkiewicz et al. 2017; Varian 2013), network embeddedness will play an important role in determining the impact of contribution solicitations issued via social media on campaign fundraising. A recent example that illustrates these synergies is the "ALS Ice Bucket Challenge,"[3] a viral phenomenon that spread across social media in the summer of 2014, wherein individuals were influenced by their friends to contribute to a social cause (i.e., advancing awareness of ALS by engaging in the ice bucket challenge,) donating money to researching a cure for the illness or both. A key reason the challenge spread so quickly and so broadly is that the solicitation to contribute to this public good was frequently made in front of an audience of the target's socially proximate peers. As a result, the potential benefit (damage) to the target's reputation and image from (not) responding was significant. Thus, the virality of the ice bucket challenge appears to have resulted from a uniquely synergistic combination of *context* (the message was propagated through embedded networks on social media) and *content* (targeted individuals were asked to contribute toward a prosocial cause, where the socially desirable response was to conform).

It is precisely these synergies we seek to explore here, systematically, in the context of online crowdfunding. Thus, we formally address the following research question:

[2]For example, http://www.crowdfundingguide.com/integrate-social-media-crowdfunding/

[3]https://en.wikipedia.org/wiki/Ice_Bucket_Challenge

How do the prosociality of campaign objectives (pursuit of a prosocial public cause versus a private good) and social network embeddedness jointly influence the impact of campaign-related social media activity on campaign fundraising responses?

We evaluate our hypotheses by analyzing a sample of campaign fundraising data from Kickstarter, combined with data from the campaign-associated Twitter activity. We construct network-level measures of embeddedness among the Twitter users who initiated social-media posts mentioning a given campaign, to assess the hypothesized relationships. Our panel data structure enables us to incorporate both campaign and time fixed effects, which jointly account for time-invariant features of campaigns and unobserved temporal trends or shocks to the broader crowdfunding market. We find that network embeddedness disproportionately amplifies the positive relationship between social media activity and campaign fundraising for public-oriented campaigns (relative to private-oriented campaigns), consistent with our expectations.

Literature Review

Crowdfunding and Social Media

Crowdfunding enables individuals to pool their money collectively, usually via Web-based platforms, to invest in or support new projects and ventures. There are four primary types of crowdfunding: reward-based, loan-based, equity-based, and donation-based (Agrawal et al. 2014). The earliest work in this space considered loan-based crowdfunding, otherwise known as peer-to-peer lending or micro-lending (Lin et al. 2013; Zhang and Liu 2012), wherein a backer expects repayment of their contribution with interest. Most recently, scholars have also begun to look into equity-based crowdfunding (Bapna 2017), in which backers purchase a small ownership stake in the venture. However, the largest body of work pertains to reward- and donation-based crowdfunding. In reward-based crowdfunding, backers provide funds in exchange for tangible rewards (e.g., product pre-orders) (Hu et al. 2015; Mollick 2014). In donation-based crowdfunding, backers have no expectation of tangible compensation. Instead, the primary incentives for contribution derive from altruism or social motives (e.g., social norms, social image concerns) (Burtch et al. 2013; Koning and Model 2013).

Recent work has found that prosocial, public-oriented campaigns tend to raise more money (Pietraszkiewicz et al. 2017). Our work addresses the related question of how campaign orientation combines with network structure amongst word of mouth emitters and recipients to drive fundraising outcomes. Social media channels are frequently used in crowdfunding to enable organizers and backers to share campaign information with peers and to solicit support (Hui et al. 2014; Lawton and Marom 2012). The role of social media in crowdfunding has begun to receive attention from scholars in information systems (Thies et al. 2016), human–computer interaction (Gerber and Hui 2013), and entrepreneurial finance (Lehner 2013). The dominant effort in this line of research has been an examination of the effect of social media activity on campaign outcomes. It has been found that the probability of campaign success is positively associated with the size of an organizer's online social network (Giudici et al. 2012; Mollick 2014), as are the number of Facebook "likes" and "shares" a campaign receives (Mossiyev 2013, Thies et al. 2016).

Recent research has also begun to examine the manner in which social media is leveraged by crowdfunding campaigns. Hui et al. (2014) report that creators use various forms of social media to ask for support, to activate network connections, to keep in contact with previous and current campaign supporters, and to expand network reach. Social media can thus help campaigns to establish connections with current and potential backers. In turn, these connections may ultimately enhance the social capital of creators (Granovetter 1973) and result in a higher likelihood of success (Giudici et al. 2012).

Public Goods and Network Embeddedness

A public good is defined as one that is non-excludable in supply (i.e., anyone can extract value from it) and non-rival in demand (i.e., one person consuming the good in no way hinders others' ability to do so) (Samuelson 1954). A prototypical example of a public good would be fireworks. An individual might decide to purchase and set off some fireworks in their backyard on a holiday, but there is no easy way to prevent others from simultaneously enjoying said fireworks show, despite having failed to contribute to the purchase. Examples of public goods that have been studied in the information systems literature include digital journalism (Burtch et al. 2013), peer-to-peer file sharing (Gu et al. 2009), and user-generated content (Huang et al. 2017).

The flip side of a public good is the private good: those that provide exclusive benefit to the individual who owns them.[4]

[4]Work subsequent to that of Samuelson (1954) elaborated on the public–private distinction, developing a two-dimensional characterization of goods in terms of (1) excludability and (2) rivalry (Ostrom 2005). Thus far, we have focused exclusively on pure private and pure public goods, because such goods are most prevalent/common. For example, common goods (Ostrom et al. 1999), otherwise known as common-pool resources, are goods characterized by rivalry and non-excludability (e.g., finite natural resources, various forms of public infrastructure, etc.). Excludability in crowdfunding is not impossible, it is typically just insurmountably expensive to implement,

When an individual consumes a private good, others are prevented from doing so, and access to the good can reasonably be restricted. When it comes to the consumption of a private good, the primary factors underlying a purchase decision are product quality and fit. These consumers will be concerned about the ultimate performance of the product, the value they are likely to derive (Dimoka et al. 2012) and whether their preferences will be met (Hong and Pavlou 2014).

Research on the private provision of public goods has a long history of study in economics (Andreoni and Bernheim 2009; Bergstrom et al. 1986; Bernheim 1994), where a variety of studies have noted that individuals' decisions are heavily influenced by cooperative norms (Coleman 1988) and social image concerns (Andreoni and Bernheim 2009; Benabou and Tirole 2006). Simply put, individuals prefer that others perceive them as fair and benevolent.

These mechanisms bear notable parallels to those cited in the literature on social networks for why certain network structures (e.g., embeddedness) lead to greater social influence. The literature theoretically proposes and empirically demonstrates that embeddedness facilitates peer influence, for a number of reasons. For example, embeddedness has been associated with more effective knowledge transfer (Reagans and McEvily 2003), and in the specific context of social media, embeddedness has been shown to lead to higher rates of information sharing (Peng et al. 2018). Embeddedness can facilitate social influence because a focal individual is likely to receive the same message from multiple sources, in tandem, making them less likely to miss the information, and more likely to discern the core elements of the message in an accurate manner.

Network embeddedness has also been shown to enable peer influence by facilitating the manifestation of cooperative norms amongst network participants (Granovetter 1985; Nakashima et al. 2017). Cooperative norms manifest because embeddedness fosters trust (Bapna et al. 2017), in part due to the presence of greater social image concerns. This mechanism is particularly germane to the present study because, as noted above, conditional cooperation and social image concerns have been argued as a key driver of private contributions to public goods (Bernheim 1994; Sugden 1984). Put simply, individuals' contributions toward public goods will be influenced by their desire to conform, to appear fair, and to seem benevolent to social peers (Andreoni and Bernheim 2009; Benabou and Tirole 2006). Such concerns are known to depend upon the presence of third-party observers, for as Granovetter (1992, p. 44) has stated:

> My mortification at cheating a friend of long standing may be substantial even when undiscovered. It may increase when a friend becomes aware of it. But it may become even more unbearable when our mutual friends uncover the deceit and tell one another.

Hypothesis Development

As noted above, social media enables a campaign organizer and prior campaign contributors to solicit monetary contributions from others within their social networks (Hui et al. 2014). Campaign contributors have an incentive to solicit subsequent contributions from peers, to ensure the campaign achieves its fundraising threshold and is implemented. As the volume of solicitations increases, total contribution volumes will increase in turn. Indeed, a number of prior studies have demonstrated this positive association between campaign-related social media activity and campaign fundraising outcomes (Giudici et al. 2012; Mollick 2014; Thies et al. 2016). Accordingly, we offer our first hypothesis in line with this past work:

> ***Hypothesis 1: Increases in social media activity around a crowdfunding campaign are positively associated with contributions to that campaign.***

The successful solicitation of campaign contributions from social media connections depends on peer influence. Prior work has established that peer influence is moderated by structural characteristics of a social network, such that influence is amplified in the presence of embeddedness (i.e., a greater number of mutual third-party connections between the influencer and his or her target) (Aral and Walker 2014). We thus expect that a greater average level of campaign-network embeddedness would positively moderate the influence of social media activity on campaign contributions. We thus offer our second hypothesis, as follows:

> ***Hypothesis 2: Network embeddedness reinforces the positive relationship between social media activity around a crowdfunding campaign and contributions toward that campaign.***

Our key focus is the degree to which the combined effect of social media solicitations and embeddedness is in turn moder-

precluding private ownership. Typically, such goods end up being regulated by governments or trade associations, because it is in the interest of social welfare to manage the resource on behalf of everyone. The other quadrant of the 2×2 matrix is filled by club goods, which are characterized by non-rivalry and excludability (e.g., movie screenings, satellite television) where consumption by one does not impede consumption by others, yet where access is nonetheless exclusive to paying customers.

ated by the nature of a focal campaign's objectives. Crowdfunding campaigns are highly heterogeneous in nature, with organizers raising funds for all manner of projects. A prominent observation that has been made in the prior crowdfunding literature is that many crowdfunding campaigns are best characterized as prosocial, pursuing the provision of a public good (Burtch et al. 2013; Pietraszkiewicz et al. 2017; Varian 2012).

Public good oriented campaigns take a variety of forms, such as community development projects and charitable fundraisers. In contrast, private good oriented campaigns aim to produce output that is ultimately sold at a profit, and campaign backers receive a direct benefit from the campaign's success in the form of a tangible reward. Examples of such campaigns include those that raise funds to support the manufacturing of smartphone accessories, video games, and so on. Contributors' concerns will be quite different in the case of public good campaigns than in the case of private good campaigns. Public goods, broadly speaking, primarily benefit others (e.g., society at large), rather than the backers themselves. The literature on public good contributions has argued at length that social motives play a more prominent role in driving an individual's contribution decisions in the absence of tangible personal returns (e.g., private ownership of a product or financial returns).

Based on prior theory and evidence on embeddedness in social networks that embeddedness enables social influence by magnifying social image concerns and fostering cooperative norms, as well as prior theory and evidence that the same mechanisms facilitate private contributions to public goods, we expect synergies between the two. That is, we expect that the joint influence of network embeddedness on the relationship between social media activity and fundraising outcomes is in turn amplified when a campaign is prosocial in nature (i.e., when a campaign's objectives are to deliver a public good). Considering the above discussion, we formalize our expectation in Hypothesis 3, as follows:

> ***Hypothesis 3: Compared with private good oriented crowdfunding campaigns, public good oriented campaigns will see a larger fundraising benefit when social media activity manifests over networks exhibiting greater embeddedness.***

Methods

We evaluate our hypotheses on a dataset that combines Kickstarter campaign contributions and campaign-associated Tweets. We construct the social networks of Twitter users initiating Tweets each day, and we measure the resulting networks' level of embeddedness. We then look to evaluate the relationships, estimating regressions that incorporate our dynamic measures of social network embeddedness, Twitter posting volumes, and the returns to campaign fundraising. We contrast results between public versus private good oriented crowdfunding campaigns, to show that the moderating influence of embeddedness is stronger for public-oriented campaigns.

Data

Crowdfunding Data: We analyze a dataset pertaining to a leading reward-based crowdfunding platform, Kickstarter. Our sample contains 1,129 Kickstarter projects launched after March 2016, and completed before September 2016. Basic campaign information in our sample includes the campaign organizer's ID, the webpage URL, the shortened version of the webpage URL, the campaign fundraising goal, the fundraising duration, as well as daily records of available campaign rewards, dollar amounts raised, and total number of backers arriving. We excluded projects from our sample that had no backers or that were seeking to raise small dollar amounts (less than $100).

To label a campaign as pursuing a public good or private good, we consider whether the output of the campaign would be of benefit to individuals other than the contributor. We employ a text analytics approach to construct our measure of public orientation, *PublicOrientation*, based on Kickstarter project descriptions, wherein we quantify the proportion of prosocial words that appear, using a dictionary-based text analysis tool, Linguistic Inquiry and Word Count, or LIWC (Pennebaker et al. 2015). This approach has been used to measure the prosociality of crowdfunding campaigns in past work (Pietraszkiewicz et al. 2017), and LIWC more generally has seen wide use in the IS literature (Hong et al. 2016; Huang et al. 2017; Yin et al. 2014).

We also consider a campaign category-based approach to operationalizing public orientation. Although our LIWC measure has the benefit of offering campaign-level variation, a category-based approach has the benefit of simplicity. Moreover, exploring this alternative approach enables us to validate the results we obtain from the dictionary-based LIWC measure and affords us the ability to easily quantify the differential impacts of social media activities for public versus private campaigns. Two Kickstarter campaign categories, in particular Games and Technology, typically comprised of campaigns that sell pre-orders of new games or gadgets. We begin by treating campaigns in these two categories as private-good oriented. In contrast, there are other categories

that typically aim at producing a product that benefits the broader public in some way (e.g., Art, Film, Music, etc.). We thus create a binary indicator, *PublicCategory*, labeling campaigns in these categories as public-good oriented.

Twitter Data: We supplement the Kickstarter data with associated social media activity for each campaign on Twitter. We collected all tweets from the Twitter stream API in parallel, based on the keywords "kickstarter" and "kck.st/." For each tweet, we recorded the timestamps, author handle, any other user handles that were mentioned in the tweet, the tweet text, and any URL's appearing in the body of the tweet. For each posting Twitter user, we then queried the Twitter API to obtain the user's metadata, as well as his or her list of followers and followees. Because a tweet is limited to just 140 characters, most URLs that appear in tweets have first been shortened using a URL shortening service. As such, we matched tweets to campaigns by first expanding shortened URLs and then identifying matches to Kickstarter campaigns based on their long-form URLs, the presence of the campaign title, or both. We report the descriptive statistics for our overall sample in Table 1, and a correlation matrix in Table 2.

Constructing Social Networks Around Crowdfunding Projects

A key task in this analysis is to examine the degree to which the network embeddedness that characterizes social network postings about a given campaign on a given day positively enhances the effect of that social media activity on campaign fundraising outcomes, and how this varies between public and private good oriented crowdfunding campaigns. Therefore, we first construct a social network for each project on each day, based on campaign Twitter activity observed on each day, and follower–followee relationships between and amongst the users posting that content. We then develop a measure of network embeddedness, operationalized on a per campaign, per day basis.

First, we construct the social network for the set of Twitter users who tweeted about a given project during its fundraising, resulting in a separate Twitter network for each campaign-day pair. As noted above, we matched a tweet to a project if the tweet contained the project's URL or project title. Once we compiled all the related tweets for a campaign, we then sorted Tweets into days based on timestamp and constructed the social network of the tweet authors for each day. Each node in each network graph is thus an author. A directed edge between a pair of nodes expresses the information flow from one author, u, to another author, v. Two criteria are used to establish the presence of an information flow: (1) the earliest tweet from v about a project must have been posted after the first tweet about the same project, by u, and (2) v follows u's handle on Twitter, or v's handle is mentioned in one of u's tweets.

Once we finish constructing the Twitter social networks for each campaign, we seek to measure network embeddedness. Here, we use a standard measure from the social networks literature, namely transitivity (Centola 2010; Holland and Leinhardt 1971; Uzzi and Gillespie 2002; Wasserman and Faust 1994). We also demonstrate robustness to an alternative measure, namely, the average number of shared connections across all dyads in a network (Aral and Walker 2014; Bapna et al. 2017; Reagans and McEvily 2003).

Constructing Embeddedness Measures

We begin with network transitivity, also known as the global clustering coefficient, which reflects the overall connectivity of a network. Transitivity operationalizes a network's structural embeddedness by capturing the degree to which a given node's first- or second-degree connections (i.e., connections' connections) are linked to one another via multiple independent paths (Moody and White 2003). Uzzi and Gillespie (2002) used transitivity measures to examine how embedded relationships between a firm and its banks facilitate the firm's access to unique capabilities that help manage its trade–credit financing relationships. Similarly, Centola (2010) employed the transitivity measure to capture embeddedness in social networks, to show that the adoption of a healthy behavior was more likely to occur in its presence because higher transitivity leads to greater social reinforcement of the behavior.

Transitivity is mathematically defined as per Equation (1). This measure reflects the proportion of all connected triplets that reside within a closed triad (i.e., embedded ties), where a connected triplet is defined as a connected subgraph consisting of three vertices and two edges. Each triangle forms three connected triplets, hence the factor of three in the formula. Note that two triplets are considered identical if they have the same path; that is, triplet 1-3-4 would be considered the same as triplet 4-3-1.

$$C = 3 \times \text{number of triangles} / \text{number of connected triplets} \quad (1)$$

We provide an example of how this measure is calculated for the network depicted in Figure 1. Here, we have one triangle involving three ties, comprised of Nodes 1-2-3, and we have a total of five connected triplets involving two ties (1-3-4, 1-2-3, 1-3-2, 2-1-3, 2-3-4). Hence, transitivity of the network, g, is equal to $3 \times 1/5$, or 0.6.

Table 1. Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max	Median
Transitivity	0.207	0.251	0.000	1.000	0.091
Overlap	0.066	0.080	0.000	0.438	0.030
ln(contribution)	8.565	1.530	0.000	13.844	8.573
ln(tweet)	2.992	1.297	0.000	7.179	2.996
PublicOrientation	9.176	3.342	0.000	21.930	9.110
pct_target	1.164	4.017	0.000	179.287	0.459
pct_duration	0.510	0.290	0.000	1.000	0.500

Table 2. Correlation Matrix

Variable	1	2	3	4	5	6	7
1. Transitivity	1						
2. Overlap	0.44*	1					
3. ln(contribution)	-0.08*	-0.18*	1				
4. ln(tweet)	0.28*	0.25*	0.36*	1			
5. PublicOrientation	0.04*	0.07*	0.01*	0.03*	1		
6. pct_target	-0.02*	-0.07*	0.21*	0.10*	-0.09*	1	
7. pct_duration	0.08*	0.04*	0.29*	0.39*	0.00	0.11*	1

Note: *p < 0.05

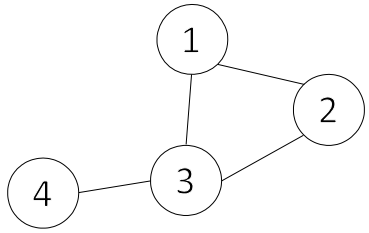

Figure 1. Transitivity

Perfect transitivity implies that if node *x* shares an edge with *y*, and *y* is connected to *z*, then *x* is connected to *z* as well. The intuition behind using this measure for network embeddedness derives from the following argument: if a node is connected to two other nodes (i.e., is a member of two dyads), those two other nodes are then much more likely to also be connected to one another than would be two nodes selected at random from the network. Based on this idea, the structural embeddedness of a social network is greater in the presence of more transitive ties, as reflected by a greater volume of closed triads in the network (Davis 1979; Louch 2000).

Second, we consider topological or network overlap (Peng et al. 2018). We begin by calculating dyad-level embeddedness as the relative overlap of the neighborhood of two users, *i* and *j* (i.e., the proportion of their connections that are shared), as in Equation (2), where, n_{ij} is the number of common network neighbors between *i* and *j*, and *k* denotes node degree (i.e., the number of edges connecting to a node).

$$O_{ij} = n_{ij} / (k_i + k_i - n_{ij}) \quad (2)$$

If *i* and *j* have no mutual connections, then $O_{ij} = 0$; if all their connections are shared, $O_{ij} = 1$. We provide an example of this measure's mathematical calculation in Figure 2. The embeddedness between Node 4 and Node 6 is $1/(4 + 4 - 1) = 1/7$. Here, there is one common neighbor, Node 5; Node 6 has a degree of 4, reflected by connections to Nodes 4, 5, 7,

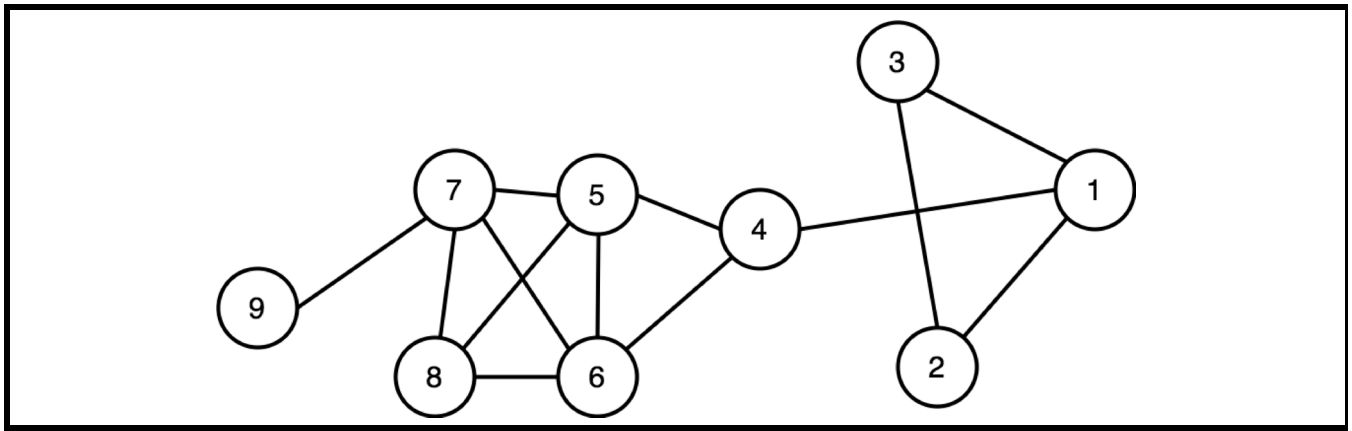

Figure 2. Topographical Overlap

and 8; finally, Node 4 also has a degree of 4, reflected by connections to Nodes 1, 3, 5, and 6.

Overlap has been used to examine various phenomena in empirical social networks, including evaluations of social influence strength (Aral and Walker 2014), community overlap (Girvan and Newman 2002), community complexity (Ahn et al. 2010), interpersonal trust (Bapna et al. 2017), content propagation on social media (Peng et al. 2018), and knowledge transfer among individuals (Reagans and McEvily 2003). Note that embeddedness is typically defined on a dyadic basis, characterizing the relationship between two nodes. To construct a network-level measure of embeddedness, we average embeddedness over all dyadic ties in a network.

Econometric Model

The main goal of our analysis is to estimate the effect that additional tweets have on fundraising activity for different types of campaigns, and how the effect changes as social media users exhibit different levels of network embeddedness. We formulate an econometric model to estimate the effect of social media activity, observed on day t-1, on total campaign contributions on day *t*, controlling for a set of dynamic factors, described below. Our data set is constructed as a campaign-day panel, similar to past studies in this domain (e.g., Burtch et al. 2013, Kuppuswamy and Bayus 2015). Campaign fixed effects are implemented, via a within transformation, and day fixed effects are captured by a vector of daily dummies. This specification thus addresses both unobserved campaign level heterogeneity and unobserved temporal trends.

Because campaign organizers are uniquely associated with a campaign, this approach also implicitly controls for the unobserved characteristics of campaign organizers, at least those characteristics that can reasonably be viewed as time-invariant, such as organizer experience in crowdfunding, the size of the organizer's offline and online social network, social capital, etc. We control for campaign fundraising progress via two variables: *pct_target* and *pct_duration*, which indicate progress toward the dollar fundraising target and progress toward the campaign deadline, respectively.

We estimate the model reflected by Equation (3), first with our transitivity measure, and then replacing transitivity with our overlap measure. The results of our transitivity estimations appear in Table 3, and those for our overlap estimations in Table 4. These results exhibit a pattern of relationships consistent with our three hypotheses: social media activity is significantly and positively related to fundraising (column 1), this effect is in turn positively moderated by embeddedness (column 2), and, further, we find that activity initiated over networks having high structural embeddedness delivers a disproportionate benefit to campaigns that employ more prosocial words in their description text (column 3), or campaigns coded as public, based on their Kickstarter category (column 4).

$$\begin{aligned} ln\left(contribution_{i,t}\right) &= \beta_0 Transitivity_{i,t-1} + \beta_1 ln\left(Tweets_{i,t-1}\right) + \\ &\beta_2 Transitivity_{i.t-1} * ln\left(Tweets_{i,t-1}\right) + \beta 3 Transitivity_{i,t-1} * \\ &PublicOrientation_1 + \beta_4 ln\left(Tweets_{i,t-1}\right) * PublicOrientation_1 + \\ &\beta_5 ln\left(Tweets_{i,t-1}\right) * Transitivity_{i,t-1} * public_i + \\ &\beta_6 pctFunded_{i-t-1} + \beta_7 pctLapsed_{i,t-1} + \alpha_i + \gamma_t + \varepsilon_{i,t} \end{aligned} \quad (3)$$

Results across both embeddedness measures are broadly consistent. Considering the estimates in the final column of Table 3 (where we use a binary indicator of public-good orientation, making interpretation straightforward), we find

Table 3. Estimation Results: Transitivity

	(1) $\ln(\text{contribution}_t)$	(2) $\ln(\text{contribution}_t)$	(3) $\ln(\text{contribution}_t)$	(4) $\ln(\text{contribution}_t)$
$Transitivity_{t-1}$	-0.088***(0.020)	-0.712***(0.052)	-0.417***(0.149)	-0.460**(0.140)
$PublicOrientation * Transitivity_{t-1}$	—	—	-0.030*(0.0.015)	—
$PublicCategory * Transitivity_{t-1}$	—	—	—	-0.273(0.149)
$ln(tweets)_{t-1}$	0.175***(0.005)	0.162***(0.005)	0.172***(0.012)	0.151***(0.008)
$Transitivity_{t-1} * ln(tweets)_{t-1}$	—	0.234***(0.018)	0.088^{+}(0.054)	0.125**(0.048)
$PublicOrientation * ln(tweets)_{t-1}$	—	—	-0.001(0.001)	—
$PublicOrientation * Transitivity_{t-1} * ln(tweets)_{t-1}$	—	—	0.015**(0.005)	—
$PublicCategory * ln(tweets)_{t-1}$	—	—	—	0.014(0.009)
$PublicCategory * Transitivity_{t-1} * ln(tweets)_{t-1}$	—	—	—	0.119*(0.052)
pct_target_{t-1}	0.022***(0.001)	0.022***(0.001)	0.022***(0.001)	0.023***(0.001)
$pct\_duration_{t-1}$	0.156***(0.055)	0.170***(0.055)	0.178***(0.055)	0.171**(0.055)
Constant	6.784***(0.035)	6.804***(0.035)	6.804***(0.035)	6.805***(0.035)
Project Fixed Effect	Yes	Yes	Yes	Yes
Day Fixed Effect	Yes	Yes	Yes	Yes
Observations	30,052	30,052	29,965	30,052
Number of projects	1,129	1,129	1,126	1,129
R-squared	0.58	0.58	0.58	0.58

Notes: 1. Standard errors reported in parentheses. 2. Coefficients significant at level ***p < 0.001, **p < 0.01, *p < 0.05, +p = 0.1.
3. Some observations are not measured for *PublicOrientation* because description text could not be retrieved (e.g., project was hidden or deleted).

Table 4. Estimation Results: Topological Overlap

	(1) $\ln(\text{contribution}_t)$	(2) $\ln(\text{contribution}_t)$	(3) $\ln(\text{contribution}_t)$	(4) $\ln(\text{contribution}_t)$
$Overlap_{t-1}$	-0.486***(0.079)	-1.886***(0.163)	-0.374(0.492)	-0.161(0.923)
$PublicOrientation * Overlap_{t-1}$	—	—	-0.153**(0.047)	—
$PublicCategory * Overlap_{t-1}$	—	—	—	-1.825(0.955)
$ln(tweets)_{t-1}$	0.179***(0.005)	0.168***(0.005)	0.181***(0.012)	0.155***(0.013)
$Overlap_{t-1} * ln(tweets)_{t-1}$	—	0.559***(0.057)	-0.118(0.181)	-0.237(0.341)
$PublicOrientation * ln(tweets)_{t-1}$	—	—	-0.001(0.001)	—
$PublicOrientation * Overlap_{t-1} * ln(tweets)_{t-1}$	—	—	0.069***(0.018)	—
$PublicCategory * ln(tweets)_{t-1}$	—	—	—	0.024(0.014)
$PublicCategory * Overlap_{t-1} * ln(tweets)_{t-1}$	—	—	—	0.877*(0.352)
$pctTarget_{t-1}$	0.022***(0.001)	0.023***(0.001)	0.023***(0.001)	0.026***(0.002)
$pctDuration_{t-1}$	0.157**(0.055)	0.170**(0.055)	0.181**(0.055)	0.524***(0.072)
Constant	-1.754***(0.035)	-1.741***(0.035)	-1.766***(0.035)	7.677***(0.225)
Project Fixed Effect	Yes	Yes	Yes	Yes
Day Fixed Effect	Yes	Yes	Yes	Yes
Observations	30,052	30,052	29,965	30,052
Number of projects	1,129	1,129	1,126	1,129
R-squared	0.58	0.58	0.58	0.58

Notes: 1. Standard errors reported in parentheses. 2. Coefficients significant at level ***p < 0.001, **p < 0.01, *p < 0.05.
3. Some observations are not measured for *PublicOrientation* because description text could not be retrieved (e.g., project was hidden or deleted).

that in the absence of any embeddedness, a 10% increase in the volume of tweets related to the campaign is associated with an approximate 1.51% increase in dollars raised the following day, regardless of campaign orientation. However, in the presence of complete embeddedness, we find that public campaigns experience an additional 2.44% increase in daily fundraising, roughly doubling the 1.25% benefit from closure that is indicated for private campaigns. Given the observed average daily fundraising total is approximately $16,679.63, this difference amounts to $198.49 per day, on average, or nearly $6,000 over a 30-day campaign.

We also assess the robustness of our results to endogeneity. Although we believe there is randomness in the daily network structure, endogeneity would be a concern if social media activity is influenced by daily campaign fundraising, implying simultaneity. We address this employing the instrumental variable method proposed by Lewbel (2012), constructing orthogonal instruments mathematically from covariates specified as exogenous (cumulative fundraising and duration elapsed). The results of this analysis are provided in Appendix A, where we observe a consistent pattern of support for our key hypothesis across all models.

Discussion

Theoretical Implications

First and foremost, this work deepens our understanding of the role that social mechanisms play in private contribution to public goods (Andreoni and Bernheim 2009; Benabou and Tirole 2006), and the moderating role of network embeddedness (Aral and Walker 2014). Whereas past work has argued and shown that image concerns and a desire for social approval are major drivers of individuals' support for public goods, our work identifies and explores a common contextual factor that underpins the manifestation of such concerns: social network structure. At the same time, our work extends prior research on peer influence by highlighting the role of message features in the peer influence process. Whereas past work has demonstrated that embeddedness amplifies peer influence (Aral and Walker 2014), our work indicates that the magnitude of amplification is, in turn, increasing in the prosocial nature of the message being transmitted.

Second, our study builds concretely on the prior literature dealing with social media and crowdfunding (Gerber and Hui 2013; Lehner 2013; Mossiyev 2013; Thies et al. 2016), which has largely focused on understanding individual patterns of use, or campaign-level associations between fundraising and social media posting activity. Our work explores the nature of individual campaigns' objectives, and how these objectives may combine with social networks to drive fundraising outcomes. Perhaps most notably, our work expands on Thies et al. (2016), who report differing effects of social media activity on the number of backers in different crowdfunding campaign categories (creative, social, and entrepreneurial), offering a plausible mechanism for those observed differences.

Third, we extend research in social media marketing that speaks to the importance of accounting for differences between social media channels in digital marketing efforts (Aral et al. 2013; Schweidel and Moe 2014). Our results suggest the potential benefit of framing word of mouth based marketing messages associated with products or services to include a prosocial element when the communication context is characterized by closed, dense networks. We also extend prior work in Information Systems about embeddedness in social networks and the effects thereof. While prior research has focused on the amplifying role of embeddedness in social influence (Aral and Walker 2014) and trust (Bapna et al. 2017), we show that the magnitude of this amplification depends in turn on the content of the message being communicated.

Practical Implications

Our results also bear important practical implications for crowdfunding platforms, campaign organizers, and more broadly for social media marketing. Although it may often be difficult for an individual entrepreneur or marketer to target specific individuals with content, so as to optimize responses, it is certainly feasible to focus on particular media and channels. This is important, because social media incorporate different features and characteristics that make them more or less likely to host embedded networks. For example, Kaplan and Haenlein (2010) characterize social media in two dimensions: degree of self-disclosure (a lack of anonymity) and degree of social-presence (a focus on social interaction).

Network embeddedness is more likely manifest in social media that are characterized by both self-disclosure and social presence, because reputation and image are of greater concern if identity is salient and individuals are directly interacting, rather than consuming another's content. Kaplan and Haenlein provide examples of media characterized by high degrees of disclosure and presence, such as Facebook and Second Life, and contrast them with media characterized by a content focus or lack of self-disclosure (e.g., Wikipedia, Twitter). Exploring these ideas in our own research context, we revisited the Kickstarter campaigns in our sample and obtained the aggregate Facebook sharing counts associated with each. Totaling the tweet volumes of each campaign, we analyzed the fundraising outcomes associated with each type of social

media activity, and how they shifted with prosocial orientation. We report the results of this analysis in the Appendix B, observing that fundraising is more strongly associated with Facebook activity when campaigns are prosocial.[5]

While it may appear on the surface that there is a negligible overhead cost associated with engaging the crowd across many social media channels, there are a number of reasons why this is not the case. Many social media platforms now provide services that allow marketers to promote content of any form for a fee. It is apparent that with a fixed marketing budget, marketing professionals must make a choice about how to allocate the budget between alternative media. Additionally, a simple Google search of "cross posting" yields a significant number of industry practitioner blogs debating the pros and cons of this practice in social media marketing, with issues ranging from technological concerns (e.g., content appropriate to one medium may not render properly on another) to negative consumer perception and the possibility of miscommunication. One of the most notable concerns raised by practitioners is that different communities host different audiences with different interests and concerns. Given the above, formulating a distinct communication strategy for each medium is prudent, yet not costless. As such, developing an understanding of where to focus has potential value.

Further, as most crowdfunding platforms offer social login, operators have insight into network structures among users. Platform operators can thus offer recommendations to entrepreneurs about which connections to target with campaign solicitations. Crowdfunding platforms also regularly engage in their own marketing efforts on behalf of popular or trending campaigns; as such, they too can engage in targeted messaging based on these results.

The theory and notions underlying our hypotheses can also generalize to calls for participation in crowdsourcing efforts more broadly (e.g., citizen science; Wiggins and Crowston 2011), prosocial marketing efforts (e.g., drunk driving prevention; Kotler and Zaltman 1971), and other social media marketing activities, to any subject that bears a public good element. A sizable literature in marketing deals with the subject of seeding networks (e.g., Aral and Walker 2011; Hinz et al. 2011), and our work speaks to strategic implications for that practice. Products and services tend to fall along a continuum between purely public or private. Even those that are purely private in nature may be combined with social benefits (e.g., for every purchase, $1 will be donated to charity). In all these scenarios, marketers would stand to benefit from highlighting or stressing prosocial factors to individuals in embedded positions.

[5]These results should be interpreted cautiously because Facebook and Twitter differ in many respects, beyond average levels of network embeddedness; thus, these results may be driven by other factors.

Limitations and Conclusion

Our analyses leave open a number of future questions that others might address. For example, we have focused here on the volume of social media activity and the structure of overall networks. These measures are an accurate representation of the volume of social media activity and average embeddedness, but they do not enable us to account for the source of activity, individuals' network positions, or the nature of the content. Future research can build on our work, incorporating characteristics, network positions, and behaviors of individuals initiating posts, to draw additional insights or to account for textual features of the content being posted.

Also, our cross-platform comparison of social media activity on Twitter and Facebook, referred to in our discussion section and presented in Appendix B, is based on arguments that Facebook networks exhibit greater embeddedness than Twitter networks. As we lack Facebook network data, we cannot validate this argument in our sample. Future work might look to collect network data among Facebook posters, to enable a placebo test in which the relative returns to embeddedness for prosocial campaigns across Facebook and Twitter might be compared. Here, we would not expect to observe statistically significant differences, unless some other differences (beyond average embeddedness) exist between these two social media platforms that can drive our results.

Social media are now a regular element of individuals' everyday lives; thus, it is important to consider the role they play in various contexts. Given the highly social nature of crowdfunding, it is only appropriate that social media would play a prominent role in campaign fundraising. This study provides a significant effort aimed at understanding the social aspects of crowdfunding and, in particular, the importance of considering the characteristics of social networks between and amongst users, and how these may interact with the features of marketed subject matter. While social media is often treated as a marketing elixir, our work suggests that realizing value from social media depends a great deal on the implementation of an appropriate campaign strategy that jointly considers the campaign objective and embeddedness of a network.

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References

Agrawal, A., Catalini, C., and Goldfarb, A. 2014. "Some Simple Economics of Crowdfunding," *Innovation Policy and the Economy* (14), J. Lerner and S. Stern (eds.), Cambridge, MA: National Bureau of Economic Research, pp. 63-97.

Ahn, Y. Y., Bagrow, J. P., and Lehmann, S. 2010. "Link Communities Reveal Multiscale Complexity in Networks," *Nature* (466), pp. 761-764.

Andreoni, J., and Bernheim, B. D. 2009. "Social Image and the 50-50 Norm: A Theoretical and Experimental Analysis of Audience Effects," *Econometrica* (77:5), pp. 1607-1636.

Aral, S., Dellarocas, C., and Godes, D. 2013. "Introduction to the Special Issue—Social Media and Business Transformation: A Framework for Research," *Information Systems Research* (24:1), pp. 3-13.

Aral, S., and Walker, D. 2014. "Tie Strength, Embeddedness, and Social Influence: A Large-Scale Networked Experiment," *Management Science* (60:6), pp. 1352-1370.

Bapna, R., Qiu, L., and Rice, S., 2017. "Repeated Interactions Versus Social Ties: Quantifying the Economic Value of Trust, Forgiveness, and Reputation Using a Field Experiment," *MIS Quarterly* (41:3), pp. 841-866.

Bapna, S. 2017. "Complementarity of Signals in Early-Stage Equity Investment Decisions: Evidence from a Randomized Field Experiment," *Management Science* (forthcoming).

Benabou, R., and Tirole, J. 2006. "Incentives and Prosocial Behavior," *The American Economic Review* (96:5), pp. 1652-1678.

Bergstrom, T., Blume, L., and Varian, H. 1986. "On the Private Provision of Public Goods," *Journal of Public Economics* (29:1), pp. 25-49.

Bernheim, B. D. 1994. "A Theory of Conformity," *Journal of Political Economy* (104:5), pp. 841-877.

Burtch, G., Ghose, S., and Wattal, S. 2013. "An Empirical Examination of the Antecedents and Consequences of Contribution Patterns in Crowd-Funded Markets," *Information Systems Research* (24:3), pp. 499-519.

Centola, D. 2010. "The Spread of Behavior in an Online Social Network Experiment," *Science* (329:5996), pp. 1194-1197.

Coleman, J. S. 1988. "Free Riders and Zealots: The Role of Social Networks.," *Sociological Theory* (6:1), pp. 52-57.

Davis, J. A. 1979. "The Davis/Holland/Leinhardt Studies: An Overview," *Perspectives on Social Network Research*, P. W. Holland and S. Ž. Leinhardt (eds.), New York: Academic Press, Chapter 4, pp. 51-62.

Dimoka, A., Hong, Y., and Pavlou, P. 2012. "On Product Uncertainty in Online Markets: Theory and Evidence," *MIS Quarterly* (36:2), pp. 395-426.

Easley, D., and Kleinberg, J. 2010. *Networks, Crowds, and Markets: Reasoning About a Highly Connected World*, Cambridge, UK: Cambridge University Press.

Etter, V., Grossglauser, M., and Thiran, P. 2013. "Launch Hard or Go Home! Predicting the Success of Kickstarter Campaigns," in *Proceedings of the 1st ACM Conference on Online Social Networks*, New York: ACM Press, pp. 177-182.

Gerber, E. M., and Hui, J. 2013. "Crowdfunding: Motivations and Deterrents for Participation," *ACM Transactions on Computer-Human Interaction* (20:6), Article #34.

Girvan, M., and Newman, M. E. 2002. "Community Structure in Social and Biological Networks," *Proceedings of the National Academy of Sciences* (99:12), pp. 7821-7826.

Giudici, G., Nava, R., Rossi Lamastra, C., and Verecondo, C. 2012. "Crowdfunding: The New Frontier for Financing Entrepreneurship?," SSRN Working Paper No. 2157429.

Granovetter, M. 1973. "The Strength of Weak Ties," *American Journal of Sociology* (78:6), pp. 1360-1380.

Granovetter, M. 1985. "Economic Action and Social Structure: The Problem of Embeddedness," *American Journal of Sociology* (91:3), pp. 481-510.

Granovetter, M. 1992. "Problems of Explanation in Economic Sociology," in *Networks and Organizations*, N. Nohria and G. E. Robert (eds.), Boston: Harvard Business School Press, pp. 29-56.

Gu, B., Huang, Y., Duan, W., and Whinston, A. 2009. "Indirect Reciprocity in Online Social Networks—A Longitudinal Analysis of Individual Contributions and Peer Enforcement in a Peer-to-Peer Music Sharing Network," McCombs Research Paper Series, University of Texas at Austin.

Hinz, O., Skiera, B., Barrot, C., and Becker, J. U. 2011. "Seeding Strategies for Viral Marketing: An Empirical Comparison," *Journal of Marketing* (75:6), pp. 55-71.

Hong, Y., Huang, N., Burtch, G., and Li, C. 2016. "Culture, Conformity and Emotional Suppression in Online Reviews," *Journal of the Association for Information Systems* (17:11), pp. 737-758.

Hong, Y., and Pavlou, P. 2014. "Product Fit Uncertainty in Online Markets: Nature, Effects, and Antecedents," *Information Systems Research* (25:2), pp. 328-344.

Holland, P. W., and Leinhardt, S. 1971. "Transitivity in Structural Models of Small Groups," *Small Group Research* (2:2), pp. 107-124.

Hu, M., Li, X., and Shi, M. 2015. "Product and Pricing Decisions in Crowdfunding," *Marketing Science* (34:3), pp. 331-345.

Huang, N., Hong, Y., and Burtch, G. 2017. "Social Network Integration and User Content Generation: Evidence from Natural Experiments," *MIS Quarterly* (41:4), pp. 1035-1058.

Hughes, D., Rowe, M., Batey, M., and Lee, A. 2012. "A Tale of Two Sites: Twitter vs. Facebook and the Personality Predictors of Social Media Usage," *Computers in Human Behavior* (28:2), pp. 561-569.

Hui, J., Greenberg, M. D., and Gerber, E. M. 2014. "Understanding the Role of Community in Crowdfunding Work," in *Proceedings of the 17th Conference on Computer Supported Cooperative Work*, New York: ACM Press, pp. 62-74.

Kane, G., Alavi, M., Labianca, G., and Borgatti, S. P. 2014. "What's Different about Social Media Networks? A Framework and Research Agenda," *MIS Quarterly* (38:1), pp. 275-304.

Kaplan, A. M., and Haenlein, M., 2010. "Users of the World, Unite! The Challenges and Opportunities of Social Media," *Business Horizons* (53:1), pp. 59-68.

Koning, R., and Model, J. 2013. "Experimental Study of Crowdfunding Cascades," SSRN Working Paper (http://dx.doi.org/10.2139/ssrn.2308161).

Kotler, P., and Zaltman, G. 1971. "Social Marketing: An Approach to Planned Social Change," *Journal of Marketing* (3:3), pp. 3-12.

Kuppuswamy, V., and Bayus, B. L. 2015. "Crowdfunding Creative Ideas: The Dynamics of Project Backers in Kickstarter," SSRN Working Paper (http://dx.doi.org/10.2139/ssrn.2234765).

Lawton, K., and Marom, D. 2012. *The Crowdfunding Revolution: Social Networking Meets Venture Financing*, New York: McGraw Hill.

Lehner, O. M. 2013. "Crowdfunding Social Ventures: A Model and Research Agenda," *Venture Capital* (15:4), pp. 289-311.

Lewbel, A., 2012. "Using Heteroscedasticity to Identify and Estimate Mismeasured and Endogenous Regressor Models," *Journal of Business & Economic Statistics* (30:1), pp. 67-80.

Lin, M., Prabhala, N., and Viswanathan, S. 2013. "Judging Borrowers by the Company They Keep: Friendship Networks and Information Asymmetry in Online Peer-to-Peer Lending," *Management Science* (59:1), pp. 17-35.

Louch, H. 2000. "Personal Network Integration: Transitivity and Homophily in Strong-Tie Relations," *Social Networks* (22:1), pp. 45-64.

Lu, C., Xie, S., Kong, X., and Yu, P. 2014. "Inferring the Impacts of Social Media on Crowdfunding," in *Proceedings of the 7th ACM International Conference on Web Search and Data Mining*, New York: ACM Press, pp. 573-582.

Lukyanenko, R., Parsons, J., and Wiersma, Y. F. 2014. "The IQ of the Crowd: Understanding and Improving Information Quality in Structured User-Generated Content," *Information Systems Research* (25:4), pp. 669-689.

Majchrzak, A., and Malhotra, A. 2013. "Towards an Information Systems Perspective and Research Agenda on Crowdsourcing for Innovation," *Journal of Strategic Information Systems* (22:4), pp. 257-268.

Mollick, E. 2014. "The Dynamics of Crowdfunding: An Exploratory Study," *Journal of Business Venturing* (29:1), pp. 1-16.

Moody, J., and White, D. R. 2003. "Structural Cohesion and Embeddedness: A Hierarchical Concept of Social Groups," *American Sociological Review* (68:1), pp. 103-127.

Mossiyev, A. 2013. *Effect of Social Media on Crowdfunding Project Results*, unpublished doctoral dissertation, College of Business, University of Nebraska.–Lincoln.

Nakashima, N. A., Halali, E., and Halevy, N. 2017. "Third Parties Promote Cooperative Norms in Repeated Interactions," *Journal of Experimental Social Psychology* (68), pp. 212-223.

Ostrom, E. 2005. *Understanding Institutional Diversity* (Vol. 241). Princeton, NJ: Princeton University Press.

Ostrom, E., Burger, J., Field, C. B., Norgaard, R. B., and Policansky, D. 1999. "Revisiting the Commons: Local Lessons, Global Challenges," *Science* (284:5412), pp. 278-282.

Pennebaker, J. W., Boyd, R. L., Jordan, K., and Blackburn, K. 2015. "The Development and Psychometric Properties of LIWC2015," Department of Psychology, University of Texas at Austin.

Peng, J., Agarwal, A., Hosanagar, K., and Iyengar, R. 2018. "Network Overlap and Content Sharing on Social Media Platforms," *Journal of Marketing Research* (forthcoming).

Pietraszkiewicz, A., Soppe, B., and Formanowicz, M. 2017. "Go Pro Bono: Prosocial Language as a Success Factor in Crowdfunding," *Social Psychology* (48:5), pp. 265-278.

Reagans, R., and McEvily, B. 2003. "Network Structure and Knowledge Transfer: The Effects of Cohesion and Range," *Administrative Science Quarterly* (48:2), pp. 240-267.

Samuelson, P. A. 1954. "The Pure Theory of Public Expenditure," *The Review of Economics and Statistics* (36:4), pp. 387-389.

Schweidel, D. A., and Moe, W. W. 2014. "Listening in on Social Media: A Joint Model of Sentiment and Venue Format Choice," *Journal of Marketing Research* (51:4), pp. 387-402.

Sugden, R. 1984. "Reciprocity: The Supply of Public Goods through Voluntary Contributions," *The Economic Journal* (94:376) pp. 772-787.

Thies, F., Wessel, M., and Benlian, A. 2016. "Effects of Social Interaction Dynamics on Platforms," *Journal of Management Information Systems* (33:3), pp. 843-873.

Uzzi, B., and Gillespie, J. J. 2002. "Knowledge Spillover in Corporate Financing Networks: Embeddedness and the Firm's Debt Performance," *Strategic Management Journal* (23:7), pp. 595-618.

Varian, H. R. 2013. "Public Goods and Private Gifts," Working Paper, University of California, Berkeley.

Wasserman, S., and Faust, K. 1994. *Social Network Analysis: Methods and Applications* (Vol. 8), Cambridge, UK: Cambridge University Press.

Wiggins, A., and Crowston, K. 2011. "From Conservation to Crowdsourcing: A Typology of Citizen Science," in *Proceedings of the 44th Hawaii International Conference on System Sciences*, Los Alamitos, CA: IEEE Computer Society Press.

Yin, D., Bond, S., and Zhang, H. 2014. "Anxious or Angry? Effects of Discrete Emotions on the Perceived Helpfulness of Online Reviews," *MIS Quarterly* (38:2), pp. 539-560.

Zhang, J., and Liu, P. 2012. "Rational Herding in Microloan Markets," *Management Science* (58:5), pp. 892-912.

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RESEARCH ARTICLE

EMBEDDEDNESS, PROSOCIALITY, AND SOCIAL INFLUENCE: EVIDENCE FROM ONLINE CROWDFUNDING

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Appendix A

IV Regression

We explore the robustness of our main estimates to endogeneity. This is a concern if social media activity is, for example, influenced by campaign fundraising, implying simultaneity. Because we lack a traditional, theoretically motivated instrument, we employ the method of Lewbel (2012), constructing orthogonal instruments mathematically from covariates specified as exogenous. We treat the cumulative fundraising percentage and duration elapsed as exogenous, and construct instruments for the various endogenous terms incorporating embeddedness, tweet volumes, and their interactions with campaigns' prosocial orientation. We implement the regressions via the *ivreg2h* command in STATA, employing the *fe* option to account for our campaign fixed effects and incorporating daily time dummies. The results appear in Table A1.

Table A1. IV Regression Using Generated Instruments (DV = $\ln(\text{contribution})_{it}$)		
	(1) Transitivity	(2) Overlap
$Embeddedness_{t-1}$	0.137(0.331)	1.846(1.193)
$PublicOrientation * Embeddedness_{t-1}$	-0.065(0.036)	-0.300*(0.125)
$ln(tweets)_{t-1}$	0.244***(0.046)	0.249***(0.049)
$Embeddedness_{t-1} * ln(tweets)_{t-1}$	-0.084(0.141)	-0.670(0.496)
$PublicOrientation * ln(tweets)_{t-1}$	-0.005(0.003)	-0.006(0.003)
$PublicOrientation * Embeddedness_{t-1} * ln(tweets)_{t-1}$	0.029*(0.015)	0.123*(0.051)
Pct_target_{t-1}	0.023***(0.003)	0.023***(0.003)
$Pct\_duration_{t-1}$	0.136(0.076)	0.138(0.076)
Observations	29,965	29,965
Number of Projects	1,126	1,126
Project Fixed Effects	Yes	Yes
R-square	0.58	0.58
F-stat	478.88 (67, 28772)	477.71 (67,28772)
Kleibergen-Paap rk LM Chi²	618.839 (359)	472.032 (359)
Cragg-Donald Wald F	21.808	22.984

Notes: 1. Standard errors reported in parentheses, clustered by campaign.
2. ***p < 0.001, **p < 0.01, *p < 0.05.
3. Instruments for social network structure, tweet volumes, and interactions between the two and prosocial orientation are instrumented using generated instruments. Other covariates treated as exogenous.

Appendix B

Cross-Media Focus and Comparison

We contrast activity manifesting across different social media, to provide some evidence in support of our suggestion in the discussion section that crowdfunding campaign organizers (and marketers in general) may be better served by focusing on certain social media, depending on the nature of the message they are pushing (e.g., media that tend to exhibit higher closure rates should be preferable for marketing messages that play to a greater degree on public good/prosocial motives). This is valuable for practitioners because allocating resources to different social media channels is likely to be a straightforward consideration for an individual campaign organizer or marketer. In contrast, engaging in targeted advocacy within a given network, toward clusters of users exhibiting embeddedness, is likely to be more challenging for a typical campaign organizer or marketer. We thus focus on the contrast between Facebook and Twitter, the social media most commonly integrated into leading crowdfunding platforms.

The differences in design affordance between Facebook and Twitter are likely to lead to behavioral differences amongst users (Kane 2014). Twitter is particularly useful for information gathering (Granovetter 1973), broadcasting, and dissemination (Kwak et al. 2010). In contrast, Facebook servers as a true social venue, providing conditions better suited to the manifestation of cooperative norms and social image concerns. Empirical evidence in the academic literature supports the supposition that Facebook networks exhibit greater levels of embeddedness than Twitter networks, on average. As an example, Ugander et al. (2011) report that the median Facebook user exhibits a local clustering coefficient of 0.14, whereas Han et al. (2016) report that Twitter users of comparable degree exhibit a local clustering coefficient of just 0.10, indicating that Twitter users of comparable network size maintain fewer embedded ties and more open networks than comparable Facebook users. Accordingly, we have cause to believe that public-good oriented campaigns should benefit more from Facebook buzz than Twitter buzz, a belief we test empirically in our Kickstarter data.

To test for this association, we revisited the Kickstarter campaigns in our sample, scraping the aggregate Facebook share volumes associated with each campaign at the time of data collection (well after campaign completion). We then aggregated our panel data from our main analyses

to the campaign level, resulting in a cross-sectional sample of campaigns, wherein we observe total fundraising, goal, duration, category, prosocial orientation (based on our LIWC dictionary approach), total tweet volumes, and total Facebook shares. We then estimated a simple regression of the natural log of the total dollar fundraising outcome onto these various factors, interacting our prosociality measure with each social media activity measure. Ultimately, we compare the two interaction effects, to assess the relative value of each type of social media activity, depending on campaigns' orientations. The results of this regression are reported in Table B1. Figure B1 presents an interaction plot of the resulting marginal effect estimates, as a spotlight analysis (+/– 1 standard deviation around the average of our prosocial measure).

Finally, to alleviate the endogeneity concern of this cross-sectional analysis, we again employ the method of Lewbel (2012). We specify five endogenous variables, *ln(tweets)*, *ln(fb shares)*, *PublicOrientation*, and interaction terms between *PublicOrientation* and *ln(tweets)*, *ln(fb shares)*, respectively. The results are reported in Column (3) of Table B1. Overall, we observe the same pattern as the estimation results without IV.

Table B1. Cross-Media Estimation

	(1) OLS ln(contribution)	(2) OLS ln(contribution)	(3) IV ln(contribution)
ln(tweets)	0.225*** (0.037)	0.526*** (0.119)	1.146***(0.181)
ln(fb shares)	0.474*** (0.039)	0.329*** (0.091)	0.102(0.154)
PublicOrientation	—	-0.015 (0.058)	-0.081(0.117)
*PublicOrientation*ln(tweets)*	—	-0.032** (0.012)	-0.103***(0.020)
*PublicOrientation*ln(fb shares)*	—	0.016* (0.010)	0.068***(0.020)
Ln(goal)	0.249*** (0.034)	0.253*** (0.034)	0.174***(0.039)
Duration	-0.002 (0.003)	-0.002 (0.003)	-0.002(0.003)
Constant	2.909*** (0.261)	2.921*** (0.588)	2.802***(0.988)
Category FEs	Yes	Yes	Yes
Observations	1,091	1,091	1,091
R-squared	0.506	0.514	0.456

Notes: 1. Standard errors reported in parentheses.
2. Coefficients significant at level ***p < 0.01, **p < 0.05, *p < 0.1.
3. A few campaigns from the original sample were dropped because they were no longer visible when we performed subsequent Facebook data collection.

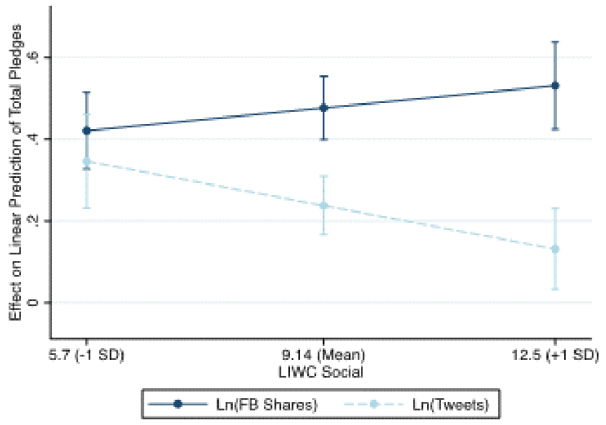

Figure B1. Spotlight Analysis

References

Granovetter, M. 1973. "The Strength of Weak Ties," *American Journal of Sociology* (78:6), pp. 1360-1380.

Han, W., Zhu, X., Zhu, Z., Chen, W., Zheng, W., and Lu, J. 2016. "A Comparative Analysis on Weibo and Twitter," *Tsinghua Science and Technology* (21:1), pp. 1-16.

Lewbel, A. 2012. "Using Heteroscedasticity to Identify and Estimate Mismeasured and Endogenous Regressor Models," *Journal of Business & Economic Statistics* (30:1), pp. 67-80.

Kane, G. 2014. "Enterprise Social Media: Current Capabilities and Future Possibilities," *MIS Quarterly Executive* (14:1), pp. 1-16.

Kwak, H., Lee, C. , Park, H., and Moon, S. 2010. "What Is Twitter, a Social Network or a News Media?," in *Proceedings of the 19th International Conference on World Wide Web*, New York: ACM Press, pp. 591-600.

Ugander, J., Karrer, B., Backstrom, L., and Marlow, C. 2011. "The Anatomy of the Facebook Social Graph," Cornell University, arXiv preprint arXiv:1111.4503.