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Industry Event Participation and Network Brokerage among Entrepreneurial Ventures

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ABSTRACT Despite the recognition that network brokerage is beneficial for entrepreneurial ventures, little is known about its antecedents. This study examines how participation in industry events (e.g. conferences) relates to entrepreneurs' brokerage positions in informal industry networks and how these positions, in turn, impact new venture performance. Using a unique dataset of 45 events and subsequent network relations among entrepreneurs from 90 firms in the open source software industry, results indicate that: (1) entrepreneurs who participated in heterogeneous events or who bridged between events with few common participants were more likely to be brokers; (2) the relationship between event bridging and brokerage was stronger for entrepreneurs with broader prior career experiences; and (3) network brokerage mediated the event participation–performance link. It appears that events may limit structural opportunities for brokerage and that individual differences matter for exploiting these opportunities. Overall, this study increases understanding of how and when particular networking behaviours are beneficial for entrepreneurs.

INTRODUCTION

The network perspective in entrepreneurship research maintains that embeddedness in social networks strongly influences entrepreneurs' ability to found and grow new firms (Aldrich and Zimmer, 1986; Birley, 1985). Through their network relationships, entrepreneurs identify business opportunities (Ozgen and Baron, 2007), acquire financial and human resources (Shane and Cable, 2002), and build legitimacy for their ventures (Stuart et al., 1999). Prior research has specifically shown that entrepreneurs who occupy brokerage positions by bridging 'structural holes' (Burt, 1992) between unconnected others benefit from valuable access, timing, and control benefits (McEvily and Zaheer, 1999; Stam and Elfring, 2008). In this regard, Burt (2000, p. 372) noted that 'entrepreneurship is inherently an exercise in the social capital of structural holes' such that 'this structurally based theory has intriguing possibilities for entrepreneurial research' (Hoang and Antoncic, 2003, p. 172).

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So far, prior research has focused on identifying strategic network positions but has neglected the logical prior question of how these positions can be obtained (Hallen, 2008; Stuart and Sorenson, 2008). This question is important, because research has shown that entrepreneurs' initial social capital endowments often comprise a small set of cohesive strong ties (Renzulli et al., 2000). To facilitate venture growth, however, entrepreneurs must enrich their networks by adding non-redundant bridging ties (Hite and Hesterly, 2001). Yet how entrepreneurs may become network brokers still remains unclear (Ozcan and Eisenhardt, 2009), especially given the evidence that they often form ties with well-known and similar others (Ruef et al., 2003). What is needed, then, is research that identifies the networking behaviours that facilitate entrepreneurs in bridging structural holes.

The current study addresses this challenge by examining how entrepreneurs' participation in industry events influences their brokerage positions in informal industry networks and how these positions, in turn, impact new venture performance. Lampel and Meyer (2008, p. 1026) describe industry events as 'settings in which people from diverse organizations and with diverse purposes assemble periodically, or on a one-time basis, to announce new products, develop industry standards, construct social networks, recognize accomplishments, share and interpret information, and transact business'. Studying events is important, because entrepreneurs invest substantial resources in organizing and attending them (Browning and Adams, 1988). Little is known, however, about when event participation facilitates entrepreneurs in developing effective networks. Given that unstructured networking may reduce one's network diversity and entails significant opportunity costs (Davis et al., 2006), a key question is what forms of event participation enable entrepreneurs to become network brokers.

Rather than arguing that all forms of event participation are equally beneficial for any entrepreneur, the main thesis I wish to advance is that only some events offer brokerage opportunities and that entrepreneurs differ in their propensity to exploit such opportunities. In particular, I build on the idea that ties emerge among those involved in joint activities (Feld, 1981) and argue that by examining patterns of entrepreneurs' affiliations with different industry events, one can identify events that offer the greatest brokerage *potential*. Event characteristics thus capture the set of meeting opportunities available to entrepreneurs.

To advance a richer understanding of when entrepreneurs are most likely to *realize* potential brokerage opportunities at events, I focus on how the breadth of their prior career experience moderates the link between event participation and brokerage. Based on the premise that forging ties with unfamiliar others requires certain social skills and credentials on behalf of the entrepreneur (Baron and Markman, 2003), I argue that entrepreneurs' prior experience influences their willingness and ability to initiate novel encounters at events.

The empirical setting of this research is the emerging open source software industry in the Netherlands. Combining unique participant data of 45 industry events covering a five-year period with original data on the pattern of social ties among entrepreneurs in this industry, I empirically examine how event participation by entrepreneurs is related to their brokerage positions in the industry's informal network structure, and if brokerage mediates the link between event participation and new venture performance.

The contributions of this study are twofold. First, it extends recent efforts to understand the origins of the network positions of entrepreneurial ventures (Ozcan and Eisenhardt, 2009). While past network research has argued that prior structural embeddedness constrains a firm's subsequent tie-formation opportunities (Ahuja, 2000), this study shows that entrepreneurs from less well-endowed firms may still *create* brokerage opportunities by strategically participating in events. Yet the findings also suggest that certain types or combinations of events limit structural opportunities for brokerage and that entrepreneurs differ in their propensity to exploit these opportunities. Second, this study contributes to the entrepreneurship literature, which so far has paid scant attention to the influence of industry events on entrepreneurial outcomes (Garud, 2008). By showing that different events may differentially shape network-building among pioneers in a nascent field, this research enhances understanding of the mechanisms through which initially dispersed actions of individual entrepreneurs may aggregate into a larger collective needed for successful industry emergence (Hargrave and Van de Ven, 2006).

THEORETICAL BACKGROUND AND HYPOTHESES

Compared to more mature organizations, entrepreneurial ventures face important liabilities of newness and smallness that threaten their survival and growth (Aldrich, 1999; Stinchcombe, 1965). Building a fledgling new firm requires that entrepreneurs identify a promising business opportunity and assemble the knowledge, people, and capital to exploit it (Katz and Gartner, 1988). As these resources are often initially unavailable, entrepreneurs must develop social network relationships that facilitate the search for and mobilization of resources (Aldrich and Zimmer, 1986; Birley, 1985).

The importance of networks for the entrepreneurial process has spurred research on the network positions that are most beneficial. A key finding is that entrepreneurs who bridge 'structural holes' among unconnected others perform better than those embedded in cohesive, homogeneous networks (McEvily and Zaheer, 1999; Nicolaou and Birley, 2003). These 'network entrepreneurs' (Burt, 2005, p. 228) indirectly link previously disconnected social circles, thereby enjoying valuable information and control benefits. Information benefits stem from early and efficient access to more diverse information, while control benefits flow from being in an autonomous, powerful position to exploit information asymmetries among unconnected actors (Burt, 1992).

The idea that brokerage positions yield returns raises the question how these positions can be obtained. Several streams of research have begun to address this issue. First, the interorganizational network literature has identified both exogenous and endogenous determinants of interfirm tie formation (Ahuja, 2000). Exogenous factors involve firms' motivations to create ties resulting from resource interdependencies or institutional demands, while endogenous factors encompass the tie formation opportunities provided by a firm's prior network embeddedness (Gulati and Gargiulo, 1999). Collectively, this research emphasizes that firms tend to minimize uncertainty by building cohesive networks through forming repeated ties with familiar partners of similar status. Yet how firms can form more distant, 'non-local' ties with unfamiliar firms remains unclear (Ozcan and Eisenhardt, 2009).

Focusing at the individual level, a second research stream has examined patterns of tie formation in intraorganizational networks. A key insight, the so-called 'homophily' principle (McPherson et al., 2001), states that similar individuals are more likely to interact. Yet empirical evidence also suggests that some individuals transcend this natural tendency by forming ties to more distant parts of the organization. Scholars examining the individual correlates of brokerage have revealed the impact of personality traits such as self-monitoring (Oh and Kilduff, 2008), as well as individual cognition (Krackhardt, 1987) in shaping one's network position. Yet again, what individuals can do to become brokers and when these networking behaviours are most effective remains unclear (Shipilov et al., 2007).

To address this limited understanding, the current paper examines how different forms of participation in industry events relate to entrepreneurs' brokerage positions in informal industry networks. In the next sections, I formulate several hypotheses regarding the link between event participation, structural holes, and new venture performance.

Industry Events and Network Formation among Entrepreneurs

Network theory suggests that relationship formation is not only a function of individual preferences, but can also be significantly constrained by structural opportunities for contact (Feld, 1981; Ruef et al., 2003). In this regard, Blau (1987, p. 79) adeptly noted that 'one cannot marry an Eskimo, if no Eskimo is around'. Interaction opportunities are contingent upon spatial proximity and the presence of social settings that enable individuals from diverse social circles to meet and interact. Indeed, the success of Silicon Valley has been attributed to the emergence of informal networks among entrepreneurs whose daily rounds tend to intersect in social settings related to work and local community life (Saxenian, 1994). The presence of such 'foci' (Feld, 1981) increases the probability that pairs of strangers meet and develop new ties. Thus, without contexts that enable social interaction there will be no 'meeting' and hence also no 'mating' (Verbrugge, 1977) among entrepreneurs in an industry.

Industry events such as conferences and business meetings represent unique temporary occasions for entrepreneurs to share knowledge, develop industry standards, and organize collective action (Garud, 2008). As such, events facilitate the collective nature of entrepreneurship (Schoonhoven and Romanelli, 2001) by serving as a social context in which entrepreneurs may interact with significant others. Notwithstanding these potential benefits, however, not all events are equally likely to create value for entrepreneurs. The core mechanism through which events generate value is by serving as networking platforms, which facilitate 'elemental encounters' (Ingram and Morris, 2007, p. 559) that allow entrepreneurs to identify and exploit business opportunities. This logic suggests that industry events may either facilitate entrepreneurs' network-building efforts or constrain them to meet new people, as it depends on the type of interaction opportunities offered by those events.

The structural holes perspective predicts that entrepreneurs emerge as brokers when they interact with others who have few shared relationships (Burt, 1992). In this paper, I propose that there are at least two distinct networking behaviours that enable entrepreneurs to become brokers: (1) attending heterogeneous events, defined as events

attracting participants with diverse characteristics and organizational affiliations; and (2) participation in multiple homogeneous events that share few participants. The importance of the former stems from the homophily principle, which states that dissimilar people are less likely to interact (McPherson et al., 2001). The compositional heterogeneity of an event thus indicates whether there are, a priori, structural holes among its participants. Yet even when entrepreneurs attend homogeneous events, they may still obtain brokerage positions if there is sufficient heterogeneity between those events. According to Feld (1981), individuals are less likely to be connected when they do not participate in joint activities. Participant heterogeneity across events thus signifies whether those events, taken together, offer entrepreneurs non-redundant networking opportunities (Burt, 1992).

Event Participation and Network Brokerage

Event heterogeneity. Conferences, business meetings, and other industry events differ in the extent to which they attract participants with different backgrounds and organizational affiliations. Whereas some events are highly heterogeneous, composed of entrepreneurs who operate in diverse market domains, other events are restricted to interactions among entrepreneurs from the same niche. Events may be relatively homogeneous on average, as participants are often recruited through preexisting networks (McPherson et al., 2001), yet variation in heterogeneity across events can still be expected.

In the present study, events unfolding in the emerging Dutch open source software industry indeed ranged from highly diverse to very homogeneous. For instance, events like the 2004 'open source experiences' conference assembled a mixture of entrepreneurs from various sectors who shared stories about commercial, technological, legal, and financial challenges related to the commercialization of open source software. By contrast, events such as those organized by various software developer communities often only attracted entrepreneurs from firms offering related products and services based on those software technologies.

The compositional heterogeneity of an industry event will affect the likelihood that its participants are initially unconnected (Davis et al., 2006). Interpersonal similarity encourages interactions because homophilous relations are often more rewarding, entail less uncertainty, and maintain existing status orderings (McPherson et al., 2001). This suggests that heterogeneous events provide entrepreneurs with a richer 'opportunity structure' (Ibarra, 1993) to bridge structural holes among strangers who share few relationships. When entrepreneurs attend events where diverse individuals assemble, homophily preferences are strongly reduced by limited availability of similar others. By contrast, entrepreneurs participating in homogeneous events are more constrained in their opportunities to expand their social networks. In this case, entrepreneurs experience significant 'induced homophily' (McPherson and Smith-Lovin, 1987), because homogeneous settings reinforce a natural preference for ties with familiar others.

The above logic suggests that participation in heterogeneous events will facilitate network brokerage through an opportunity-mediated mechanism. It should be noted, however, that events will almost never be completely heterogeneous such that

entrepreneurs may still prefer to form redundant, homophilous relations even when they attend relatively heterogeneous events. Yet before delving into the role of individual preferences, I first examine the baseline prediction that event heterogeneity yields brokerage opportunities among entrepreneurs. Specifically, I propose:

> *Hypothesis 1*: The degree of heterogeneity among all events in which an entrepreneur has participated is positively related to the entrepreneur's brokerage position in the industry's social network structure.

Event bridging. In examining how network structure is shaped by social settings, Feld (1981, p. 1016) noted that relationships tend to form around a focus, defined as 'a social, psychological, legal, or physical entity around which joint activities are organized'. Individuals whose activities are affiliated with the same focus (e.g. membership in the same sports club, living in the same neighbourhood) thus tend to form a dense cluster of network ties among each other. Despite this local clustering, however, Breiger (1974) noted that events not only create ties among actors, but actors with multiple affiliations also establish linkages between events, thereby integrating the different social groups and activities that are organized around these foci (Faust, 1997).

Of special interest is whether entrepreneurs serve as a unique bridge (Granovetter, 1973) by creating linkages between otherwise disconnected events. Entrepreneurs whose networking behaviours display high degrees of 'bridging' attend non-redundant events that attract different people. Participant heterogeneity *between* events ensures that entrepreneurs have opportunities to meet others who are unlikely to know each other from joint participation in common events (Feld, 1981). By contrast, entrepreneurs who engage in low levels of event bridging participate in redundant events with overlapping participants. In this case, entrepreneurs mainly reinforce preexisting ties established at prior events, but lack opportunities to meet new people.

As an illustration, consider the case of two entrepreneurs, Emma and David, who each participate in three conferences (A, B, C, D, or E). Figure 1 visualizes the patterning of these entrepreneur–event affiliations. Both participate in three events, but the affiliation network reveals that Emma is the one who creates unique bridges between otherwise disconnected events. Her events share no common participants and therefore yield non-redundant networking opportunities (e.g. with actors 1, 5, and 8). By contrast, David attends events that attract the same participants (e.g. actors 1, 2, and 3). As a result, David is more likely to establish contacts who are all connected through joint participation in common events.

First-hand observations of event participation in the Dutch open source software industry also revealed how event bridging yielded brokerage opportunities. For instance, the industry initially witnessed rapid growth and fragmentation as many new firms, projects, and initiatives emerged without much coordination and mutual awareness. As multiple groups began to organize their own events, some entrepreneurs turned this situation to their advantage and emerged as network brokers by attending disparate events and linking the cliques that had gradually formed around them. In so doing, some became prominent community leaders who enjoyed privileged access to information on

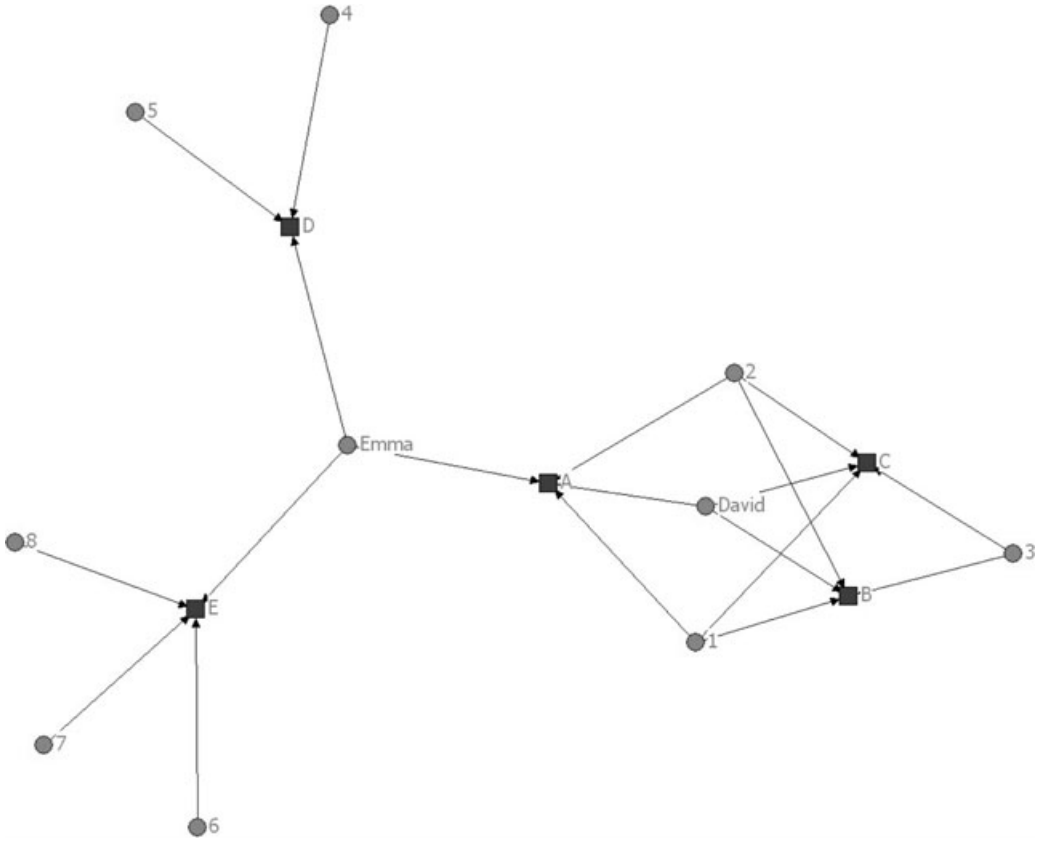

Figure 1. Illustration of event bridging

Note: Circles represent entrepreneurs, whereas events are denoted by squares. An arrow *ij* indicates that entrepreneur *i* participated in event *j*.

new developments and had greater visibility among potential customers like the Dutch government, which had become an important buyer of open source software. Interestingly, event bridging appeared especially valuable for entrepreneurs during these early stages of industry development, as individual events only began to transform into collective action in 2005 when the 'Holland Open' association was founded with the aim to further unite community activities by organizing an annual conference and monthly networking receptions.

More broadly, there are several reasons for why event bridging enables entrepreneurs to obtain brokerage positions. First, exposure to new people constrains entrepreneurs' natural tendency to rely on preexisting network contacts to establish new ties. This lack of familiar faces encourages entrepreneurs to initiate new encounters with strangers (Ingram and Morris, 2007). By contrast, when entrepreneurs repeatedly attend events with the same individuals they are more likely to use referrals from these preexisting contacts, thereby increasing their network cohesion. Second, limited joint event participation among an entrepreneur's network contacts minimizes the possibility that those persons meet and form a direct tie. By serving as a unique bridge between different

events, entrepreneurs may establish non-redundant network contacts that have few opportunities to directly interact. When an entrepreneur's network contacts do participate in common events, however, they are likely to connect and develop shared relations, thereby eliminating potential brokerage opportunities (Feld, 1981).

Similar to the previous hypothesis, the anticipated link between event bridging and network brokerage is premised on an opportunity-mediated mechanism. Notwithstanding increased brokerage opportunities, however, events will almost never be entirely non-redundant such that entrepreneurs may still only interact with the few participants whom they already know from prior events. To disentangle the role of opportunities and preferences, I first test the baseline prediction that event bridging will support network brokerage and examine the role of individual differences in the next section. Specifically, I hypothesize:

> *Hypothesis 2*: The degree of bridging among all events in which an entrepreneur has participated will be positively related to the entrepreneur's brokerage position in the industry's social network structure.

Realizing Brokerage Opportunities: The Moderating Role of Prior Experience

So far the assumption has been that once event participation affords entrepreneurs potential brokerage opportunities, they will automatically enact those opportunities. Previous research suggests, however, that interaction opportunities alone are a necessary but insufficient condition for relationships to be formed (Ahuja, 2000). That is, entrepreneurs need to possess the appropriate motivation and capability to take advantage of the brokerage opportunities that emerge from participation in industry events.

I build on these ideas by proposing that the breadth of entrepreneurs' prior career experiences increases their willingness and ability to pursue brokerage opportunities. Breadth of prior experience is defined as the range of an entrepreneur's past work experience across different industries, organizations, and functional areas. Entrepreneurs with a wide array of prior experience have accumulated more diverse knowledge, skills, and relationships than entrepreneurs with a very narrow career path. Past research has revealed the importance of entrepreneurs' past experiences by showing that they strongly affect the strategies, structures, and performance of their ventures (Burton et al., 2002; Eisenhardt and Schoonhoven, 1990). Extending this literature, I examine how the breadth of entrepreneurs' prior experiences conditions the link between event participation and network brokerage.

Breadth of prior experience increases entrepreneurs' pursuit of brokerage opportunities among other event participants for three reasons. First, recent research has shown that as individuals gain more experience, they become more adept at accurately perceiving network structures (Janicik and Larrick, 2005). Rather than assuming that entrepreneurs possess certain innate capabilities to detect structural holes, this literature suggests that entrepreneurs develop cognitive abilities during their careers that improve their ability to recognize brokerage opportunities at industry events.

Second, entrepreneurs with broad prior experience are more motivated to enact brokerage opportunities. Past involvement in diverse social groups reduces an individual's perceived uncertainty associated with brokerage (Burt, 2000). When entrepreneurs have worked in different settings, they feel more comfortable pursuing the information and control benefits of structural holes. Krackhardt (1999) indeed argues that multiple group affiliations may induce role conflict that translates into stress and uncertainty, suggesting that prior experience in resolving such tensions facilitates the pursuit of brokerage opportunities at industry events.

Third, breadth of prior experience enhances entrepreneurs' ability to initiate novel encounters and broker connections among event participants. Nahapiet and Ghoshal (1998) argue that relationships are more likely to be formed among individuals with shared languages and experiences. This suggests that entrepreneurs with diverse experiences possess the necessary social skills (Baron and Markman, 2003) that enable them to interact with event participants who speak different languages. Compared to entrepreneurs with narrow prior experiences, these entrepreneurs are also more attractive network contacts since they possess valuable human and social capital resources.

In sum, the above suggests that the broader the prior experience of entrepreneurs, the more they will pursue brokerage opportunities at industry events. Thus, I hypothesize:

Hypothesis 3a: The relationship between event heterogeneity and network brokerage will be stronger for entrepreneurs with broad prior experience than for entrepreneurs with narrow prior experience.

Hypothesis 3b: The relationship between event bridging and network brokerage will be stronger for entrepreneurs with broad prior experience than for entrepreneurs with narrow prior experience.

Event Participation and New Venture Performance: The Mediating Role of Brokerage

Extant literature presents accumulating empirical evidence for the positive link between network brokerage and the performance of entrepreneurial ventures (McEvily and Zaheer, 1999; Nicolaou and Birley, 2003; Stam and Elfring, 2008). Brokerage facilitates early access to more diverse information about changing market conditions, competitor strategies, and partnership opportunities (Galaskiewicz and Zaheer, 1999). Entrepreneurs with brokerage positions span otherwise disconnected industry firms by moving ideas from one to another, thereby making novel and wealth-creating combinations (Hargadon, 2002).

Linking this empirical evidence regarding the positive performance impact of network brokerage with the first three hypotheses on the interactive effects of entrepreneurs' event participation and prior experience on brokerage, a mediating role of network brokerage in the event participation–performance relationship can be expected. A mediation model points to the idea that event participation affects the brokerage positions of

entrepreneurs, which in turn influence the performance of their firms. Thus, network brokerage constitutes the causal mechanism through which event participation translates into venture performance outcomes.

In addition to network brokerage, however, there may be other important mechanisms at play. Previous literature has highlighted at least two: (1) knowledge acquisition; and (2) legitimation. First, industry events represent platforms through which entrepreneurs may acquire essential market and technological knowledge from other industry participants (Ozgen and Baron, 2007). Second, industry events enable entrepreneurs to develop legitimacy among external constituents. New ventures face the problem that potential resource providers may not understand or acknowledge the new business concept (Aldrich and Fiol, 1994). At industry events, entrepreneurs can engage in story-telling to present their innovations as more appropriate than existing alternatives (Lounsbury and Glynn, 2001). Hence, event participation may also impact venture performance via learning or legitimacy mechanisms.

Based on the above, I theorize that brokerage partially mediates the link between event participation and new venture performance. That is, attending events influences entrepreneurs' brokerage positions within industry networks, which in turn affect new venture performance. Compared to the case of full mediation, where brokerage would completely account for the performance impact of event participation, I hypothesize partial mediation in order to acknowledge that learning and legitimization constitute equally important mechanisms underlying the event participation–performance relationship. Hence, I propose:

Hypothesis 4a: Network brokerage partially mediates the relationship between event heterogeneity and new venture performance.

Hypothesis 4b: Network brokerage partially mediates the relationship between event bridging and new venture performance.

As a summary, Figure 2 presents the conceptual model underlying the predicted relationships between event participation, network brokerage, and new venture performance.

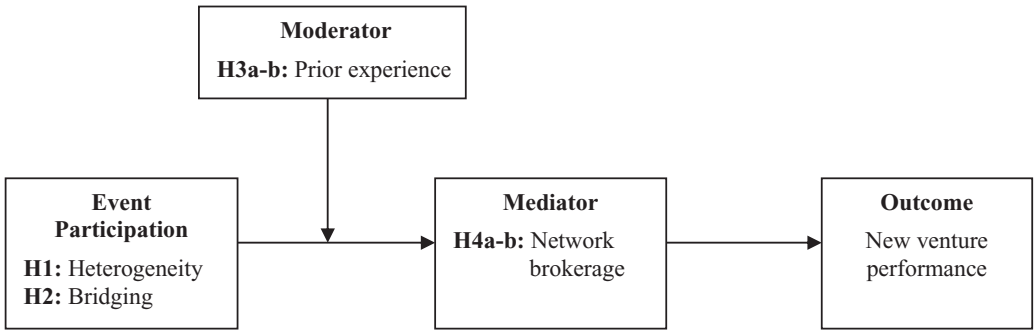

Figure 2. Conceptual model

METHODS

Research Setting

This study was situated in the open source software industry in the Netherlands. In recent years, many new ventures have emerged that sell open source software products and services. These firms employ innovative business models that include several distinctive features, including: (1) using and contributing to online community resources; (2) employing mainly open standards; (3) applying new forms of intellectual property protection; and (4) adhering to a different ideology about the generation and appropriability of innovations (Bonaccorsi et al., 2006). Accordingly, this research examined a distinct population of firms whose boundaries were defined by spatial proximity, common resource needs, and shared institutional pressures.

Several features of this industry made it an appropriate setting. First, it involved a nascent market in which networks are still emerging. Past research has mostly concentrated on alliance formation. Yet in new industries alliance networks have yet to emerge, thus pointing to the need to understand the formation of informal networks. Second, the industry association, software developer associations, and the government have organized various industry events aimed at network formation. Thus, this setting offered a unique opportunity to study the link between event participation, network brokerage, and venture performance.

Data Collection

Data were collected from multiple sources to enhance the validity and reliability of the measures. I combined secondary data on industry events with survey data obtained directly from the entrepreneurs.

Event data. I obtained data on entrepreneurs' event participation from multiple archival data sources. Industry events first included various conferences on Linux and open source software that had been organized since the end of the 1990s. Next, software developer communities such as the Dutch UNIX User Group and the Dutch Linux User Group had organized several technology-oriented conferences and seminars that were intended to share and diffuse knowledge on new open source technologies. Third, various informal meetings had been initiated by the industry association VOSN, the government agency OSOSS, and the MMBase Foundation, amongst others. Most of these events were structured around several distinct themes such as 'open source and government', 'open source business models', 'reliability and costs of open source', and 'participating in open source communities'.

Given the prevalent use of the internet in this research setting, data on most events could be gathered online. I conducted online searches using keywords like 'Linux' and 'open source', together with items such as 'conference', 'seminar', and 'meeting'. Moreover, websites of relevant industry organizations were consulted to identify additional events. These websites often contained an overview of the programme and the names of the speakers, track chairs, and participants. Given the problem that some websites were unavailable, I used the 'Wayback Machine' to search for older versions of these websites.

This allowed me to trace additional information on the events. Finally, I collected participant data directly from event organizers. Taken together, the use of various data sources resulted in a total of 45 events that took place during 1999–2004. Although the possibility that certain events are unobserved cannot be ruled out, data triangulation reduced this problem considerably.

Social network and company data. Data on social networks, prior experience, and venture performance were collected through a two-wave survey that was administered with the founders of each firm. I gathered data on the independent variables in May 2005. One year later, a second survey was administered to obtain new venture performance data.

In the absence of a complete overview of all firms in the industry, I identified the complete study population by following a two-step approach (Laumann et al., 1983). First, I used several secondary data sources to construct an initial list of firms. Relevant sources included: (1) the membership list of the Dutch open source trade association, called 'Vereniging Open Source Nederland' (VOSN); (2) the website of the governmental program 'Open Standards and Open Source Software' (OSOSS) that contained a list of open source companies; and (3) internet searches by means of keywords such as 'open source solutions', 'open source services', and 'Linux solutions'. In total this search resulted in 127 firms. In the second step, I conducted interviews with key informants knowledgeable about the industry to validate the initial list. The experts were asked to indicate which firms had to be added to or deleted from the list. Nine ventures were mentioned by more than one expert and were added, yielding 136 firms in total. Since 11 ventures had gone out of business or had ceased their open source activities, the final study population amounted to 125 firms.

After using the informant interviews as input for questionnaire construction, I first pretested the questionnaire on six firms. I followed several suggestions by Dillman (2000) in order to maximize response rates. Firms were sent a letter stating the purpose and importance of the research project, followed by a phone call in which they were requested to participate. Whenever possible, appointments were made during which the questionnaires were personally administered on-site. Of the 195 surveys sent, 121 entrepreneurs from 90 ventures responded, representing an overall participation rate of 72 per cent (i.e. 90/125) and an internal response rate of 62 per cent (i.e. 121/195). Missing data reduced the usable sample to 87 firms. One year later, in 2006, a second survey was mailed directly to the same respondents to assess their firm's performance. This yielded 102 responses from 75 firms, for an 86 per cent overall response rate and a 73 per cent internal response rate.

Analyses of non-response in both survey rounds indicated no significant differences between respondents and non-respondents in terms of firm age, firm size, and number of events attended. Since respondents indicated their ties to all firms, I also assessed differences in number of incoming ties. This analysis revealed no significant variation between respondents and non-respondents (5.71 versus 4.29 ties; $t = 1.25$, $p < 0.21$). As for the second survey, I examined differences in firms' past performance. Using data on performance evaluations relative to competitors obtained from the first survey round, this exercise revealed that respondent firms had experienced a slightly higher past performance (mean past performance of 4.70 versus 4.28; $t = 1.98$, $p < 0.05$).

Measures

New venture performance. While studies have employed various measures to gauge new venture performance, scholars agree that sales growth constitutes a key performance indicator for entrepreneurial firms (Zahra, 1996). Given the unavailability of secondary data on firms' sales, I followed previous research (e.g. Wiklund and Sheperd, 2005) by asking entrepreneurs to state their firm's sales over 2004 and 2005. Sales growth was measured as the relative change in total sales over both years. To assess the validity of this measure, I assessed its correlation with a subjective performance measure. Respondents were asked to rate their venture's sales growth, employment growth, market share, gross profits, and net profit margin over the previous two years relative to competitors. A seven-point Likert scale was employed ranging from 'much worse' to 'much better' ($\alpha = 0.83$). A significant positive correlation between both measures ($r = 0.56$, $p < 0.01$) supported the validity of the sales growth measure.

Network brokerage. I mapped the informal networks among the firms by using the roster method (Wasserman and Faust, 1994) in which respondents were presented with a list with the names of all firms in their industry. Specifically, entrepreneurs were asked to check off those firms 'where you personally know the CEO or someone else from the board' and 'where you are friends with the CEO or someone else from the board'. The responses were combined into a single binary 90×90 matrix and were symmetrized using the union rule (Wasserman and Faust, 1994), i.e. if either member of a pair nominated the other, the pair of firms was considered to have a tie. Findings remained unchanged when alternative approaches to symmetrize the data were used. To capture each firm's network brokerage, I used the complete network data to calculate each firm's network constraint (Burt, 1992, p. 55):

$$c_{ij} = \left(p_{ij} + \sum_{q} p_{iq} p_{qj} \right)^2, q \neq j, i \tag{1}$$

where p_{ij} represents the proportional strength of ties between firm i and firm j. Summing across all contacts j yielded each firm's aggregate network constraint. Since constraint measures a firm's lack of structural holes, I computed network brokerage as 1 minus the firm's aggregate constraint score. Scores were multiplied by 100 to yield integer values.

Event heterogeneity. Participant data on all 45 industry events were arranged in a binary 90×45 event data matrix, in which cell Xij was coded '1' when any of firm i's founders had participated in event j. I measured event heterogeneity as the extent to which entrepreneurs attended events that had attracted firms from different product and market domains. To collect data on firms' business activities, the survey asked respondents to check off the product and service categories in which their firms had been active. In total, 14 categories were distilled from past research (e.g. Bonaccorsi et al., 2006).[1] I then compared the responses across all entrepreneurs who participated in the same event. To measure dissimilarity between two firms' business activities, I followed Tsai

(2000, p. 932) by creating a variable counting the number of categories for which firms i and j had different responses. This variable ranged from 0 (both firms operated in exactly the same domains) to 14 (both firms operated in entirely different domains). Summing these scores across all pairs of firms participating in event w and dividing by the number of pairs yielded the heterogeneity score of that event:

$$eh_w = \frac{1}{Nw(Nw-1)} \sum_{i=1}^{Nw} \sum_{j=1}^{Nw} \sum_{k=1}^{14} (a_{ik} - a_{jk})^2, i \neq j. \quad (2)$$

To arrive at an average event heterogeneity score for each firm, I summed the individual heterogeneity scores of all events in which its founders had participated and divided this value by the number of events.

Event bridging. The pattern of a firm's event affiliations was considered 'bridging' when its founders connected otherwise disconnected events. Following Faust (1997), I measured event bridging using a betweenness centrality measure since 'actors are always between events', suggesting that 'betweenness centrality will be appropriate for studying affiliation networks' (Faust, 1997, p. 163). Since betweenness centrality measures the number of times each actor falls onto the shortest path between each pair of events, it effectively captures whether a firm's founders bridged otherwise disconnected events. Since betweenness centrality is applied to square matrices, the 90×45 data matrix was transformed into a bipartite graph (Faust, 1997). Using this new 135×135 data matrix, I calculated each firm's betweenness centrality. This measure is large when entrepreneurs attended multiple events that shared few other participants connecting them.

Prior experience. The breadth of entrepreneurs' prior experience was measured as a count of the total number of areas in which they had worked prior to founding the current venture. Following prior research (Beckman and Burton, 2008), entrepreneurs were asked to indicate their prior experience across the following six areas: (1) industry experience; (2) start-up experience; (3) senior management experience; and functional experience in (4) R&D, (5) marketing & sales, and (6) finance. The count measure ranged from a low of 0 (no experience) to a maximum of 6 (experience in all six areas).

Control variables. Several controls were included in the analyses. *Firm age* was taken as the logarithm of the number of years since firms were founded. *Firm size* was calculated as the logarithm of total number of employees including founders. Next, I controlled for new ventures' *entrepreneurial orientation* by including Covin and Slevin's (1989) nine-item scale ($\alpha = 0.84$). Entrepreneurs' *network size* was also controlled for by including their in-degree centrality. This measure sums for each firm its corresponding column in the 90×90 data matrix to yield all direct nominations from other actors in the network, thereby overcoming limitations of self-reports (Wasserman and Faust, 1994). I controlled for *participation frequency* by computing the total number of events attended by the entrepreneurs. This measure was log-transformed to reduce positive skew and account for possible diminishing marginal benefits of participation. Finally, I included a dummy variable *event*

role that equalled one when the entrepreneur had at least once assumed an 'active role' (i.e. organizer, keynote speaker, or track chair) at an event. Given the possibility that entrepreneurs' prior network ties affects their subsequent event participation and network brokerage, controlling for activities that are generally performed by well-networked entrepreneurs may remove spuriousness in the link between the focal event participation variables and brokerage.

Common Method Bias

Podsakoff et al. (2003) noted that using self-reports may introduce common method bias that threatens the validity of the research findings. I therefore implemented several procedures to minimize method variance. First and foremost, I obtained measures of the main independent, mediating, and outcome variables from different sources. Whereas performance data were self-reported, event participation data originated from archival sources and I collected network data from all respondents to construct the network measures. Podsakoff et al. (2003, p. 897) noted that this is a most powerful procedure such that additional statistical remedies are unnecessary. Second, I introduced a time lag between the measurement of the independent (event participation in 1999–2004), mediating (brokerage in 2005), and dependent variables (sales growth in 2005–06). Third, I assessed interrater reliabilities for the 29 firms where I obtained data from multiple respondents. Intraclass correlation coefficients for the measures of sales growth (ICC = 0.78) and breadth of prior experience (ICC = 0.83) exhibited high interrater reliability (Shrout and Fleiss, 1979). Although method variance cannot be ruled out completely, these procedures suggested it was unlikely to be a problem.

Analytical Approach

The hypothesized main and interaction effects were tested using hierarchical regression analysis (Cohen and Cohen, 1983). Multiple models were constructed to identify the unique contributions of the main effects of event participation and prior experience, and their interactive effects, to the variance explained in network brokerage. For interpretation purposes, I mean-centred the variables prior to the formation of interaction terms, as recommended by Aiken and West (1991).

Given some high pairwise correlations reported in Table II, there is concern about the potential of multicollinearity. Although coefficient estimates are unlikely to be biased, collinearity inflates standard errors, making it more difficult to obtain significant results. To assess this issue, I examined several collinearity diagnostics. According to Belsley et al. (1980), multicollinearity is a concern when a predictor has a variance-inflation factor (VIF) larger than 10 or a conditioning index greater than 30. The maximum (average) VIF was 2.46 (1.56) and the maximum (average) conditioning index was 13.68 (4.06), considering all variables in the models. In addition, if collinearity is severe, we would expect that parameter estimates are unstable to small changes in model specification. I therefore ran a series of models with each hypothesized variable included individually. In all cases, the sign and significance of the reported estimates remained substantively unchanged across all models.

To test the mediation hypotheses, I conducted a series of hierarchical regressions based on the causal steps approach recommended by Baron and Kenny (1986): (1) regressing the dependent variable on the independent variables; (2) regressing the mediator on the independent variables; and (3) regressing the dependent variable on both the independent variables and the mediator. In the case of moderated mediation, the interaction terms are included in each regression (Muller et al., 2005).

ANALYSES AND RESULTS

Descriptive Statistics

Table I presents some descriptive statistics of the sample firms. Most firms are still young and small, as can be expected in an emerging industry. Consistent with prior research on the open source software industry (Bonaccorsi et al., 2006), most firms in the Dutch

Table I. Descriptive statistics[a]

	Mean	*S.D.*	*Min.*	*Max.*
Firm characteristics				
Firm age	4.89	3.29	1.16	15.08
Firm size	5.31	7.49	1.00	50.00
Sales in 2004 (in €1000)	257.00	395.00	5.00	1,900
Sales in 2005 (in €1000)	232.66	237.49	15.00	2,300
Share of open source software sales[b]	0.70	0.35	0.00	1.00
Share of government and non-profit sales[b]	0.27	0.29	0.00	0.99
Share of SME sales[b]	0.42	0.35	0.00	1.00
Share of foreign sales[b]	0.04	0.10	0.00	0.50
Number of product market domains active	6.41	3.32	3.00	12.00
Founding team characteristics				
Team size	2.01	1.35	1.00	8.00
IT industry experience[c]	12.82	11.09	0.00	60.00
Marketing and sales experience[c]	2.82	5.20	0.00	24.00
R&D and engineering experience[c]	9.14	11.37	0.00	60.00
Finance experience[c]	2.19	4.59	0.00	20.00
Senior management experience[c]	5.07	7.35	0.00	29.00
Start-up experience[d]	1.26	1.84	0.00	8.00

Notes:
[a] N = 75.
[b] Computed as a percentage of total sales in 2004.
[c] Measured as the team's total number of years of work experience at time of firm formation.
[d] Measured as the team's total number of prior foundings at time of firm formation.

market are active in multiple market segments and combine open and closed source software into hybrid solutions. Examining the prior experiences of the entrepreneurs reveals that most had substantial prior experience in the information technology industry but were relatively inexperienced in marketing and finance.

Table II provides means, standard deviations, and zero-order correlations among the variables used in the analyses. As shown, the typical entrepreneur had participated in about two events, with a maximum of nine events. Regarding the network variables, entrepreneurs from a typical firm were nominated as acquaintances or friends by founders from five other firms (maximum network size was 28). As expected, significant positive correlations existed between entrepreneurs' event participation, network brokerage, and new venture performance.

Hypothesis Tests

Table III presents the results of the hierarchical regression analyses used to predict network brokerage. At Step 1, I included only the control variables. As shown in Model 1 of Table III, the set of control variables explained a significant share of the variance in network brokerage ($R^2 = 0.31$, $p < 0.001$). Both network size ($b = 2.00$, $p < 0.01$) and participation frequency ($b = 23.59$, $p < 0.10$) had a significant positive relationship with brokerage, suggesting that entrepreneurs with larger networks and who had participated in more events were more likely to occupy brokerage positions in the industry's social network structure.

Next, Step 2 introduced the main effects of event heterogeneity and event bridging to test Hypotheses 1–2. This addition significantly increased the variance explained in brokerage relative to the baseline model ($\Delta R^2 = 0.12$, $p < 0.01$). In support of Hypothesis 1, which predicts a positive relationship between event heterogeneity and brokerage, Model 4 of Table III shows that the coefficient for event heterogeneity is positive and statistically significant ($b = 4.86$, $p < 0.05$). Next, Hypothesis 2 states that event bridging is positively related to network brokerage. As shown in Model 4 of Table III, the results provide support for Hypothesis 2 ($b = 0.18$, $p < 0.01$). Interestingly, the coefficient of participation frequency is no longer significant in Model 4. This result illustrates that frequent event participation can actually either enhance or constrain entrepreneurs' brokerage positions, as it depends on the compositional characteristics of the events in which entrepreneurs participate.

At Step 3, I entered the two interaction terms to test Hypotheses 3a and 3b. Hypothesis 3a predicts that prior experience moderates the relationship between event heterogeneity and network brokerage in such a way that the link is stronger when entrepreneurs have broader experience. As shown in Model 5 of Table III, Hypothesis 3a received no support ($b = -0.71$, N.S.). Yet Hypothesis 3b, which states that prior experience positively moderates the relationship between event bridging and brokerage, was supported by the data ($b = 0.08$, $p < 0.05$). Using results from Model 5, I followed Aiken and West (1991) by plotting the relationship between event bridging and network brokerage at low and high values (i.e. mean $\pm$ 1 S.D.) of prior experience. As shown in Figure 3, event bridging indeed has a more positive relationship with brokerage for entrepreneurs with broad experience.

Table II. Means, standard deviations, and correlations[a]

	Mean	*S.D.*	*Min.*	*Max.*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
1. New venture performance	29.80	33.34	−50.00	125.00										
2. Event heterogeneity	3.96	3.11	0.00	11.07	0.41**									
3. Event bridging	56.75	62.30	0.00	255.00	0.51**	0.40**								
4. Network brokerage	60.68	31.83	0.00	100.00	0.48**	0.46**	0.52**							
5. Prior experience	3.20	1.71	0.00	6.00	0.13	−0.13	0.09	−0.01						
6. Firm age	4.89	3.29	1.16	15.08	0.03	0.12	0.12	0.13	−0.12					
7. Firm size	5.31	7.49	1.00	50.00	0.36**	0.26*	0.26*	0.12	−0.05	0.34**				
8. Entrepreneurial orientation	4.33	0.97	2.00	6.44	0.26*	0.25*	0.20	0.12	0.27*	−0.10	0.15			
9. Network size	5.03	5.59	0.00	28.00	0.45**	0.40**	0.55**	0.49**	0.12	0.22	0.38**	0.25*		
10. Participation frequency	1.52	2.18	0.00	9.00	0.42**	0.57**	0.63**	0.46**	−0.01	0.27*	0.29*	0.12	0.59**	
11. Event role	0.47	0.46	0.00	1.00	0.27*	0.08	0.09	0.25*	0.21*	−0.20*	0.18	0.09	0.24*	0.24*

Notes:
[a] N = 75.
* $p < 0.05$, ** $p < 0.01$.

Table III. Hierarchical regression results predicting network brokerage[a]

Independent variables	*Network brokerage*				
	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*
Step 1: Control variables					
Firm age	5.21	5.39	8.23	8.43	7.94
	(10.04)	(9.81)	(9.67)	(9.40)	(9.29)
Firm size	−10.29	−7.64	−13.41	−9.84	−5.28
	(9.03)	(9.05)	(8.74)	(8.65)	(9.21)
Entrepreneurial orientation	0.37	−1.073	0.46	−1.64	−1.23
	(3.47)	(3.64)	(3.43)	(3.47)	(3.42)
Network size	2.00**	1.87*	1.54*	1.35†	1.20
	(0.76)	(0.75)	(0.76)	(0.74)	(0.75)
Participation frequency	23.59†	7.94	4.05	−9.94	−8.98
	(12.91)	(14.39)	(14.11)	(15.12)	(14.91)
Event role	9.85	11.59	14.73†	15.16*	14.90*
	(7.67)	(7.64)	(7.59)	(7.39)	(7.28)
Step 2: Main effects					
Event heterogeneity		4.96*		4.86*	4.51*
		(2.32)		(2.21)	(2.24)
Event bridging			0.19**	0.18**	0.15*
			(0.07)	(0.07)	(0.07)
Prior experience		−0.58	−2.20	−1.15	0.16
		(2.04)	(1.94)	(1.95)	(2.04)
Step 3: Interactions					
Event heterogeneity × experience					−0.71
					(0.96)
Event bridging × experience					0.08*
					(0.04)
Model F	5.08***	4.65***	5.20***	5.42***	4.93***
R^2	0.31	0.36	0.39	0.43	0.46
Adjusted R^2	0.25	0.28	0.31	0.35	0.37
ΔR^2		0.05†	0.08*	0.12**	0.03

Notes:
[a] N = 75.
† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; standard errors in parentheses.

To test Hypotheses 4a and 4b, I conducted a moderated mediation analysis. According to Baron and Kenny (1986), three conditions must be met to establish mediation: (1) the independent variables significantly affect the mediator; (2) the mediator is significantly related to the dependent variable; and (3) after controlling for the mediator, the effects of the independent variables on the dependent variable are no longer significant ('full mediation') or are significantly reduced in strength ('partial mediation'). For moderated mediation, an additional requirement is that the relationship between either the independent variables and the mediator, or the mediator and the dependent variable, is moderated (Muller et al., 2005).

As shown in Model 4 of Table III, both event heterogeneity ($b = 4.86$, $p < 0.05$) and event bridging ($b = 0.18$, $p < 0.05$) have a significant positive relationship with network brokerage, thus satisfying the first condition for mediation. As shown in Model 6 of

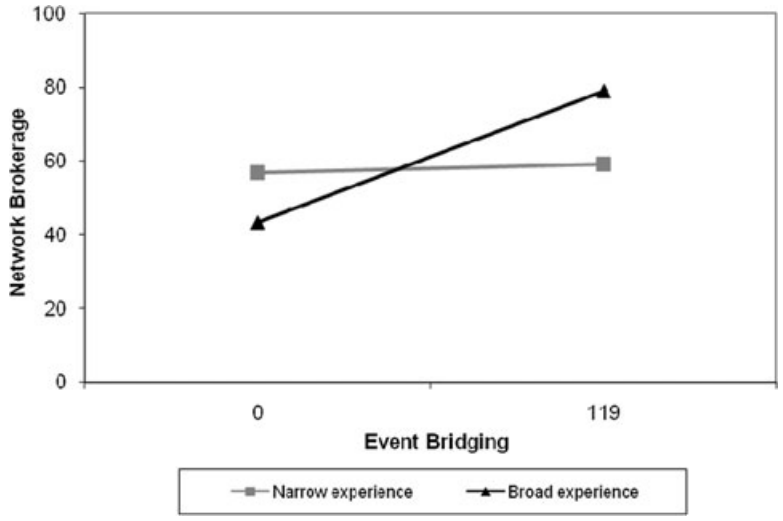

Figure 3. Event participation and prior experience interaction

Table IV, the second condition was also supported since network brokerage was significantly positively related to new venture performance ($b = 28.86$, $p < 0.05$). Turning to the third condition, Models 5 and 6 in Table IV indicate that the positive effect of event heterogeneity on performance was no longer statistically significant after brokerage was controlled for ($b = 4.92$, $p < 0.05$ versus $b = 3.62$, N.S.). Thus, all three conditions for mediation were met and Hypothesis 4a was supported. Finally, a comparison of Models 5 and 6 in Table IV reveals that the positive relationship between event bridging and new venture performance significantly diminished after controlling for network brokerage ($b = 0.18$, $p < 0.01$ versus $b = 0.12$, $p < 0.10$). This suggests partial mediation, thus providing support for Hypothesis 4b.

To increase understanding of these results, I tested the significance of the conditional indirect effects at different levels of the moderator using the bootstrapping method described by Preacher et al. (2007, pp. 198–200).[2] With no moderator in the model, the indirect effects of event heterogeneity and event bridging were both significant (95% CI: 0.0689, 4.0547; and 0.0004, 0.1095, with 5000 resamples). Consistent with Hypothesis 3b, however, including the moderating role of prior experience revealed that the indirect effect of event bridging on performance was insignificant (95% CI: –0.0461, 0.1066; $Z = 0.44$, N.S.) at low experience, marginally significant at moderate prior experience (95% CI: 0.0076, 0.1245; $Z = 1.70$, $p < 0.10$), and significantly positive at high levels of experience (95% CI: 0.0255, 0.2008; $Z = 1.96$, $p < 0.05$). Muller et al. (2005, p. 859) note that 'this pattern is what is expected under prototypical moderated mediation' and is consistent with the observation that the event bridging and experience interaction term turns negative in Model 4 of Table IV. It indicates that the indirect effect of event bridging, via the mediator, is much higher when experience is high rather than low, while the residual direct effect is much higher when experience is low rather than high. For inexperienced entrepreneurs, event bridging still enhances performance but these entail direct, not mediated, effects.

Table IV. Results of mediation analysis[a]

Independent variables	*New venture performance*					
	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*	*Model 6*
Step 1: Control variables						
Firm age	−11.31	−11.01	−8.56	−8.34	−7.34	−9.63
	(10.40)	(10.16)	(10.21)	(9.91)	(9.86)	(9.62)
Firm size	18.07†	22.59*	16.81†	22.66*	14.40	15.93†
	(9.35)	(9.38)	(9.23)	(9.12)	(9.77)	(9.50)
Entrepreneurial orientation	4.32	1.53	3.31	1.04	0.68	1.03
	(3.59)	(3.77)	(3.62)	(3.65)	(3.63)	(3.53)
Network size	1.20	0.94	0.69	0.48	0.77	0.42
	(0.79)	(0.78)	(0.80)	(0.78)	(0.80)	(0.79)
Participation frequency	24.80†	9.97	9.39	−5.71	−6.03	−3.44
	(13.36)	(14.90)	(14.89)	(15.93)	(15.82)	(15.39)
Event role	6.52	6.21	8.88	9.35	9.45	5.14
	(7.94)	(7.91)	(8.01)	(7.78)	(7.73)	(7.74)
Step 2: Main effects						
Event heterogeneity		5.33*		5.24*	4.92*	3.62
		(2.41)		(2.33)	(2.38)	(2.38)
Event bridging			0.16*	0.16*	0.18**	0.12†
			(0.07)	(0.07)	(0.07)	(0.07)
Prior experience		2.25	0.61	1.75	0.56	0.51
		(2.11)	(2.05)	(2.05)	(2.17)	(2.10)
Step 3: Interactions						
Event heterogeneity × experience					−0.52	−0.31
					(1.02)	(0.99)
Event bridging × experience					−0.06	−0.08*
					(0.04)	(0.04)
Step 4: Mediator						
Network brokerage						28.86*
						(12.97)
Model F	5.46***	4.93***	5.00***	5.28***	4.65***	4.94***
Adjusted R^2	0.27	0.30	0.30	0.34	0.35	0.39
ΔR^2		0.05†	0.05†	0.10*	0.03	0.04*

Notes:
[a] N = 75.
† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; standard errors in parentheses.

Robustness Analyses

I conducted several robustness checks. First, I tested the assumption that joint event participation increases the likelihood that two entrepreneurs actually have a network tie. To conduct this dyadic analysis, I used the multiple regression quadratic assignment procedure (MRQAP) developed by Krackhardt (1987). This is a non-parametric test that regresses a dependent matrix on one or several independent matrices. The main advantage of MRQAP is its robustness against autocorrelation of errors commonly found in

Table V. Results of MRQAP analysis predicting social ties[a]

Independent matrix	*Unstandardized coefficient*
Firm age similarity	0.00
Firm market domain similarity	0.05***
Entrepreneur background similarity	0.01
Joint event participation	0.26***
Intercept	0.02
Adjusted R^2	0.27

Notes:
[a] Number of permutations = 4000.
[†] $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

network data (Krackhardt, 1987). My dependent matrix was the social network among the entrepreneurs and the independent matrices were joint event participation, firm age similarity, product market domain similarity, and entrepreneurs' prior experience similarity.[3] Consistent with my assumptions, Table V reveals that joint event participation was indeed a significant determinant of social ties among the entrepreneurs ($b = 0.26$, $p < 0.001$).

Second, I conducted the analyses using an alternative measure of event heterogeneity. Again using formula (2), I computed event heterogeneity as the average dissimilarity between the prior experiences of the entrepreneurs participating in the same event. This analysis showed that the main effects of event heterogeneity on brokerage and performance were insignificant. Yet the interactive effect of event heterogeneity and experience on network brokerage was positive and significant ($p < 0.10$). Using the alternative heterogeneity measure thus provided no support for Hypothesis 1, but supported Hypothesis 3a.

Third, I tested alternative models by adding additional control variables including event size (measured by average number of participants), founding team size, and firms' level of open source specialization (measured as share of open source activities in total sales). For these analyses, the results were consistent with those presented in this paper.

DISCUSSION

This study examined how participation in industry events structures the network positions of entrepreneurs and how these positions, in turn, impact their venture's performance. Although prior studies established the value of brokerage for entrepreneurs (Hoang and Antoncic, 2003), few have addressed the networking behaviours through which entrepreneurs may become brokers (Ozcan and Eisenhardt, 2009). The empirical results reveal that: (1) entrepreneurs who participated in heterogeneous events or who bridged between events with few common participants were more likely to be brokers; (2) the relationship between event bridging and brokerage was stronger for entrepreneurs with broader prior career experiences; and (3) network brokerage mediated the event participation–performance link.

In studying the role of event characteristics, I found that simply participating in more events did not increase entrepreneurs' access to structural holes. Rather, the results show that entrepreneurs who participated in events with diverse participants were more likely to occupy brokerage positions, whereas those attending homogeneous events actually tended to be embedded in cohesive networks. This result is interesting, because it indicates that industry events represent social settings that exert significant structural constraints on entrepreneurs' network-building efforts. To date, prior research has emphasized the individual dispositions and abilities that account for observed differences in individuals' social capital endowments (e.g. Oh and Kilduff, 2008). This study extends this line of work by revealing that the network positions of entrepreneurs are also structured by the characteristics of the social contexts in which they build network relations. Irrespective of entrepreneurs' individual preferences for close, homophilous relationships (Aldrich, 1999), industry events appear to constrain individual dispositions by limiting the pool of contacts whom entrepreneurs can meet and form ties with.

Interestingly, this research also shows that entrepreneurs may escape the constraints of homogeneous events by bridging between multiple events that each attract different sets of participants. Participation in homogeneous events can still foster the development of structural holes as long as there is sufficient heterogeneity between those events. This finding suggests that only studying the characteristics of a single event may paint an incomplete picture of its value for entrepreneurs. To more fully understand the implications of event participation, it is critical to adopt a holistic perspective and consider the level of non-redundancy across *all events* in which an entrepreneur participates. According to Burt (1992), the building blocks of structural holes are ties to non-redundant network contacts. My research extends this idea by suggesting that to explain the formation of non-redundant ties, scholars need to consider the overall efficiency of the networking behaviours of entrepreneurs in terms of the interaction opportunities they generate.

The observed positive interactive effect of event bridging and prior experience on brokerage suggests that different entrepreneurs might differentially take advantage of brokerage opportunities at industry events. It appears that entrepreneurs with broad experience tend to develop brokerage positions in informal industry networks when they bridge between non-redundant events, whereas those with narrow prior experience are less likely to realize these brokerage opportunities. Traditionally, the structural perspective has ignored interpersonal differences that might affect how individuals arrive at and benefit from their network positions (Kilduff and Krackhardt, 1994). Although some studies have begun to address this limitation by examining how individual differences moderate social capital performance effects (e.g. Batjargal, 2007), few studies exist that analyse how individuals' characteristics shape the effectiveness of their actual network-building efforts (Baron and Markman, 2003). This study thus makes a contribution by revealing that entrepreneurs' human capital conditions the returns to their network-building behaviours.

The results also indicated a relationship between entrepreneurs' involvement in industry events and new venture performance, with network brokerage mediating this link. This finding is important for two reasons. First, it extends the emerging literature on network formation by revealing an important antecedent of structural holes. Although much research has focused on the consequences of network brokerage,

few studies have examined through what networking behaviours brokerage positions can be obtained (Hoang and Antoncic, 2003). Burt (2005, p. 28) indeed noted that 'brokerage creates an advantage, but we know little about how people come to be brokers'. This study reveals the role of industry events as social settings that structure entrepreneurs' brokerage positions, thus adding to recent explanations based on individual personality (Oh and Kilduff, 2008) and social skills (Baron and Markman, 2003).

Second, it contributes to the literature on entrepreneurship and industry emergence (Aldrich and Fiol, 1994; Garud, 2008) by exposing how events may structure network formation among pioneers in a nascent field. As noted by Hargrave and Van de Ven (2006, pp. 873–4), new industries only take off when 'the paths of independent entrepreneurs, acting out their own diverse intentions and ideas, intersect'. Yet despite the importance of social interactions for collective action and coordination among innovative entrepreneurs (Aldrich and Fiol, 1994), we know little about when and how disparate sets of entrepreneurs in new fields come to 'run in packs' (Hargrave and Van de Ven, 2006, p. 873). This study contributes by exposing conditions under which industry events perform a 'linking-pin' role and enable the social integration of an emerging industry's subsystems. Studying industry emergence, then, requires consideration of how events mediate important micro-macro linkages. Future research could, e.g. fruitfully examine how the sequence of industry events unfolding in a nascent industry relates to the speed and effectiveness by which initially uncoordinated entrepreneurial activities transform into collective action among its members.

Limitations and Future Research

This study has several limitations that point to interesting avenues for future research. First, the use of self-reports may have introduced common method bias. Following Podsakoff et al. (2003), I took several steps to address this issue including the use of multiple data sources (e.g. secondary event data, complete network data), a time lag between data collection on the main independent, mediating, and outcome variables, multiple measures, and secondary respondents. It is also unlikely that the observed interaction effect was artifactually caused by the respondents. Nevertheless, readers are advised to interpret the results with caution.

Second, the generalizability of the results may be limited. In response to recent calls for more research on networks and entrepreneurship in emerging industries (Aldrich and Fiol, 1994), the empirical context concerned a dynamic, emerging high-technology industry. Future studies are encouraged to examine the link between event participation, social networks, and performance in other empirical contexts. An interesting question is whether the results hold for the intraorganizational context since events may also structure internal networks.

Third, the event data employed in this research may suffer from sample selection and restricted range bias. Although I used multiple sources to identify relevant events, it could be that certain events – especially those that were more informal, small-scale, and perhaps less successful – were excluded from the data. In addition, the average

participation frequency in this research setting was rather low and its distribution was skewed. The data therefore did not provide a range of event participation full enough to permit testing for curvilinear effects.

Fourth, my cross-sectional network data did not capture the dynamic interplay between event participation, social networks, and performance. Yet it is likely that entrepreneurs' prior network ties, experience, and success affected their event participation. It is therefore vital that future work examines the co-evolution of event participation and its outcomes over time. Longitudinal studies could track how industry events facilitate network-building among entrepreneurs and how these ties, in turn, affect entrepreneurs' propensity to participate in new events. This research may also examine the motivations of entrepreneurs to attend events. Knowing that events impact entrepreneurial outcomes raises the question how entrepreneurs decide which events to attend and whether their participation is intentional and strategic.

Fifth, future research is encouraged to examine other mediators of the event participation–performance link since multiple mechanisms may be at play. The current study's exclusive focus on network structure can be extended by drawing from cognitive theories (e.g. Porac et al., 1995) to examine how industry events influence the development of shared mental models among entrepreneurs. Viewing events as key settings for sensemaking (Garud, 2008), future work may go beyond the notion that events facilitate networking by considering the link between these micro interactions and convergence or dispersion in entrepreneurs' perceptions of their task environments. In doing so, new insights may also be gained into the process by which product categories arise and develop in nascent industries (Lounsbury and Rao, 2004). In addition, future work may adopt an institutional perspective (e.g. Aldrich and Fiol, 1994) and investigate the relationship between industry events and the legitimation activities of innovative entrepreneurs. It would be valuable to discover what events trigger entrepreneurs' awareness of the specific legitimacy needs of their ventures and how different events provide distinct social cues on what legitimation strategies might work best. Collectively, these research streams may increase understanding of when industry events enable or constrain the development and growth of entrepreneurial ventures.

Practical Implications

Despite some limitations, this research provides important practical implications. The results indicate that heterogeneous and non-redundant events may facilitate entrepreneurs in building strategic network positions. Thus, this study lends support for the value of organizing networking events where industry participants can meet strangers and bridge structural holes. In particular entrepreneurs with small and cohesive networks will benefit from attending events, as the findings demonstrate that it is brokerage that accounts for the performance effects of event participation. Yet the findings also highlight that event participation is not costless, as homogeneous and redundant events appears to constrain entrepreneurs' network-building. This result shows that rather than focusing on how many events to attend, entrepreneurs must carefully consider the compositional heterogeneity and bridging potential of the events that they consider attending. Thus, the findings underscore that it is more beneficial for entrepreneurs to participate in events

where they do not know anyone compared to co-attending events with existing network contacts. In so doing, they may serve as a critical linking pin and obtain strategic brokerage positions in the network structure of their industry.

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NOTES

[1] As noted by Lounsbury and Rao (2004), ambiguity often exists as to the appropriate classification scheme of firms operating in an industry. Especially in emerging fields, categorizations may be subject to diverse interpretations and significant change. To deal with this issue, I primarily relied on prior research by Bonaccorsi et al. (2006) who identified relevant categories for classifying open source software companies. For services, categories included installation, documentation, distribution, consulting, training, support, and maintenance. For products, categories included entertainment & multimedia applications, networking/internet applications, productivity applications, enterprise solutions, operating systems, systems and development tools, and content management systems. Although the assumption that each pair of categories is equally distinct may not necessarily be valid for all pairs, the overall validity of the categorization was supported by the fact that similar categories were used in available industry directories of open source companies that were maintained by the Dutch government institute OSOSS at the time of the study.

[2] A common approach to test the significance of mediation effects is the Sobel test, which evaluates the statistical significance of each indirect effect by dividing the product of coefficients of each indirect path by its standard error (Shrout and Bolger, 2002). Yet since the product of coefficients has a skewed distribution in case of small to moderate samples, the Sobel test can be inefficient and prone to erroneous conclusions (Shrout and Bolger, 2002). I therefore applied the bootstrapping methodology described by Shrout and Bolger (2002, pp. 426–9) and Preacher et al. (2007, pp. 198–200), which constructs asymmetric confidence intervals to assess the significance of individual mediation effects. The results of this procedure confirmed that both mediation effects were significant, thus supporting Hypotheses 4a and 4b. Moreover, in support of Hypothesis 3b, these analyses revealed that the indirect effect of event bridging was conditional on the breadth of entrepreneurs' prior experience.

[3] In the 'joint event participation' matrix, cell X*ij* equals the number of common events in which entrepreneurs from firm *i* and firm *j* participated. As for the 'firm age similarity' matrix, cell X*ij* indicated the difference in firm age between firm *i* and *j*. I also created a matrix 'product market similarity' in which cell X*ij* showed the total number of product/service categories in which both firms were active (ranging from 0 to 14). Finally, in the matrix 'prior experience similarity' cell X*ij* indicated the total number of prior experience areas (i.e. prior industry, managerial, entrepreneurial, R&D, marketing, and finance experience) that entrepreneurs from firm *i* and *j* had in common (ranging from 0 to 6).

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