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Formation of ties through action learning: A case from a multicultural entrepreneurship camp

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Background: Entrepreneurship camps are an important platform for students to learn through action-based learning, problem-solving, knowledge and information sharing, which is enhanced through the development of social networks and their dynamics within the networks.

Aim: The research aims to: (1) explore the formation and development of networks and structure in the network over time and (2) explore the association between predominant personality traits and network position measures and network locations in the networks.

Setting: This study is conducted on a multicultural entrepreneurship camp involving 35 master's students from three Norwegian and two South African universities, which took place for two weeks in South Africa. The objective of the entrepreneurship camp is to empower students through entrepreneurship by knowledge and action-based learning.

Methods: This is a quantitative study using social network analysis (SNA) in a case study. Three rounds of questionnaires were distributed to capture the network data, individual learning and personality traits.

Results: There is an increase in network density over time, and the students' network positions have improved during the camp. The two predominant personality traits that positively relate to network position and cliques are extraversion and openness to experience.

Conclusion: The case provides evidence of a favorable climate for learning by improved network position and overall network density. The predominant of personality traits in relation to a specific network measure were also identified.

Contribution: This study contributes to theory by offering one of the first empirical investigations of entrepreneurship camps using social network analysis and also exploring the personality traits (Big Five).

Keywords: entrepreneurship camp; social network analysis; action-based learning; personality traits; network centrality; cliques; South Africa; Norway.

Introduction

Small businesses are key drivers of economic growth as they create more new jobs than larger firms; this resulted in policymakers and economic developers asking 'how can we get more entrepreneurs and create more new jobs' (Rideout & Gray 2013:329). Governments in sub-Saharan Africa, where youth unemployment is a social and economic challenge, have placed emphasis on entrepreneurship and small enterprise development as the viable solution with the aim to foster job creations and resolve poverty problems (Kuada 2011; Maxwell & Stephen 2018). University-based entrepreneurship education has introduced the camp model and concepts, which has benefits such as out-of-box thinking and experiments and team building (Bager 2011). Entrepreneurship education literature has shown the importance of entrepreneurship camps as a platform for training and mentoring young entrepreneurs. These entrepreneurship camps became popular in several countries, for example, in Denmark alone there were at least 40 camps during 2005–2008 (Bager 2011); other examples are from the United States (Bodnar, Clark & Besterfield-Sacre 2015) and Norway (Neergard, Aaboen & Politis 2022). In these entrepreneurship camps, the intention is to provide action learning for which 'learning by doing' is an important aspect in the design of the camp (Robinson & Stubberud 2014). Action learning has been identified as an

Note: Special Collection: Creating value through entrepreneurial learning.

appropriate method for entrepreneurs to deal with complex problems by solving these problems collaboratively with others in the network. This 'social dynamic' is a principal theme in action learning and is centred around a small group of participants (Taylor, Jones & Boles 2004). With the support from one another, participants are able to reflect the issues or problems at hand and further develop problem-solving abilities.

Interpersonal interaction (i.e. social networks) is important to learning behaviour and outcomes. In collaborative learning theory, it is assumed that learning emerges through interactions of an individual with others (Yang & Tang 2003). These interpersonal relationships allow trust to be built, resulting in stronger relationships that facilitate knowledge sharing (Lin 2008). With ever-increasing globalisation, universities exchange students from different cultural backgrounds. This results more and more often in student groups of different cultures. Having groups of different cultures may play a role in the formation (or discourages the formation) of various types of relationship. For example, it is found that international students from collectivist society show less help-seeking behaviour (Gonzales 2001), and this can obstruct the formation of new relationships with peers.

The case chosen for this study is an entrepreneurship camp that consists of 35 master's students from three Norwegian and two South African universities. This entrepreneurship camp's objective is to empower students through entrepreneurship by knowledge and action-based learning. The uniqueness of the case lies within the multicultural context that the students are embedded in during the 12 days of action-based entrepreneurial learning process, which also creates the dynamics of network formations. Details of the camp are provided in the 'Research Methodology' section.

The research aims to address the research gap among three main theoretical concepts, namely social networks, action-based learning and entrepreneurial learning, in the context of a multicultural entrepreneurship camp. People (in this case students) learn through knowledge and information sharing, and this is made possible through social networks that they develop. Besides knowledge, these relationships in the networks also provide other resources such as support (Mishra 2020), advice (Durda & Ključnikov 2019), prestige (Kebede 2020) and awareness of the market (Ioanid, Deselnicu & Militaru 2018), just to name a few. These resources are particularly important to entrepreneurs because they can help in the identification of (business) opportunities (Paul et al. 2014; Sithas & Dissanayake 2019). But how these networks in such an entrepreneurship camp develop is less clear. Similarly, it is not clear what kind of participants end up in more central positions or central parts (subgroups) of the network. Our objective of this study is therefore twofold. Firstly, we explore the formation and development of networks and structure in the network over time in the context of an entrepreneurship camp. Secondly, we explore the association between predominant personality traits and the network position measures and network location in the networks.

Our main research question is: To what extent and how do networks form in the context of an entrepreneurship camp?

This article makes two scientific and one practical contribution. Scientifically, it offers one of the first empirical investigations of entrepreneurship camps using social network analysis (SNA) and exploring the personality traits (Big Five) in a multicultural context. Studies on entrepreneurship are predominately focused on developed countries (Bustamam 2012). The uniqueness of this study lies in the co-development of the entrepreneurship camp by universities from two different countries, Norway and South Africa. The insights will contribute to the entrepreneurship education literature, especially in the development of entrepreneurship camps. The second scientific contribution is examining the development of social networks over time (i.e. temporal networks), which has become an important aspect of SNA (Tabassum et al. 2018). Moreover, studying the network structure change over time facilitates the understanding of the dynamics of the social network and informs interventions necessary to promote positive social interactions (DeLay et al. 2016; Grunspan, Wiggins & Goodreau 2014). The practical contribution is allowing entrepreneurship educators in finding the area for improvement so that an informed intervention by the educators can be provided. International students' personal ties with other international students are important as these networks can influence their cross-cultural adjustment to their new environment, and understanding these interactions allows institutions to play an active role in improving cross-culture adjustment that links with positive outcome such as increased task performance (Rienties & Nolan 2014). Being embedded in these networks, students obtain social capitals (resources embedded in a social structure) that facilitate information flows between students. Moreover, students' interactions can create a favourable climate for learning. Insights into the development of students' networks and students who have the tendency to be central players provide room for educating interventions.

After a review of the literature and offering two more specific research questions, the remainder of this article presents the methodology and results, followed by a discussion of the findings, conclusions and recommendations.

Theoretical background

Social network and social capital

A social network per definition is a social structure that consists of nodes (actors) that are connected by ties, relations or links (Li 2013; Tabassum et al. 2018). Portes (1998) stated that:

> Whereas economic capital is in people's bank accounts and human capital is inside their heads, social capital inheres in the structure of their relationships. To possess social capital, a person must be related to others, and it is those others, not himself, who are the actual source of his or her advance. (p. 7)

Moreover, network ties are channels where information can be accessed and one is able to reduce the cost (time and money) in searching (Nahapiet & Ghoshal 1998). In sum, Burt in 1992 stated that social capital is a set of resources embedded in these social relationships.

Social network provides access to external and diverse resources, and therefore, it is essential for creating and developing entrepreneurial businesses (Sithas & Dissanayake 2019). Entrepreneurs are no longer seen as 'independent' but 'interdependent' and embedded in social networks (Klyver & Foley 2012) in order to access a diverse set of knowledge, support and cooperation and identify potential opportunities.

The concept of social networks is fundamentally a theory as well as an analysis method (Han, Yoon & Chae 2020). From the structural perspective, social networks can be viewed as a structure of various types of relationships among the actors. The types of relationship relate to different resources that are exchanged, and also, the social influence is exercised. Two types of relations commonly exist in organisations: the relation between friends (friendship ties) and the relation between advisor and advisee (advice tie). Taking both friendship ties and advice ties together, one can observe the friendship network and advice network (Gibbons 2004).

Friendship and advice networks

Although there are many other ties such as adversarial relations (that involve negative exchange), in the setting of an entrepreneurship camp where the duration is very short, the chance of developing other types of ties is low. It is found that most of the literature studies advice and friendship ties (e.g. Clarke, Richter & Kilduff 2022; Jo, Harrison & Gray 2021). Therefore, this study focuses on friendship and advice ties as they are most relevant in the given context of this study.

Friendship ties are conduits of emotional support (Jo et al. 2021). These relationships are formed based on the attraction to similar others (e.g. gender, race, social status, education and personality) (Carley 1991; McKay, Grygiel & Karwowski 2017) and common interests (Marmaros & Sacerdote 2006). Friendship network creates a safe environment for sharing ideas because of the affect-based trust that is tied to beliefs about mutual altruism between friends (Gibbons 2004). Because of trust, friendship ties allow for sharing of more information, more commitment with one another and higher cooperation (Jehn & Shah 1997). Moreover, friendship ties enhance an individual's creativity because people are drawn to creative others and feel more comfortable to share new ideas (McKay et al. 2017). In an educational setting, it is found that friendships are important for social, communicative and affective development in students so that they can help each other to solve problems (Goldstein & Morgan 2002).

Advice ties are connections that allow the exchange of work information (Burt 1992). These are further expanded as sharing of resources such as assistance and guidance (Yang & Tang 2003). Through these relationships, individuals seek and voluntarily share advice for the successful completion of work tasks. These are more instrumental than friendship ties (which are more social-oriented) because they are driven by the seeker's task and the desired outcome is knowledge (Nebus 2006). In the qualitative study performed by Cross (2001), the results of interviews indicated five informational benefits when one seeks advice from another: solutions to problems; meta-knowledge from an interaction that yields pointer to the individual with expertise or the location of relevant documents; problem reformulation by defining important dimensions of problem; validation of an individual's solution or plan; and legitimation as the ability to cite a respected source. These advice ties can be seen as social conduits for the circulation of information and knowledge freely (Bland & Williams 2019). Moreover, when an individual provides advice, (s)he is able to process complex problems raised by advice seekers and can absorb and process the information for producing diverse ideas and solutions as alternatives in another situation (Hu et al. 2018).

In the field of educational research, it is observed that a student asks advice from another student because that student is performing well or it can also be that the advice the student obtained can enable for further process of the course material and in return advances the student's performance (Smith & Peterson 2007). Observing from a network position perspective, when a student is central in the advice network, the student is able to exchange and accumulate information, knowledge and experience in the process of problem-solving (Yang & Tang 2003).

Personality traits and network

The past research has shown that personality traits might have an effect on network structures where certain personality traits are related to network formation and perception. After reviewing the past literature, Selden and Goodie (2018) concurred with others that individual personality is related to the structure of the networks. For instance, 'extraverts are more likely to seek connections whereas agreeable individuals receive connections from others' (Selden & Goodie 2018:81).

In recent years, the Five Factor Model of personality (also often referred as the 'Big Five') has received the most attention from network researchers (e.g. Hasan & Koning 2020; Schwind & Albert 2022) and is stable over time (Selden & Goodie 2018). The Big Five model is a multidimensional approach in defining personality by examining the five domains: extraversion, agreeableness, conscientiousness, emotional stability and openness to experience. Quoted from Gustavsen and Hegnes (2020), the description of each is as follows:

- Extraversion is associated with assertiveness, sociability, talkativeness and the tendency to seek stimulation in the company of others.
- Agreeableness is the tendency to be compassionate towards and trusting of others.
- Conscientiousness is about organisation, self-discipline and the ability to work hard to achieve goals.

- Emotional stability is associated with the degree to which an individual is responsive to psychological stress – whether he or she is calm and stable or exhibiting nervousness when faced with stress.
- Openness to experience is associated with curiosity, creativity and preference for variety and novelty.

Entrepreneurship camps and entrepreneurship learning

Entrepreneurship learning is simplistically referred to as the intersection between entrepreneurship and learning (Nogueira 2019). However, entrepreneurship learning encompasses both teaching *about* entrepreneurship, for example, in classroom pedagogy about the theories of entrepreneurship, and teaching *in* entrepreneurship (Hindle 2007). The latter provides students within the field gaining experience of various practices of entrepreneurship.

Wang and Chugh (2014) identified individual and collective learning as a key learning type of entrepreneurial learning. Collective learning is defined as a 'social process of cumulative knowledge, based on a set of shared rules and procedures which allow individuals to coordinate their actions in search for problem solutions' (Capello 1999:354). Collective learning is differentiated from individual learning by its social nature of learning involving formal and informal networks contributing to what, how and with whom entrepreneurs learn.

Interactive entrepreneurship camps provide learning within the social constructivist paradigm where learning occurs from interactions in a group of students. Social constructivist theory assumes that 'learning is a result of the individual's interaction with the environment' (Thomas et al. 2014:5). Students obtain a deeper learning experience by active learning or learning by doing, which provides them the opportunity to synthesise and test in a social environment their ideas with other students (Yucel & Habiyakare 2011).

Entrepreneurship camps often make use of problem-based learning forcing multidisciplinary students to integrate theory and practice by applying knowledge and skills to develop a solution for a worthwhile problem (Savery 2006). The learning process is enhanced by starting from a problem resulting in action-based learning rather than a topic, which is associated with passive learning.

The relevance and importance of interactions and networks in the context of entrepreneurship camps are clear from the related literature reviewed in the previous sections. However, the development of networks in this context and the structural characteristics of each actor in the network are less well understood. Thus, we ask the following two specific and related research questions:

Research Question 1: What is the overall network structure and how does this develop over time (before, during and at the end of the entrepreneurship camp)?

Research Question 2: What is the network position of each student over time (before, during and at the end of the entrepreneurship camp) and how are predominant personality traits related to the network position?

Research methodology

Case description

Data were collected from a 2-week Entrepreneurship School (denoted as entrepreneurship camp in this study) that was hosted in South Africa during 04 July 2022 and 15 July 2022. This was part of the INTPART Project: Developing entrepreneurial mindsets across cultures. It is a collaboration between three Norwegian universities and two South African universities. A total of 35 master's students (15 from Norway and 20 from South Africa) participated in this entrepreneurship camp. The programme of entrepreneurship camp has the objective to empower students through entrepreneurship by knowledge and action-based learning in order to combat youth unemployment and address socio-economic problems. A social activity (Safari tour) was organised before the camp started on the 4th July, which allowed the students to meet one another. On the first day afternoon, there was a team-building activity, which also allowed the students to form groups among themselves with certain criteria such as two Norwegians students from different universities per group, as well as a relatively equal mix of first degree (business vs. science or engineering) and gender. A total of seven groups that consist of five students each were then formed. The programme of the camp was designed to provide opportunities for learning through interaction with others, including team members, industry experts, entrepreneurs and faculty. The programme comprised four parts. In part one students were provided with an overview of the South African context. Part two was on identifying an opportunity including meeting industry experts of different sectors, doing scenario analysis and identifying a problem with opportunity and assessment. The third part of the programme included the business case and prototype development. The final part of the programme included a business case pitching. Each day was divided about equally into entrepreneurship pedagogy followed by group work in which the students had to apply the theory and practise the different aspects required to develop for the competition: a business case and pitch on the last day of the camp.

The focus on a specific case limits the external validity of our study. We do think the insights are valuable for other entrepreneurship camps. The given case description helps other researchers to position their empirical context.

Questionnaire design and data collection

Social network analysis method was chosen to explore the network formation during the camp. For this, it is crucial to know about the relationships among the students. There are three rounds of questionnaires, on Day 1 of the camp (t_1), mid-camp (t_2) and last day of the camp (t_3). Before the class

started on the first day, students were given a paper questionnaire, which consists of the class list. They were asked to tick next to the names of who they knew as a friend before they came to the camp (t_1). During the end of the first week (t_2), the same class list was given and the students were asked to tick next to the names of friends with whom they enjoyed spending time with or discussed personal matters that were not related to the camp (as a measure for friendship ties) and those from whom they have received task-related advice about matters important to the camp (as a measure for advice ties) (source: Jo et al. 2021). The same questions about friendship ties and advice ties were also asked on the final day (t_3). On the basis of these questions, five different directed networks have been determined: Three friendship networks (before the camp started, during the camp and at the end of the camp) and two advice networks (during the camp and at the end of the camp). These networks over time enable us to gain insight into the network development as well as the student's position in the respective networks. These network measures will be discussed in detail in the next section. To investigate the predominant personality traits with the association of the network measures, this study uses the validated Ten-Item Personality Inventory by Gosling, Rentfrow and Swann (2003), which has been commonly used in other studies (Azucar, Marengo & Settanni 2018) because of its reduced items of the Big Five Personality traits model. Students were asked (on the last day only) to indicate the extent to which they agree or disagree with 10 statements about their personalities (e.g. Extraverted, Enthusiastic, Anxious, Easily upset, Sympathetic, Warm). Reliability test showed a low score (below 0.6) for all items under each trait, except Extraversion (Cronbach's alpha of 0.73). Therefore, all items are seen as individual items under each trait. For individual learning, on the last day, students were asked to rate the extent to which they displayed various learning behaviours using the nine items by Sujan, Weitz and Kumar (1994) on a 7-point Likert scale. Cronbach's alpha for this scale in this study was 0.798, which shows a good reliability of the items used. Examples of the items used are: There are a lot of new things to learn from the activities I did in this Entrepreneurship School; It is important to me to learn from each one of the activities during this Entrepreneurship School; Sometimes, I put a great deal of effort into learning something new.

Network measure and analysis

In order to analyse the networks and gain insight into our research objectives, we applied different network measures. The network analyses have been conducted in R (R Core Team 2014) using the I-Graph package (Csardi & Nepusz 2006).

The first step of the network analyses entails the exploration of the development of the networks. In order to do so, we need concepts at the network level that can provide insight into the network structure. Cohesion (density), cohesive subgroups and centralisation are often used concepts in the context of a network structure (Van Der Valk et al. 2011). Density refers to the cohesion of the network and is determined by the ratio of the number of edges and the number of possible edges (Wasserman & Faust 1994).

We also looked into the presence of cohesive subgroups. 'Cohesive subgroups are subsets of actors among whom there are relatively strong, direct, intense, frequent, or positive ties' (Wasserman & Faust 1994:249). Specifically, we look at cliques. 'A clique in a graph is a maximal complete subgraph of three or more nodes' (Wasserman & Faust 1994:254). This means that in this subgraph, all nodes are linked to each other. For each network, we identified the largest cliques (e.g. the clique(s) with the largest number of nodes).

Centralisation indicates if the network is organised around central nodes (e.g. are there nodes with a high centrality compared with other nodes) (Wasserman & Faust 1994). This can be calculated on the basis of different centrality measures (see also next paragraph). We used the eigenvector as this centrality measure gives insight into the prestige of a node and shows to what extent the network is organised around nodes that are connected to very well-connected nodes. In addition to these concepts, we assess reciprocity, which refers to mutuality (Wasserman & Faust 1994) as the proportion of mutual connections. This is important while considering that we use directed networks. And it is relevant to know if friendship and advice ties are confirmed.

Finally, we obtained several centrality measures. These are measures at the node level. First of all, we look at the indegree and outdegree, which are the number of incoming and outgoing links, respectively (Wasserman & Faust 1994). These are considered to be local centrality measures as they only considered the direct links of a node. Several other centrality measures can also be used that are considered to be global network measures as they do not only consider the direct links. In this study, we use two of them: betweenness and eigenvector centrality. Nodes have a higher betweenness centrality when they are on more shortest paths between other nodes (Wasserman & Faust 1994). Eigenvector centrality is finally is about prestige. Nodes have higher eigenvector centralities when they are connected to other well-connected nodes (Csardi & Nepusz 2006).

Our analysis of the personality trait data, individual learning data and network measures consists of several steps. Firstly, descriptive statistics of the students are provided after which the network development is described based on the measures mentioned above. Secondly, we analyse the association between personality traits and network centrality measures by means of Pearson's correlation. Thirdly, we analyse the association between nationalities and clique membership using Cochran and Mantel Haenszel test and the relation between personality traits and clique membership using *t*-test.

The conceptual model that indicates the measures under each theoretical concept is presented in Figure 1.

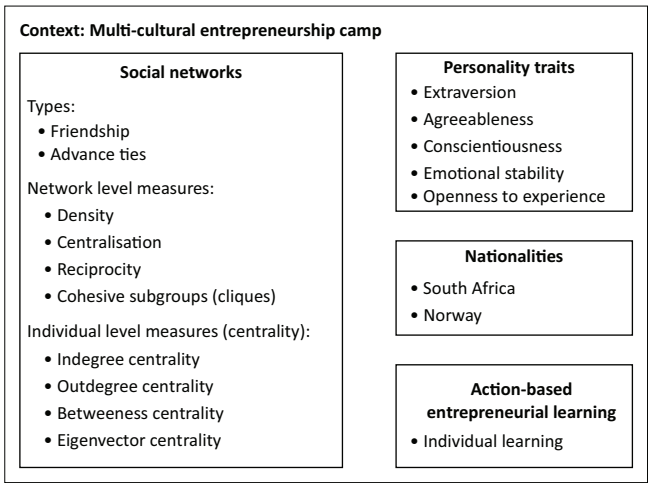

FIGURE 1: Conceptual model indicating measures for each theoretical concept.

Ethical considerations

Research ethics clearance was obtained from the principal investigator's (PI) university's research ethics committee (protocol no.: EBIT/48/2020). The research participants (students) were explained orally by the PI about the purpose of the research projects on the first day of the class and that the participation is voluntary. The names of the participants were asked, and the names in the class list were provided in the questionnaire. This is essential in order to perform SNA. The names were then coded in the data set so that participants' identities are protected. The paper questionnaires are safely locked in the PI's office at the university and will be destroyed after Five years of archiving. The electronic data files (in Excel and SPSS) are stored in PI's password-protected laptop and will later be stored in the university's repository.

Results

Descriptive statistics of the students

From Table 1, the distribution of the two nationalities (Norway and South Africa) and gender (male and female) are 42.9% and 57.1% of the class. Most students do not own his or her own business, with the exception of 8 (22.9%). About half of the group has no prior entrepreneurship education.

Table 2 shows the descriptive statistics of individual learning and personality traits. On the Likert scale of 7 on agreement (where 1 = disagree strongly to 7 = agree strongly), individual learning showed a mean value of 5.89 (close to 6 = agree moderately). This result indicates that after the action-based learning experience, the students have shown a high degree of individual learning outcome (6 out of 7 on the Likert scale).

Also, on the Likert scale of 7 on agreement (where 1 = disagree strongly to 7 = agree strongly), the two dominant personality traits that exist among the students are Openness to Experience (average of 5.80 between the two items) and Conscientiousness (average of 5.66 between the two items) as compared with other traits with lower average scores.

TABLE 1: Demographic statistics of Norway and South Africa.

Demographic variables	Categories	Number of students	%
Nationalities	Norway	15	42.9
	South Africa	20	57.1
Gender	Female	20	57.1
	Male	15	42.9
Own business	Yes	8	22.9
	No	26	74.3
Prior entrepreneurship education	Yes	18	51.4
	No	17	48.6

TABLE 2: Descriptive statistics of individual learning and personality traits.

Variables	Minimum number of individuals	Maximum number of individuals	Mean	Standard deviation
Individual learning	4	7	5.89	0.70
Big Five personality traits				
Extraversion				
1. Extraverted, enthusiastic	2	7	5.03	1.54
6. Reserved, quiet[R]	1	7	4.53	1.73
Agreeableness				
2. Critical, quarrelsome[R]	1	7	4.02	1.38
7. Sympathetic, warm	1	7	5.57	1.22
Conscientiousness				
3. Dependable, self-disciplined	4	7	5.91	0.90
8. Disorganised, careless[R]	2	7	5.41	1.52
Emotional stability				
4. Anxious, easily upset[R]	2	7	4.83	1.74
9. Calm, emotionally stable	2	7	5.29	1.07
Openness to experience				
5. Open to new experience, complex	3	7	6.31	0.96
10. Conventional, uncreative[R]	2	7	5.29	1.54

[R], Reverse coded to represent the corresponding trait.

Network results

Figure 2 shows a visualisation of the networks. Visually, we can see that the networks become more connected over time, and friendship networks are more cohesive than advice networks. These patterns are also supported by the increasing density of the networks over time and the higher density for the friendship networks compared with the advice networks. There are seven different colours representing the seven groups that the students formed on Day 1. And there are two shapes (circles and squares) representing the two nationalities. In Figure 2, it also becomes clear that friendship and advice ties are not only formed within groups and with the same nationality but we also see many ties between students from different groups and different nationalities.

In Table 3, the decreasing centralisation over time and the higher centralisation of advice networks compared with friendship networks also support this. A lower centralisation indicates that more nodes (students) are getting more relations and therefore a more central position. So, the network is less centred around very central players.

Similar insights are obtained while looking at the centrality measures. Table 4 shows the descriptive statistics of the different centrality measures. The average number of

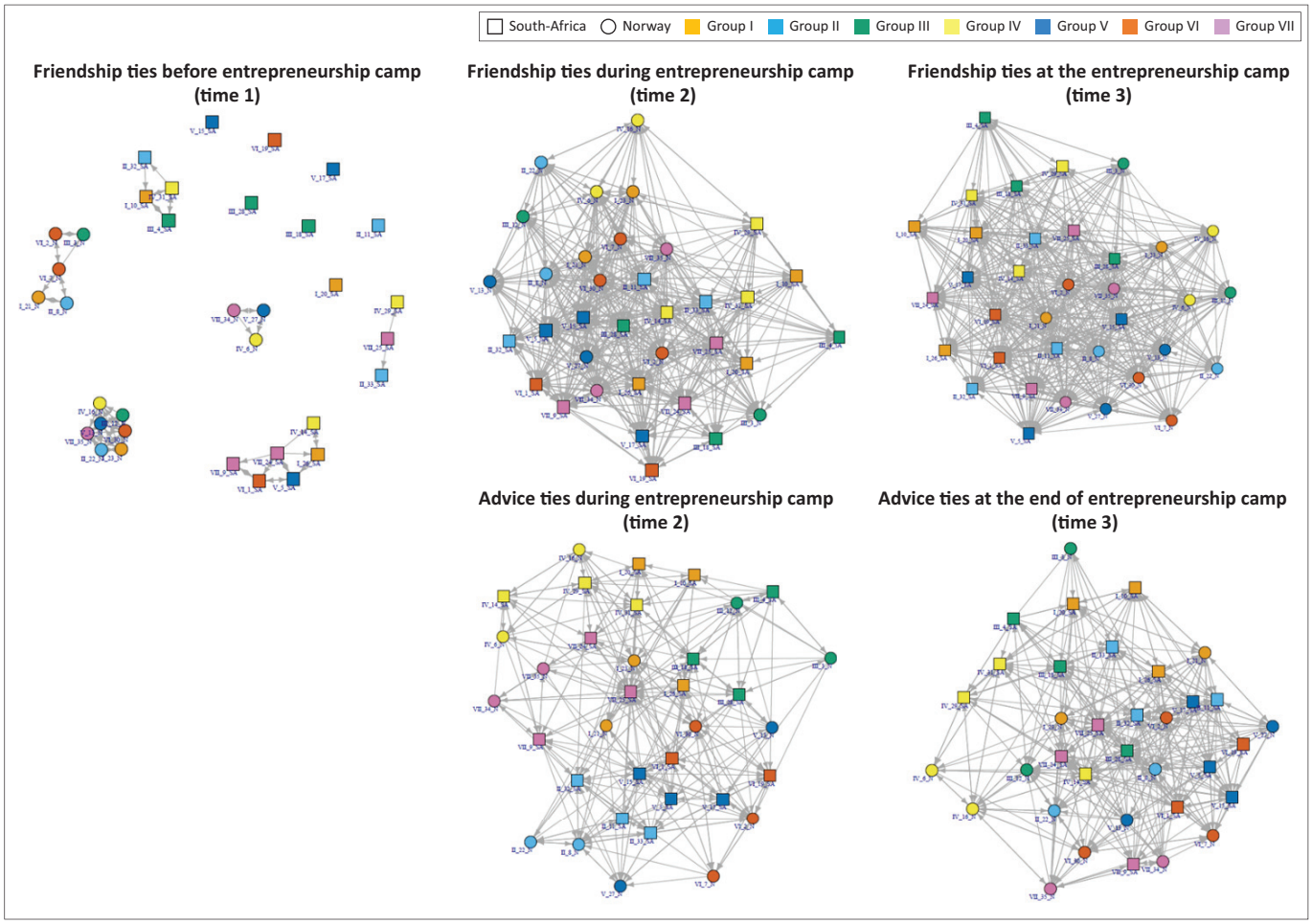

FIGURE 2: Visual representation of friendship networks and advice networks.

TABLE 3: Network-level measures over time.

Network-level measures	t_1	t_2		t_3	
	Friendship	Friendship	Advice	Friendship	Advice
Density	0.07	0.51	0.26	0.62	0.35
Centralisation	0.84	0.35	0.72	0.26	0.62
Reciprocity	0.84	0.73	0.62	0.78	0.66

friendship ties is higher compared with advice ties (indegree and outdegree), and for both types of ties, we see a higher number at t_3 compared with t_2. In general, we see an increase in the average centrality measures (so nodes are becoming more central on average resulting in a decrease in the centralisation). We not only observe this increase for indegree (number of incoming links) and outdegree (number of outgoing links) but also for the eigenvector centrality, which indicates that more students are connected to other well-connected students. The exception is betweenness centrality for which the average is becoming lower. This is, however, in line with the trend as the betweenness centrality indicates to what extent nodes are on the shortest paths between the other nodes. When the average decreases, it means the nodes are more equal to each other.

We also tested for these four centrality measures if the differences between t_2 and t_3 are statistically significant by means of a paired sample *t*-test. Results show that indeed the differences (the higher average for indegree, outdegree and eigenvector centrality and the lower average for betweenness centrality) are statistically significant. The results can be found in the Appendix 1.

TABLE 4: Descriptive statistics of centrality measures.

Centrality measure	Time	Network tie	*N*	Min	Max	Mean	Standard deviation
Indegree	t_1	Friendship	35	0	6	2.26	1.90
	t_2	Friendship	35	8	25	17.43	4.79
		Advice	35	2	31	8.80	5.14
	t_3	Friendship	35	13	28	21.23	4.44
		Advice	35	3	32	11.94	5.55
Outdegree	t_1	Friendship	35	0	6	2.26	2.11
	t_2	Friendship	35	8	30	17.43	5.11
		Advice	35	4	15	8.80	2.37
	t_3	Friendship	35	10	34	21.23	5.81
		Advice	35	7	17	11.94	2.73
Betweenness	t_1	Friendship	35	0.000	0.007	0.001	0.002
	t_2	Friendship	35	0.004	0.030	0.015	0.008
		Advice	35	0.003	0.122	0.027	0.023
	t_3	Friendship	35	0.003	0.029	0.011	0.006
		Advice	35	0.001	0.072	0.021	0.015
Eigenvector	t_1	Friendship	35	0.00	1.00	0.19	0.38
	t_2	Friendship	35	0.35	1.00	0.71	0.19
		Advice	35	0.28	1.00	0.48	0.13
	t_3	Friendship	35	0.42	1.00	0.75	0.14
		Advice	35	0.26	1.00	0.59	0.15

Looking at the reciprocity, we would expect this to be present for friendship ties, but not necessarily for advice ties. Indeed, we observe a higher reciprocity for the friendship networks, but for advice networks, the reciprocity is relatively high.

Looking closer at the development of the networks, we can also look at the development of the ties over time. When we look at the development of the friendship ties, we see 75 friendship relations still present and 535 new friendship ties, and 4 ties disappear when comparing t_2 with t_1. When comparing the friendship network of t_3 with t_2, 574 friendship relations are still present, 169 new friendship ties developed, and 35 ties were no longer mentioned. Overall, we can conclude that many friendship relations develop over time, especially at the beginning of the camp.

The same can be done for the development of the advice ties. When comparing the advice network of t_3 with the advice network of t_2, 261 advice ties are still present, 157 new advice ties developed and 45 ties were no longer mentioned. Overall, we also see an increase in the number of advice ties over time. But the fluctuation over time is larger than observed in the friendship networks. This means that relatively more people are no longer approached for or no longer given advice. This can be expected as advice ties refer to specific expertise that might be required at a certain moment (and no longer at a later moment) and one would expect friendship to last longer. Another reason for this finding is that over time people are able to identify the person(s) with useable advices and approach them for suggestions of other person(s) for advices on different topics.

Finally, we also compared the friendship network with the advice network for the two points in time. The comparison of the two types of networks at t_2 shows that 262 friendship ties are also advice ties; 335 ties are only friendship ties (so no advice) and 46 ties are only advice ties (so no friendship). The comparison at t_3 reveals 403 friendship ties also being advice ties; 328 ties are solely friendship ties (so no advice) and 15 ties are solely advice ties (so no friendship). These results show that most advice ties are also friendship ties. And this is especially true later in time (t_3).

In order to stimulate the formation of ties, educators can use different types of activities. In this entrepreneurship camp, a safari was organised before the start of the camp. Seven students were not able to attend this safari. When we compare their centrality measures with the centrality measures of the other students who did participate in the safari, we see that their indegree in the friendship networks (M = 13.00, SD = 3.37 at t_2 and M = 17.14, SD = 3.98 at t_3) is statistically significantly lower compared with the group of students who did attend the safari (M = 18.54, SD = 4.47 at t_2 and M = 22.25, SD = 3.99 at t_3), $t(33) = 3.06$, $p = 0.004$ and $t(33) = 3.03$, $p = 0.005$, respectively. This implies that they on average are less indicated to be a friend by others. We do

TABLE 5: Correlation table of network measures and personality traits.

Big Five personality traits	Indegree				Outdegree				Betweenness				Eigenvector centrali			
	t_2		t_3		t_2		t_3		t_2		t_3		t_2		t_3	
	Friendship	Advice	Friendship	Advice	Friendship	Advice	Friendship	Advice	Friendship	Advice	Friendship	Advice	Friendship	Advice	Friendship	Advice
Extraversion																
1. Extraveted, enthusiastic	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6. Reserved, quiet[R]	0.381*	-	0.37*	-	-	-	-	-	-	-	-	-	0.369*	-	-	-
Agreeableness																
2. Critical, quarrelsome[R]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7. Sympatheticm, warm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Conscientiousness																
3. Dependable, seif-disciplined	-	-	-	-	-	-	0.411*	-	-	-	-	-	-	-	-	-
8. disorganised, careless[R]	-	-	-	-	-	-	-	-	-	-	-	-	-	-0.358	-	-
Emotional stability																
4. anxious, easily upset[R]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9. Calm, emotionally stable	-	-0.426*	-	0.289*	-	-	-	-	-	-	-	-	-	-	-	-
Openness to Experience																
5. Open to new experince complex	0.34*	-	-	-	-	-	-	0.365*	-	-	-	-	-	-	-	-
10. Conventional, uncreative[R]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Difference is significant at $p < 0.05$ (two-tailed).

Definitions of each network measure can be found in the method section.

[R], Reverse coded to represent the corresponding trait.

not observe significant differences for any of the other centrality measures.

Personality traits and central positions

To explore the predominant personality traits and network position measures, we use Pearson's correlations. The statistically significant results (significance level of 5%) are provided in Table 5.

Students who show higher personality traits in Extraversion associate with more central positions (indegree and eigenvector) in friendship networks. Students who show higher personality traits in Openness associate with a more central position in terms of indegree in friendship networks and in terms of outdegree in advice networks. Students who show higher personality traits in Emotional stability associate with a less central position in terms of indegree, but a more central position in terms of outdegree in advice networks. In other words, calm people and emotionally stable students associate with less incoming advice but with more outgoing advice. The results for Conscientiousness and centrality in advice networks are mixed: negative for eigenvector centrality, but positive for outdegree.

Nationalities and personality traits in cliques

The number of South African versus Norwegian students who belong to a clique in the two types of networks is indicated in Table 6.

Over time, Norwegian students increased the number of friendship cliques from t_1 to t_2 then dropped slightly (by one student) at t_3. On the contrary, the South African students have dropped the number of students in friendship cliques from t_1 to t_2 but increased at t_3 (by three students). In terms of advice cliques, the number of students in both Norwegian and South African has dropped significantly from t_2 to t_3. This is an indication of higher density in the advice network among the students (i.e. less sub-groups). From the Cochran and Mantel Haenszel test, the nationality (Norwegian and South African) and cliques (in a clique = Group 1; not in a clique = Group 0) are not significant. Therefore, there is no association between nationality and cliques.

To explore the relationship between cliques and personality traits during the camp (t_2) and on the last day of the camp (t_3), independent sample *t*-tests were performed. For each group (not in a clique = Group 0; in a clique = Group 1), the difference in group mean value (Group 0 – Group 1) of each personality trait item is shown in Table 7.

TABLE 6: Number of students in cliques per nationality.

Countries	t_1	t_2		t_3	
	Friendship	Friendship	Advice	Friendship	Advice
Norwegian (15)	5	9	12	8	4
South African (20)	10	8	17	12	5

When looking at cliques in friendship networks, at t_2 the predominant traits are Extraversion and Consciousness for students being part of a clique (Group 1) compared with students not being part of a clique (Group 0), whereas at t_3 Extraversion stays as the predominant trait and then Openness to Experience becomes higher for students being part of a clique (Group 1) compared with students not being part of a clique (Group 0). In terms of cliques in advice networks, at t_2 there were no predominant personality traits, but at t_3 Extraversion and Openness to Experience are higher for students being part of a clique (Group 1) compared with students not being part of a clique (Group 0). In summary, students who are part of cliques show Extraversion and Openness to Experience as their predominant personality traits.

Discussion and conclusion

Summary of findings and scientific implications

The popularity of entrepreneurship camps around the world has inspired entrepreneurship scholars to investigate this action-based education platform for training and developing young entrepreneurs. International students' personal ties with other international students are important as these networks can influence their cross-cultural adjustment to their new environment and understanding these interactions allows institutions to play an active role in improving cross-culture adjustment that links with positive outcome such as increased task performance (Rienties & Nolan 2014). Researchers in the past have adopted a methodological approach called SNA to measure and visualise these social interactions among students. This study aimed to explore the formation and development of the networks and structure in the network using the case of the Entrepreneurship School in which 15 Norwegian and 20 South African master's students attended in two weeks. The predominance of personality traits in relation to a specific network measure was also identified. From the scientific implication, this is one of the few empirical studies that uses

TABLE 7: Difference of group means per personality trait.

Big Five personality traits	t_2		t_3	
	Friendship	Advice	Friendship	Advice
Extraversion				
1. Extraverted, enthusiastic	-0.059	-0.638	-0.050	-0.859
6. Reserved, quiet[R]	**-1.176***	0.083	**-1.186***	**-1.396***
Agreeableness				
2. Critical, quarrelsome[R]	-0.516	0.368	-0.400	-0.410
7. Sympathetic, warm	0.310	-0.690	-0.767	0.171
Conscientiousness				
3. Dependable, self-disciplined	0.059	0.107	-0.2	-0.442
8. Disorganised, careless[R]	**-1.059***	1.321	-0.856	-0.769
Emotional stability				
4. Anxious, easily upset[R]	0.239	1.011	-0.633	-0.231
9. Calm, emotionally stable	-0.131	0.460	0.083	0.085
Openness to experience				
5. Open to new experience, complex	-0.304	0.425	**-0.783***	**-0.774***
10. Conventional, uncreative[R]	0.327	-1.351	0.200	-0.214

[R], Reverse coded to represent the corresponding trait; *Difference is significant at $p < 0.05$.

SNA in the entrepreneurship education literature, especially from a temporal perspective that has become an important aspect of SNA (Tabassum et al. 2018).

From the descriptive statistics, it is evident that on average, the students have shown a high degree of individual learning outcome (mode of six on a Likert scale of seven of agreement on nine statements on individual learning). The limitation of this finding is that it is self-reported and self-bias may exist.

To answer the first research question (What is the overall network structure and how does this develop over time [before, during and at the end of the entrepreneurship camp]?), we analysed the network formation and development over time and found that both friendship and advice relations were developed over time. For friendship relations, this increase is more at the beginning of the camp. The increase in advice relations over time has more fluctuations than the friendship networks. The latter could have resulted from taking part in a competition during the camp. According to Russell, Atchison and Brooks (2008) business plan competitions present a substantial prospect for enriching entrepreneurial education as students can acquire valuable advantages, such as the development of entrepreneurial skills, self-confidence and willingness to take risks. Students taking part in business plan competitions gain various immaterial benefits, such as networking opportunities and skills development that could lead to entrepreneurial intention and subsequent entrepreneurial behaviour (Dana et al. 2023).

It is also observed that most advice ties are also friendship ties towards the last day of the camp. When a tie is both advice and friendship in nature, it can be seen as having a 'stronger' tie strength. In the weak or strong tie theory (Granovetter 1973), strong ties provide relational cohesion and support, contributing valuable resources, especially complex knowledge (Hansen 1999). In the overview of literature on knowledge transfer and network in the last 20 years, Ferrer-Seraano, Fuentelsaz and Latorre-Martinez (2022) stated that high motivation is needed to transfer tacit knowledge, and consequently, strong social ties are required to transfer this type of knowledge more efficiently. Moreover, they also found that in a context where cultural distance is high, organisation with experience in dealing with diverse cultures can better overcome these difficulties. It is evident in the case of this study that the number of friendship and advice ties has increased over time, especially ties that are stronger with both friendship and advice in nature. The organiser arranged a pre-camp activity (the Safari trip) before Day 1 of the official programme. It is noticed that for those seven students who couldn't attend the pre-camp activity because of their flight delays (but they joined the camp as soon as they arrived), their indegree friendship ties are significantly lower than others over time. This indicates the importance of the pre-camp activity for early network formation. On the first day, a lecture on 'Knowing the past – an overview of South Africa' was presented to all students, and this allowed to bring the cultural distance closer. Moreover, on the same day, students attended a team-building activity that allows them to strengthen existing relations and also create new ones.

With respect to the first part of the second research question (What is the network position of each student over time [before, during and at the end of the entrepreneurship camp]?), it is also evident that in this action-based learning environment, the students' network positions have increased over time, not only in degree centrality (as discussed here) but also in eigenvector centrality, which indicates more students are connected to other well-connected students. By having access to many indirect ties from this one specific (well-connected) direct tie, information can be accessed (or knowledge spillover) without paying the costs of network maintenance (Ahuja 2000; Martínez Ardila et al. 2020). The average of betweenness centrality is lower over time, which means that nodes are more equal to each other, which coincides with the increasing density in the network over time (more and more students are connected to one another). Denser network promotes more intense social interaction, experimentation, joint problem-solving, and triangulation, which then improve the ability to absorb diverse knowledge (Phelps 2010). The case in this study has shown to have created a favourable climate for learning by improved network position and overall network density.

Looking at personality traits in relation to network position and cliques (for the second part of research question 2), two predominant traits are Extraversion and Openness to Experience. Students with these traits have better network position and are likely to be part of a large clique.

Practical recommendations

Three practical recommendations from this result are as follows. Firstly, for students who have a low degree in Extraversion and Openness to Experience, the educator can provide some interventions as part of the class activities to facilitate these students in network development. Interventions such as designing different instructional environments such as web-based instructional environment (WBIE) and classroom environment that are suited for students with different levels of extraversion increased a student's opportunity to participate and build networks (Caspi et al. 2005). Secondly, students who have a low degree of extraversion although prefer time to reflect and think rather than engaging in discussion with other students, appreciate the opportunity to get feedback from a fellow (Murphy et al. 2017). It is recommended that both self-reflecting sessions and group work session should be included on each day of the entrepreneurship camp, and this will facilitate students with lower extraversion to share their thoughts and ideas with fellow students in the group work after they have gone through the self-reflecting sessions first.

A third practical intervention that facilitators can conduct is to pre-assign students into groups of mixed personality traits in terms of extraversion and openness to experience. Studies have shown that members reported greater attraction to their teams when their level of extraversion was dissimilar, and in return, they make greater individual contribution to that team's success (Kristof-Brown, Barrick & Kay Stevens 2005). Assigning students to a specific role is also an intervention that can facilitate students in improving their network position. For example, assigning students with lower Openness to Experience a specific role play (e.g. group leader, group facilitator and presenter) can build the student's self-confidence and to initiate communication (Fatima et al. 2020).

Limitation and future directions

Like all research, this study has few limitations too. The finding is limited to one case of an entrepreneurship camp where the formation and development of networks are explored over time. This type of explorative study will require further empirical study with multiple entrepreneurship camps to explore the relationships between learning outcome and network characteristics, both at individual level and at group level. The learning outcome in this study is at an individual level (i.e. individual learning). Studies (e.g. Saqr et al. 2020) using SNA have shown how networks also facilitate group learning.

For personality traits, we only examined the Big Five model, although it is the second most prevalent personality trait in entrepreneurs in the review by Kerr, Kerr and Xu (2018). Other traits such as risk attitudes, need for achievement, locus of control and self-efficacy or proactivity of entrepreneurships may also have a relation on how networks form and develop. For future study, we recommend to include other personality traits in the design of the study.

Finally, the network data were collected only during the entrepreneurship camp. These new relations created during the camp may continue further after the camp and maybe one day be a strategic resource for the student's new venture. Further study can look at what is needed in designing entrepreneurship camps to continue these network connections. It has been shown in studies (e.g. Bhushan, Kovid & Kumari 2020) that entrepreneurs who are embedded in continuing social network have shown positive growth of ventures.

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Authors' contributions

K.-Y.C, E.V.D.L. and M.M.H.C. contributed to the development and writing of the article. E.V.D.L. and K.-Y.C. collected the data. M.M.H.C. and K.-Y.C. analysed the data.

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Data availability

Raw data were generated at the Entrepreneurship School. Derived data supporting the findings of this study are available from the corresponding author, K.-Y.C., on request.

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Appendix 1 starts on the next page →

Appendix 1

TABLE 1-A1: Results from the paired sample *t*-test for the differences in the four centrality measures over time.

Pair	Paired samples test								
	Paired differences					*t*	*df*	Significance	
	Mean	Standard deviation	Standard error mean	95% Confidence interval of the difference				One-sided *p*	Two-sided *p*
				Lower	Upper				
Friendship ties: indegree t_2 – indegree t_3	-3.80	2.47	0.42	-4.65	-2.95	-9.10	34.00	0.00	0.00
Advice ties: indegree t_2 – indegree t_3	-3.14	3.74	0.63	-4.43	-1.86	-4.97	34.00	0.00	0.00
Friendship ties: outdegree t_2 – outdegree t_3	-3.80	3.23	0.55	-4.91	-2.69	-6.95	34.00	0.00	0.00
Advice ties: outdegree t_2 – outdegree t_3	-3.14	2.45	0.41	-3.98	-2.30	-7.59	34.00	0.00	0.00
Friendship ties: betweenness t_2 – betweenness t_3	0.00	0.01	0.00	0.00	0.01	3.86	34.00	0.00	0.00
Advice ties: betweenness t_2 – betweenness t_3	0.01	0.02	0.00	0.00	0.01	2.45	34.00	0.01	0.02
Friendship ties: eigenvector t_2 – eigenvector t_3	-0.04	0.09	0.02	-0.07	-0.01	-2.65	34.00	0.01	0.01
Advice ties: eigenvector t_2 – eigenvector t_3	-0.11	0.11	0.02	-0.14	-0.07	-5.63	34.00	0.00	0.00