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CONNECTING WORKSPACE AND HEALTH: A CASE STUDY

Louise Suckley¹, Shona Kelly, David Legge, James Pinder
Sheffield Hallam University

Abstract

The purpose of this paper is to explore the influence of the physical workspace and work health on workplace connectivity (level and type of interactions). It summarises the first stage of research being undertaken by an interdisciplinary team of researchers² on a university engineering research department that is relocating into temporary office accommodation. The research incorporates the measurement of spatial and social connectivity, as well as work health on two occasions: prior to the relocation from traditional cellular office accommodation and following the relocation into an open plan workspace. On completion of both stages, comparisons will be made to assess for changes that could be attributed to the change in workspace.

The measurements taken before the move to temporary accommodation showed a limited level of physical connectivity in the traditional cellular office space. There were a number of individuals in the research department that had a much greater level of social connectivity but no pattern emerged in terms of their physical location in the workspace. However a pattern did emerge with regard to work health and social connectivity, where those with a high level of connectivity also had a high level of work stress.

The practical implications of the research are to demonstrate a methodology for assessing social connectivity with workspace and health that can be applied to other organisations. It makes a contribution to the fields of work psychology, facilities management and environmental psychology that has not before considered spatiality and social connectivity with work health.

¹ Corresponding author l.suckley@shu.ac.uk

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Introduction

Innovation and organisational creativity is increasingly recognised as being a wholly social process involving complex phases of interaction (Amabile *et al*, 1996). Achieving the correct balance of interactions at the right stage of the innovation process (preparation, incubation, illumination, verification according to Wallas, 1926; Lubart, 2001) and between the right type of people, is an even more complex phenomena for organisations to manage and engineer. The nature and volume of interactions that individuals have with their colleagues for the purposes of innovation and other equally important purposes such as decision making or getting expert advice, is an indicator of their 'connectivity'. All individuals require a certain degree of connectivity in order to make an effective contribution to the organisation, but understanding the mechanisms through which this is achieved and maintained at a level conducive to the needs of the individual and the organisation in which they work is a complex field of study.

The extent and type of connectivity of individuals and mechanisms through which these interactions take place is influenced by many factors such as job role, organisational structure, culture, social processes, individual preferences and historical contexts. This has been the subject of extensive study in the field of organisational behaviour (see Huczynski and Buchanan, 2007).

There is an expanding field of research into the spatiality of organisational interaction and how the physical location of individuals influences the largely social process of creativity. Research has been undertaken in the field of facilities management, environmental psychology and space management to understanding the most conducive spaces to facilitate interaction, provide privacy and engineer serendipity (Martens, 2011; Parkin *et al*, 2011; Boutellier, 2008; Haynes, 2007).

Understanding the determinants and the impact of connectivity on the individual has yet to feature in the field of work psychology, health and well-being. The focus of work stress levels as an indicator of health tends to be upon the characteristics of the work rather than the individual. Research has shown the value of 'social support' for reducing the impact of work stress on health (Moreau *et al* 2004). In this research we consider the individual's work health characteristics specifically in relation to their levels of social support and connectivity in the workplace.

The university research unit³ that is being investigated in the present work is undergoing a period of change as far as its physical location is concerned. At the time of the study, the unit were located in their original workspace. They will then be relocated to temporary office accommodation for a period of 10 months whilst their existing offices are refurbished as open plan office space. It is hoped that they will be established in these new spaces within a year.

This move provides an ideal opportunity to carry out a longitudinal study of the effects of the change from 'traditional' to a more contemporary workplace layout, via the interim 'high density' temporary accommodation.

Measures will be taken on two occasions: prior to the relocation from traditional cellular office accommodation and following the relocation into an open plan workspace. Comparisons will be made to better understand the relationship between workspace connectivity and health. The results of the 'pre-move' measures have been collected to date and highlight areas where a number of individuals dominate the social network who also display high levels of work stress.

³ Materials and Engineering Research Institute – MERI

Literature Review

Workspace layout

Workplace layout is increasingly being seen as an important factor in the wellbeing and effectiveness of organisations. Numerous researchers have studied different aspects of this. For example, Peponis *et al*, (2007) studied the link between workplace layout and exchange of information. Sailor (2011) and Cross and Borgatti, (2004) studied the role of workplace layout in creating opportunities for serendipitous exchange. A specific example is given by Suckley and Dobson (2014 in press) where a new open plan office had a kitchen/ dining area located at its centre to increase the chances of serendipitous interaction and enhance opportunities for collaboration and connectivity. This approach is supported by Gladwell (2000) who argues:

"...put all places where people tend to congregate - the public areas - in the centre, so they can draw from as many disparate parts of the company as possible." (p. 67).

Fayard and Weeks (2007) also support the role of communal focal points as important means to foster informal serendipitous interaction which they developed into 'the water-cooler' effect. Their effectiveness is influenced by issues of privacy, propinquity and legitimacy

Openshaw (2013) observed that staff interaction and performance increased in a mixed environment incorporating quiet spaces, buzzy social spaces such as dense open plan seating and meeting spaces such as break-out spaces, cafes and 'war rooms' / project areas.

However, creative use of workplace layout is not without its pitfalls. Suckley & Dobson (2014) found that the physical location of individuals in the workplace as well as social context such as individual personality and the organisational culture are both influential. A workplace created to encourage serendipitous interaction was seen to be ineffective in this due to the limited size of the 'connecting' spaces and organisational history which had a detrimental effect on the willingness of individuals and teams to be integrated and connected to the rest of the organisation.

Techniques used to study workplace layout range from semi-formal methods such as Participant Observation and interviews with staff through to more analytical techniques such as Space Syntax Analysis (SSA). This describes the social logic (Hillier and Hanson 1984) of spatial systems and helps provide an understanding of the spaces that could enhance or inhibit social exchange. Software is available to support SSA, for example Syntax 2D (Turner *et al*, 2007).

Connectivity

Social networks within an organisation have a strong influence on an organisation. Workers with large social networks have been observed to perform better than those with small social networks since larger networks provided access to different information that encouraged new thinking. Openshaw (2013) investigated knowledge workers in a pharmaceutical company. He found that scientists who worked in a 'dense' open plan environment populated by different groups of staff (scientists, administrators, project managers) performed better than those that worked in more traditional, small cellular offices; suggesting that innovative networking is a measure of a 'healthy' social network within an organisation.

Formal techniques have been developed to help analyse social networking. Social Network Analysis (SNA) uses visualisation “... to describe patterns of relationships among actors, to analyse the structure of these patterns and discover what their effects are on people and organizations.” (Martinez *et al* 2003, p354). SNA offers an analytical means for mapping these multi-level, but often tacit, channels of collaboration and may be considered in terms of; general social practices, knowledge acquisition, knowledge management, and innovation - both within and between groups. This approach therefore extends social analysis beyond what might be gleaned from initial observations and discussion with participants, helping to further reveal, for example, barriers to communication or other such structural weaknesses; characteristics which may only become evident when more formally modelling the structure of a workplace relationship network (Hanneman, 2001; Burt, 1992).

Analysis of social networks tends to be undertaken using correlational methods on a case by case adjacency matrix (see Scott, 2000). Software packages such as yEd (yWorks⁴) process the data relations (Scott, 2000).

Health & Work Stress

The impact of work stress on health is widely recognised and studied (Belkic *et al*, 2004; van Vegchel *et al*, 2005) but this has never been considered as a factor of workspace connectivity. Considerable research has been conducted on occupational groups that are generally perceived to have stressful jobs (Mark & Smith, 2012) but surprisingly little attention has been paid to academics. Perhaps because working as an academic has been considered a high status job in which workers hold a high degree of autonomy. However, the nature of the academic job is changing considerably with many more demands, time constraints and increasing amounts of monitoring and oversight.

The self-reported health question can be used to provide a composite measure of individuals' physical and mental health and have been shown to be a strong predictor of future health problems (Kelly, 2003, DeSalvo 2006). Research on work stress tends to focus on characteristics of the work rather than characteristics of the person. For example, in academia work stressors could be “...*high levels of workload and job demands, low peer support, and poor working relationships...*” (Kinman 2010).

Two models dominate the field: 1) the Job Strain Model, also known as the Demand Control Model (Karasek and Theorell, 1990); 2) the Effort Reward Imbalance (ERI) Model (Siegrist 1996). Both models are good predictors of mental and physical health problems and seem to tap into different aspects of work stress (Ostry 2003). The job strain model focuses on control over tasks, work pace and repetition in tasks and high strain is measured as low control combined with high demands. While the ERI model focuses on rewards, respect and other peer relationships and is the ratio of effort over reward.

Methodology

The unit being studied consists of 63 academic research staff, 11 business administration staff and 78 post graduate research students divided into a number of research groups (n=152). The office space occupied consists of cellular offices accommodating 3-4 academics with small laboratories

⁴ http://www.yworks.com/en/products_yed_about.html

located in close proximity. The administrators occupy an open plan situated outside the research group director's individual offices.

A large proportion of the research unit are physically located together and have experienced the move into temporary office accommodation (49%), but there are also members located in offices across the university who were also included in the network for this research. Those located elsewhere within the university have a dual teaching and research role.

A mixed methods approach has been applied to understand the social and physical connectivity of this research unit, with measurements being taken before their move to the temporary office accommodation (reported here) and following a period of 3 months of occupation (to be taken in May 2014). Participant observation, SSA and SNA have been combined with measures of Work Health, to understand the social and physical connectivity of the individuals and their workspace.

Social Network Analysis

For the current research, SNA was carried out using a web-based survey to collect data about the relationships between all of the members of the research unit. The questions aimed to understand the form (how they interacted) and context (about what) of their interactions with colleagues. Respondents were therefore asked to indicate who they had a formal or informal working relationship with and what the nature of this relationship was (face to face, email, telephone or all methods) in terms of: completing everyday work processes, developing new ideas, discussing social topics, making improvements to everyday working practices, seeking expert advice, finding out what's going on and making decisions. The key forms of SNA visualisation used to model each of these interactions were 'Connectivity' and 'Betweenness'. Connectivity is a measure of the number of instances an individual is acknowledged for each interaction type outlined above; Betweenness is a measure of the strategic importance of the individual for each interaction type; i.e. the level to which they may be considered a broker, mediator or disseminator.

Space Syntax Analysis (SSA)

SSA was used to help consider the spatiality of social relations. This describes the social logic (Hillier and Hanson 1984) of spatial systems and provides an understanding of the spaces that could enhance or inhibit social exchange. A measured floor plan of the office space was input into the software Syntax 2D to analyse the space for its grid depth and connectivity. Depth provides a measure of the most private/ complex space to navigate to from a visual perspective and at the other end of the spectrum Connectivity describes the areas with the greatest number of connecting spaces. These are the areas where most activity is likely to take place and they tend to also be the most integrated and easiest places to find.

Health and Work Stress

As part of the web-based survey respondents were asked the self-reported health (SRH) question: *"In General how would you report your health: excellent, very good, good, fair or poor."* (DeSalvo 2006). Respondents were also asked to complete the Perceived Stress Scale (PSS) (Cohen *et al* 1983) which consists of ten questions with five Likert responses ranging from 'never' to 'very often'. Scores can range from 0 to 40.

An established measure of Job Strain (Karasek and Theorell, 1990) was included in the survey -the Perceived Stress Scale (PSS) and consisted of 14 questions with four Likert responses of agreement. This scale had three components to its calculation. 'Demands' are calculated from the first five questions. 'Control' is derived from two components which are equally weighted and then summed. Control and demands are then split into 'high' and 'low' at the median. Job strain is classified as those who have high demands and low control.

An established Effort Reward Imbalance (ERI) scale (Siegrist 1996) was also included and consisted of 10 questions (three on effort and seven on reward) with four Likert responses of agreement. The effort and reward components are equally weighted and then the ratio of effort to reward is calculated. If the ratio is greater than one, the respondent puts in more effort than rewards. A ratio of less than one means less effort than reward (the arguably desirable outcome). A second component of the scale, over commitment, was also included. This is a continuous scale ranging from 6-24.

Findings / Discussion

A total of 68 of 152 members of the university research department submitted a response to the pre-move web based survey (44.7% response rate). Of these 15% were business administration; 59% were research academics and 26% were research students. 58% of these individuals were directly affected by the office move with the remaining 42% located elsewhere in the university.

Space Syntax Analysis (SSA)

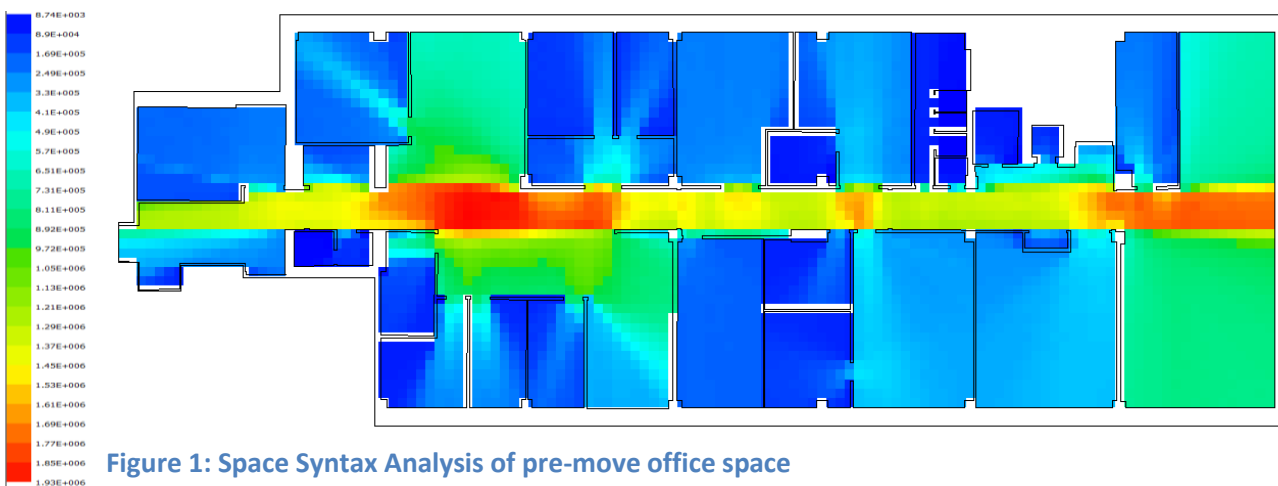


Figure 1 illustrates the connectivity of the workspace that the research department previously occupied. The hotter colours display a higher level of connectivity and are where most activity and chance meetings are likely to take place; the colder colours display lower levels of visual connectivity (and subsequently greater Depth) which are the most private spaces and would suit individuals with less need or desire for interaction. There is clearly a low level of connectivity in the office space because of the walls making up the cellular offices. The greatest connectivity is shown across the centre of the open plan space to the left of the figure and is the location of the administrators including the receptionist. The more connected space at the far right of the figure is an open laboratory which is used on an ad hoc basis by those occupying offices and also research students.

The level of interaction afforded by the physical workspace was confirmed in the participant observation. There was a hub of activity taking place between the business administrators that occupied the open plan space, where they were formally and informally interacting with other across the space and academic staff and research students were coming out of their offices for purposeful interaction with this team, such as enquiring about the availability of staff and collecting printing.

Health & Work Stress

Responses provided to the self-reported health (SRH) question suggested that the research department staff were pretty typical of the working age population, who are mostly healthy. The majority (70%) rated their health as excellent or very good (Figure 2).

In general, how would you rate your general health?

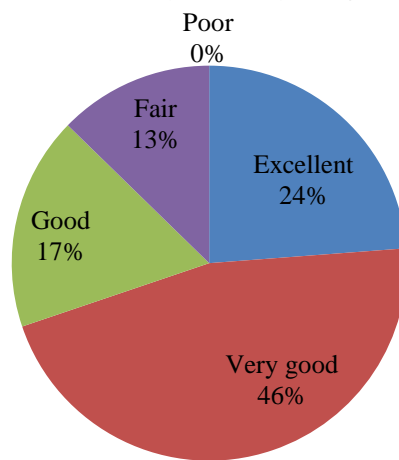


Figure 2: Self reported general health

In spite of what is assumed by the medical fraternity, most people assess their general health using three criteria: 1) their physical health/disability, 2) their mental health, 3) with reference to the social standards. For example a person with no physical or mental health problems who knows their diet is poor and that they don't get enough exercise will select 'very good'. Most of the people who select 'fair' or 'poor' have a physical or mental health problem. In the working population this physical or mental health problem is as likely to be work-related stressors, family problems, financial worries, etc. as it is to be a limiting condition like obesity or a chronic health problem. Only 13% of the sample selected less than 'good' SRH which is the usual cut-off in national health surveys.

The results of the remaining Health & Work Stress measures are shown in Table 1.

Table 1: Health & Work Stress by Staff Group

	Academic research staff	Administrative	Research students	significance test
ERI (mean (SD)) (min, max)	1.20 (0.44) (0.67, 3.21)	1.16 (0.47) (0.74, 2.33)	0.81 (0.30) (0.28, 1.22)	0.015
Over-commitment mean (SD)	15.0 (3.4)	12.9 (2.5)	15.3 (3.3)	0.189

(min, max)	(9-23)	(9-16)	(8-22)	
Self-reported health mean (SD) (min, max)	3.7 (0.9) (2-5)	3.7 (1.1) (2-5)	4.1 (0.9) (2-5)	0.282
Perceived Stress mean (SD) (min, max)	13.8 (6.9) (1-32)	12.3 (5.3) (6-20)	13.3 (7.4) (1-27)	0.783
job strain n (%)s	7 (18.9%)	0 (0%)	9 (56.2 %)	<.001

At this stage of the research, the analysis has been undertaken on the Effort Reward Imbalance (ERI) indicator to explore its relationship with the connectivity of the members of the research department given that this was the only result where stress levels were significantly different between the staff groupings. This looks at the weighted ratio of efforts to rewards. If more effort is exerted than rewards the ratio is greater than one. If less effort is exerted than reward (the arguably desirable outcome) then the ratio is less than one Table 1 presents the mean and standard deviation of the ERI according to the staff groupings.

Academics and administrators are shown to believe that they put in more effort into their work than they gain in reward, since their mean rating is over 1. The research students however feel that they exert less effort than they do reward and so on average can be considered healthier. The difference between the staff and student groupings were found to be significant ($p < 0.05$).

Social Network Analysis (SNA)

The results of the SNA indicated the level of personal interaction across the research department. Data was gathered according to a number of variables and in a number of forms of communication (face to face, email, telephone). For the purposes of this analysis, two areas will be considered: making decisions using all forms of communication to give an indication of the formal reporting structure of the research department; and discussing new ideas to investigate the existence of innovation, which Openshaw (2013) suggests is a measure of a 'healthy' social network.

The size of the squares in figures three to six indicate the correlational strength of the individual's interaction. The stronger the interaction, the larger the shape. For each of the purposes of communication results are shown for the individual's Connectivity (where they are approached directly by an individual) and Betweenness (where there is indirect interaction through a mutual connection, and they mediate or translate). The colour coding signifies their Health and Work Stress. The results on the ERI indicator have been classified into low (0-0.849; blue), medium low (0.850-0.999; green), medium high (1.00-1.19; orange), high (> 1.20 ; red).

Figure 3 shows that there are a number of key individuals (large squares) approached for making decisions which suggests that the formal decision making structure is effective.

An ineffective network for this type of interaction would be where only one or two individuals emerged which would result in delays in the decision making process and an over-burdening pressure on these individuals. The Health and Work Stress of many of the key individuals making the decisions however is not good. Their ERI indicator is high/ medium high which signifies a high level of work stress and is a cause for concern.

There are fewer individuals in the Betweenness measure (large squares) for Making Decisions (Figure 4) which tends to be the case for the SNA. The same two individuals with high levels of ERI that were directly approached for making decisions (connectivity) are also mediators of this activity. They have

the ability to bring networks together by communicating decision making to disparate parts of the network. Having both sets of responsibilities in the decision making process will contribute to the over-burdening of these individuals leading to high work stress. It would be advisable to develop the Betweenness of other members of the network in this area.

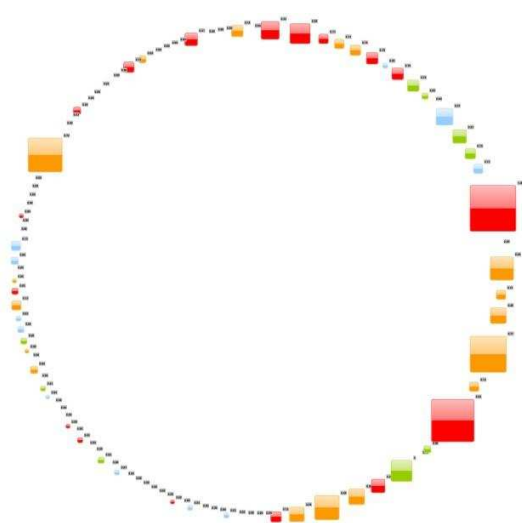


Figure 3: Make decisions (Connectivity)

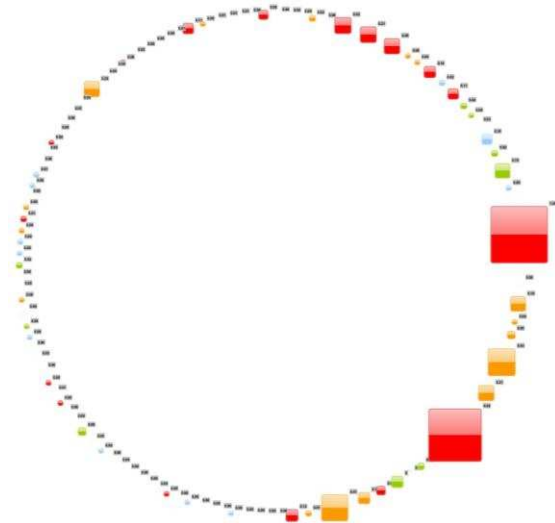


Figure 4: Make decisions (Betweenness)

Figure 5 shows there is a wide spread of individuals across the social network within the research unit that are approached to discuss new ideas. This is a good sign of innovation being embedded across the entire research department and would align with the nature of the organisation. There are a number of individuals with a higher level of connectivity in this area and further analysis into their work role, length of service, office location and methods used for connectivity will give a better understanding of their 'openness' for new ideas. Because there are many individuals involved in discussing new ideas, their Work Health varies.

The individuals with the highest connectivity in this area have high / medium high ERI scores and both also feature as key mediators of New Ideas as demonstrated by their Betweenness (Figure 6). Because of their role, history, location or personality, these individuals are not only approachable directly for New Ideas but they are also able to link across the network by translating these ideas in ways that can be understood by others. There is however a danger in the over-reliance on these two individuals to perform this mediating role across the research department in such a core function as developing new ideas. A handful of other individuals are emerging as alternative mediators and they should be nurtured further.

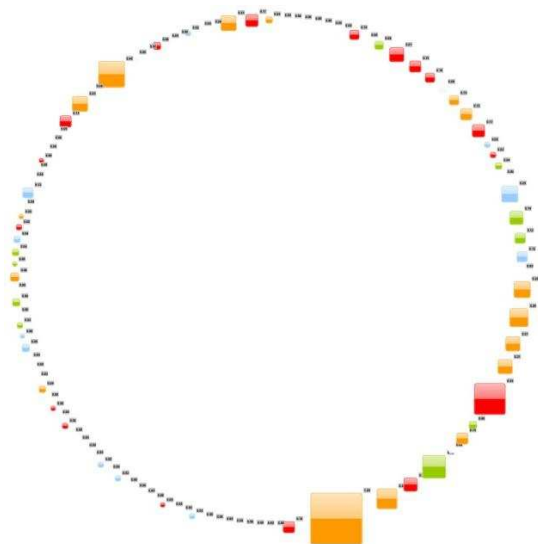


Figure 5: Discuss new ideas (Connectivity)

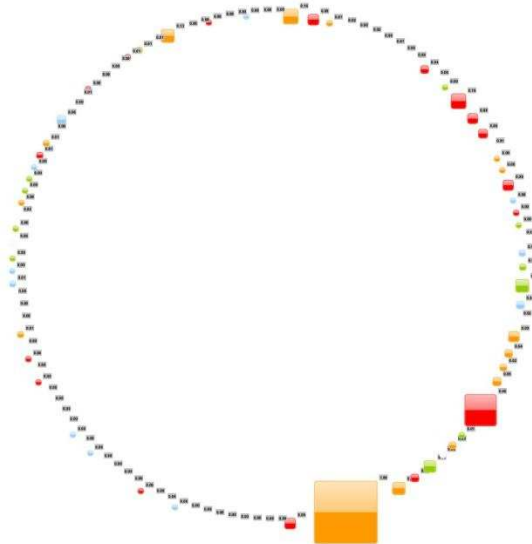


Figure 6: Discuss new ideas (Betweenness)

Conclusions / Implications

The initial analysis of the research suggests there is an over-reliance on certain individuals in the social network to perform significant organisational functions which are impacting negatively on their work health. Further analysis is needed to understand how this over-reliance has emerged and whether it is consistently maintained.

There are a number of explanatory factors for the dominance of these individuals that requires further investigation. It could relate to the individuals' work roles where they have the line management or budget responsibility for many others, or act in a supervisory capacity for a number of research students. Dominance could be due to the individuals' historical context in the organisation for example relating to their length of service or occupying various work roles that extends their knowledge of the organisation. Their physical location in the office space could also explain their dominance, where they are located in areas that have high connectivity to other spaces which makes them more accessible. However this would have much less significance if only email or telephone methods of communication are considered. The high levels of control that these individuals have in the social network may also be explained simply by their personality, where they are able to adapt their approach to many different individuals which makes them more accessible. This makes a significant contribution to the level of Betweenness that individuals have in a social network as they're able to communicate effectively across the entire network including those that are most disparate.

As well as undertaking further analysis on the results gathered to date, a second round of data collection is scheduled following three months' occupation of the temporary office space. Comparisons will be made of the Work Health and SNA results between these two occasions to assess for any change. This will be examined according to the various explanatory factors outlined above with emphasis placed on the physical workspace changes that have been experienced from moving into an open plan office space.

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