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EXPLORING THE INFLUENCE OF SOCIAL RELATIONSHIPS ON MULTISOURCE FEEDBACK ASSESSMENTS FOR UK GENERAL PRACTITIONERS: A SOCIAL NETWORK ANALYSIS

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1

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EXPLORING THE INFLUENCE OF SOCIAL RELATIONSHIPS ON MULTISOURCE FEEDBACK ASSESSMENTS FOR UK GENERAL PRACTITIONERS: A SOCIAL NETWORK ANALYSIS

by

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3

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Author's Declaration

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ABSTRACT

Sebastian Andrew George Stevens

Exploring the Influence of Social Relationships on Multisource Feedback Assessments for UK General Practitioners: A Social Network Analysis

One of the most common approaches to assess the performance of qualified doctors is that of multisource feedback (MSF). Previous research often cites MSF to be a valid, reliable and feasible method of assessing performance. However, potential biases in the self-selection of raters has been highlighted as a concern for the utility of MSF, particularly when used in high-stakes assessments such as medical Revalidation.

This research uses general practice as the study setting to explore the extent to which social relationships influence the rater selection choices made by doctors. A case study approach was adopted recruiting three GP practices varying in staff team size and geography. Social relationships between staff were measured through a network questionnaire, with rater selection data collected for participating GP's most recent MSF assessment. Finally, qualitative interviews were conducted to provide a narrative to the network findings using a framework analysis approach.

Variation in the structure of socialising and trust networks was observed between all three cases. Staff frequently socialised with and trusted the same colleague(s), largely socialising tribally with colleagues from within their own occupation. All doctors interviewed selected their own raters, with the vast majority discussing social relationships to be a factor impacting their choices. A network analysis using multiplex exponential random graph models (ERGM) demonstrate a positive tendency towards GP's requesting performance feedback from those with whom they had a social relationship. The rurality of the practice and the size of the workforce had no clear impact on the study results.

Biases in the selection of raters may have significant consequences for the assessment validity of MSF with the potential to jeopardise patient safety and quality of care. Recommendations to address biases in the selection of raters are discussed, alongside highlighting the limitations of this study and the implications for future research.

ABBREVIATIONS

CFEP	Client Focused Evaluation Program
CFET	Colleague Feedback Evaluation Tool
CQC	Care Quality Commission
CRN	Clinical Research Network
ERGM	Exponential Random Graph Model
GP	General Practitioner
GMC	General Medical Council
GOF	Goodness of Fit
HCA	Healthcare Assistant
HRA	Health Research Authority
MSF	Multisource Feedback
NCAS	National Clinical Assessment Service
NIHR	National Institute of Healthcare Research
NHS	National Health Service
ONS	Office for National Statistics
QAP	Quadratic Assignment Procedure
SNA	Social Network Analysis
TCS	Typical Case Sampling
WBA	Workplace Based Assessment
UK	United Kingdom

GLOSSARY OF TERMS – SOCIAL NETWORK ANALYSIS

Actor	A subject in a network sample (synonyms = agent, node, vertices)
Alter	An actor who is named as having a connection to one or more egos
Centrality	Identifies where an actor resides in a network
Degree	Number of direct contacts a person has
Density	Extent to which individuals a connected (at the network level)
Dyad	The sets of ego-alter ties
Ego	The actor whose network characteristics are the focus
Homophily	The tendency of similar individuals to have a relationship
In-degree	The total number of alters who have named an ego
Out-degree	The total number of alters an ego has named
Reciprocity	Extent to which the direct relationship are bidirectional
Ties	The relations or interactions between actors (synonyms = edges/lines)
Transitivity	The tendency of individuals who maintain relationships with the same third person to also have a relationship

Table of Contents

11

List of Tables

13

List of Figures

14

CHAPTER 1. INTRODUCTION

1.1 About the study

This study explored the extent to which social relationships influence general practitioners (GP's) choices when selecting colleagues to provide feedback on their clinical performance. The research adopted a relational approach using social network analysis, with data collected through a combination of quantitative and qualitative methods at three sites within the South West of the England. The study was funded by the National Institute of Healthcare Research (NIHR) and the Peninsula School of Medicine, University of Plymouth.

1.2 Organisation of the thesis

Background literature influencing the developing of this study is detailed in Chapter 2. It highlights multisource feedback (MSF) as a tool to assess and quality assure clinical practice within medicine, discussing the inclusion of MSF as source of supporting evidence for medical Revalidation. The chapter goes on to explore the importance of assessment validity and current gaps in the validity evidence in respect to the selection of raters. The chapter concludes by presenting the aim, objectives and research question for the study.

Chapter 3 provides an overview of the philosophical and theoretical perspectives underpinning the study design, followed by a discussion of the setting and sampling approach for the study. The data collection methods and analytical techniques and detailed, followed by a discussion of ethical concerns and limitations of the study design.

15

Chapter 4 provides a description of the study sites and summary of the respondents and non-respondents. Chapter 5 goes on to provide the study findings, beginning with an exploration of the structure of social relationships between colleagues within healthcare teams in UK general practice. This chapter goes on to discuss the process that participating doctors adopted in order to nominate colleagues for MSF assessments within Revalidation, followed by a detailed exploration of the potential impact of social relationships on the nominations choices made by doctors within MSF assessments.

Finally, Chapter 6 provides a discussion of the key themes emerging from the study results, exploring how these findings relate to the wider literature on rater selection bias for MSF assessments within medicine. Chapter 7 provides a summary of the key findings and a discussion of the impact on practice and future research as result of the study.

CHAPTER 2. BACKGROUND

2.1 MSF

Within medical education, the assessment of postgraduate performance is considered to be an important, yet difficult challenge (Norcini, 2005). Historically, the assessment of clinical performance has been criticised for being implicit, unstandardized and largely based on holistic and subjective judgements (van der Vleuten C, 1996). However, recent reforms in medical education have bought about a greater emphasis on competency-based assessment focusing on *'outcomes rather than processes of learning' (*Saedon et al., 2012, p.1). Initially focussed on doctors completing high stakes examinations to demonstrate their clinical competence, recent educational trends have moved towards *'gathering evidence of clinical competence and professional behaviour on a daily basis in the workplace'* (Liu, 2012, p.24). One of the most common approaches to assessing clinical competency and performance is that of workplace based assessments (WBA).

Many different WBA's have been developed and adopted within postgraduate medical education, with examples including (but not limited to) Direct Observation of Clinical Skills, Mini-Clinical Evaluation Exercise (mini-CEX), Case-based Discussion, Procedure based Assessment, Patient Feedback and Criterion Audit (Liu, 2012; Murphy *et al.*, 2009; Saedon *et al.*, 2012). However, as proposed by Saedon (2012), one of the most popular methods of WBA is that of Multisource Feedback (MSF). As Mackillop *et al.*, (2011, p.844) describe:

'Multi-source feedback [MSF], or 360-degree feedback, is a questionnaire-based method of assessing an individual in which multiple respondents (assessors),

representing discrete informant groups, provide confidential feedback on key performance behaviours'.

Dating back to the early 1920's, MSF has been used as a method of assessment or appraisal within the fields of management, psychology, education, the military and industry (Bracken, Timmreck & Church, 2001). MSF has today grown to become a popular method of assessing performance due to reasons including:

1. *Dissatisfaction with traditional performance appraisal systems*
2. *Increased focus on empowerment, participation and 'customers'*
3. *Larger spans on control*
4. *Attempts to improve organisational processes and communication*
5. *Imitation of competitors*
6. *Increased need to communicate critical organisational behaviours an values*
7. *Increased need for managers to adjust to turbulent business environments*

(Becton & Schraeder, 2004)

In more recent years, MSF has been adopted within healthcare environments, particularly within medicine, as a tool to assess and quality-assure clinical practice (Archer, Norcini & Davies, 2005; Campbell *et al.*, 2008)

2.1.1 MSF within Medicine

Within healthcare, MSF has grown to be a popular method of assessing professional competence, behaviours and attitudes (Lockyer & Clyman, 2008). MSF has been widely implemented within undergraduate medical curricula and for doctors in postgraduate training internationally in recognition of the need to evaluate the humanistic qualities of training doctors (Dannefer *et al.*, 2005). Based on the assumption that MSF assessments provide a valid assessment about an individual's behaviour (Batista-Foguet *et al.*, 2019), it has gained widespread support and credibility within medicine due to its ability to provide doctors with critical feedback in order to help *'monitor, develop, maintain and*

18

improve their competence' (Donnon *et al.*, 2014, p.512). MSF has also gained support as an effective method of WBA due to the increasingly multidisciplinary nature of healthcare delivery, with doctors today working with a wide variety of colleagues to deliver patient-centred care from both clinical (e.g. medical peers and subordinates, physician associates, nurses, pharmacists, paramedics) and non-clinical (e.g. healthcare managers, secretaries, administrators) roles.

In opposition to the traditionally restrictive approach of relying on a single supervisor's judgement, a combination of feedback from clinical peers and co-workers arguably has the potential to *'provide a better assessment and contextually based understanding of physician performance than any single person could'* (Donnon *et al.*, 2014, p.511). Such a conclusion is based on the premise that colleagues from different occupational groups will each focus on the clinical and psychosocial skills of the doctor that they are familiar with and knowledgeable about, providing a more comprehensive evaluation than could be observed from a single source (Sala & Dwight, 2002; Swanwick & Chana, 2013)

Based on this understanding, MSF has widely been adopted for qualified doctors internationally within mandatory frameworks of continuing professional development (Archer *et al.*, 2015a; Marcovitch, 2015; Naylor, Gerace & Redelmeier, 2015). MSF has also more been recently mandated for regulatory purposes, including within the UK as part of a medical recertification process known as medical Revalidation (General Medical Council, 2012c).

2.2 Medical Revalidation

Medical Revalidation is a regulatory process overseen by the General Medical Council (GMC) (the UK medical regulator) designed to ensure that all doctors licensed to practice in the UK are both '*up-to-date and fit-to-practise' (General Medical Council, 2012b, p.1)*. Following its introduction in December 2012, all licensed doctors are required to collect and submit a portfolio of evidence (called supporting information) including evidence of continuous professional development, colleague and patient feedback, quality improvement or audit, and significant events (General Medical Council, 2012c, Figure 1). Supporting evidence is to be discussed and reflected upon at annual appraisals, with a Responsible Officer making a recommendation to maintain (or otherwise) a doctor's license to practice (Bryce *et al.*, 2018). Doctors who do not engage with Revalidation can, ultimately, lose their license to practice (Tazzyman *et al.*, 2019).

Figure 1. Six sources of supporting information required for Revalidation

The implementation of Revalidation in the UK is the latest in a number of policy shifts surrounding the governance of medicine. Historically, since the introduction

of the 1858 Medical Act the medical profession in the UK had been trusted to operate within a model of self-regulation (Archer & de Bere, 2013), often described as autonomy-based professionalism (Light, 2010). Doctors were expected to regulate themselves free from interference and control against a number of shared professional standards (Chamberlain, 2012; Waring, 2007). Through Revalidation, medical regulation in the UK has arguably now moved towards a more bureaucratic regulatory oversight (Waring, Dixon-Woods & Yeung, 2010), leading to an erosion of professional autonomy and increased public accountability (Dixon-Woods, Yeung & Bosk, 2011).

The reasons underpinning the implementation of Revalidation are contentious (Tazzyman *et al.*, 2019). The retreat from a self-regulatory model for UK medicine has been argued by some to be a result of societal wide shifts from trusting professions and institutions, to holding them to account (Power, 1997). Secondly, many scholars cite the emergence of Revalidation to be driven by the adoption of neoliberal principles of governance, managerialism and the increasing commercialisation and corporatization of healthcare (Chamberlain, 2012; Greenhalgh & Wong, 2011). The traditional social organisation of expert work for medicine (Freidson, 1988), like many other industries, is being transformed by global models of bureaucracy that *'encourage rationalised and standard practices and identities' (Archer, Nunn & Regan de Bere, 2017, p.994)*. Finally, a number of high-profile malpractice cases in the 1990's and 2000's, most notably the Shipman and Bristol cases (Kennedy, 2001; Smith, 2004), called into question the efficacy of self-regulation for many and has often been cited as the final catalyst behind the GMC's implementation of Revalidation (Chamberlain, 2012).

Figure 2. Competing discourses surrounding medical Revalidation (Archer et al: 2015)
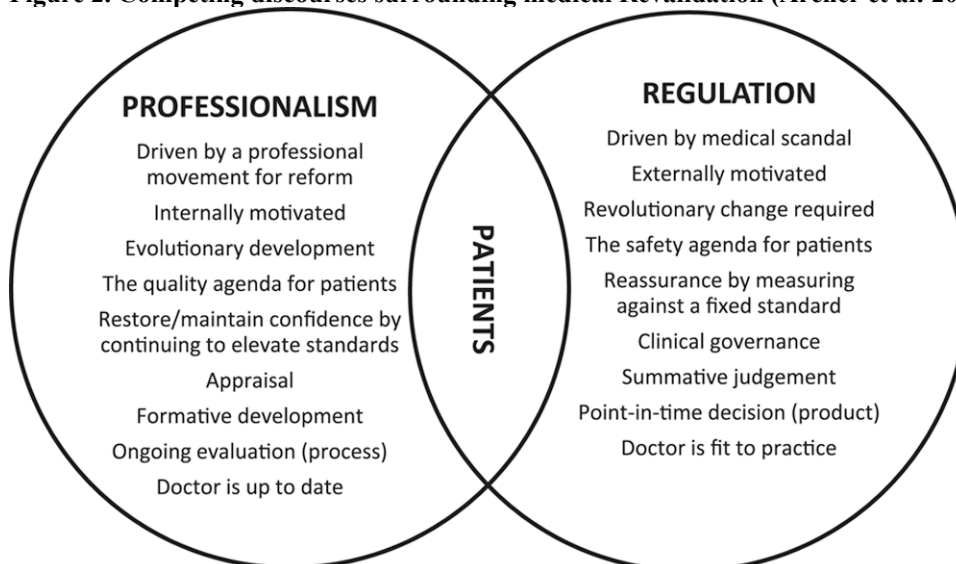
Alongside competing views surrounding the implementation of Revalidation (Tazzyman *et al.*, 2019), contention also exists towards the extent to which the Revalidation process fulfils a summative or formative function (Archer *et al.*, 2015b; Tazzyman *et al.*, 2018). Summative assessments are widely recognised as those which evaluate performance against a standard or benchmark and which are often 'high stakes' for those participating. Conversely, formative assessments seek to monitor learning or performance and provide ongoing feedback in order to support development (Kibble, 2017). Prior to the implementation of Revalidation, Archer *et al.* (2015b) identified two key discourses from stakeholders surrounding the purpose of Revalidation, that of regulation and professionalism (see Figure 2). The dominant discourse of regulation describes Revalidation as a summative process (Archer *et al.*, 2015b) designed to catch 'bad' doctors, ensuring only those who are competent and 'fit-to-practice' remain on the medical register. In contrast, professionalism framed Revalidation as a process by which all doctors are 'up-to-date', focussed around a developmental model requiring a formative approach (Archer *et al.*, 2015b). The GMC websites highlights the purpose of Revalidation as being to *'develop your*

practice, drive improvements in clinical governance and give your patients confidence that you're up to date' (General Medical Council, 2019). However, others argue that engagement with Revalidation in order to maintain a license to practice predicates a summative function to the process (Archer, Nunn & Regan de Bere, 2017; Archer *et al.*, 2015b; Hill *et al.*, 2012). Since the implementation of Revalidation, these two competing discourses have potentially been reconciled to coexist, with notions of *'accountability and regulatory oversight [now] embedded in a redefined, modern conceptualization of professionalism'* (Tazzyman *et al.*, 2018, p.646).

Furthermore, pertinent to the context of this study is the perceive function of Revalidation from a doctors perspective. A small number of studies have explored doctors perceptions and attitudes towards Revalidation, with doctors largely citing discontent towards the regulatory process. A common theme throughout much of this research is the view that the formal process of Revalidation has turned annual appraisals into a bureaucratic exercise, where doctors are jumping through hoops, completing a 'tick-box' exercise in order to pass the 'test' of Revalidation (Curnock *et al.*, 2012; Dale *et al.*, 2016). As one doctor highlighted *"the formative value of appraisal is going to go down as a result of Revalidation"* (Hill *et al.*, 2012, p.318). Dale *et al.* (2016, p.4) demonstrate further negative attitudes towards Revalidation from doctors, who highlight the process is *"stressful and devoid of much real meaning", "tick box, limited scope for professionalism and over emphasis on legalism and managerialism"* and a *"complete waste of time…to fulfil the legal requirements rather than for self-improvement".* Doctors also highlight that an annual appraisal within Revalidation is *"overkill…expensive and unnecessary"* and that *"the degree of invasive scrutiny by the GMC, CQC,*

23

appraisals, Revalidation is completely demeaning to a highly intelligent profession". Although these studies may not be reflective of all doctors or the wider medical profession generally, such negative views towards Revalidation may have significant consequences on the effectiveness of the process and therefore the quality and safety of patient care for a number of reasons as outlined below.

Firstly, if Revalidation is viewed by doctors as an administrative and bureaucratic exercise, then the likelihood of personal development may be severely undermined. Secondly, critical perspectives towards Revalidation and concerns around a summative judgment may jeopardise patient care as:

"Patients require professionals who are able to make difficult judgements in risky situations…if bureaucratic systems stop them doing that out of fear… that would be harmful to patients" (Archer, Nunn & Regan de Bere, 2017, p.997)

Finally, if doctors believe they need to 'pass the test' of Revalidation in order to order to maintain their license to practice, there is the potential that they may be *'creative in the way they collect and present data for appraisal'* (Archer, Nunn & Regan de Bere, 2017, p.998). Currently, doctors themselves are responsible for collecting and collating the six elements of supporting information required for appraisal at Revalidation, including their colleague feedback. However, limited research has explored the way in which doctors may be *'creative in the way they collect and present data for appraisal'* as suggested by (Archer, Nunn & Regan de Bere, 2017, p.998).The following sections will therefore explore the use of MSF within Revalidation and consider how current methods of collecting and presenting MSF may impact on the validity of the assessment process and outcome.

24

2.3 MSF and Medical Revalidation

Largely due to its success in formative appraisal processes prior to Revalidation, MSF is considered an *'integral component'* of Revalidation (General Medical, 2011, p.5) and a *'valuable source of evidence to support or refute a doctor's application to revalidate'* (Campbell *et al.*, 2011, p.1). When used for developmental purposes, doctor's often value the feedback from undertaking MSF assessments and appreciate the formative aspects of it (Saedon *et al.*, 2012). Some argue that MSF assessments should not be relied upon alone to assess the performance of a doctor, others suggest MSF should never serve a summative function within the healthcare enviroment (Brown *et al.*, 2014; ten Cate & Sargeant, 2011). Prior to the implementation of Revalidation, Campbell *et al.* (2011) stated that MSF within Revalidation should be largely formative in nature and intent, undertaken within the context of strengthened systems of appraisal where results should always be considered alongside the full range of other evidence that the doctor collects during the Revalidation cycle.

2.4 Assessment Validity

The wide adoption of MSF within medicine internationally predicates an inherent need to critically evaluate evidence to support or refute its validity, reliability and feasibility. For competency-based performance assessment (as in the case of MSF), assessment validity can be considered the extent to which *'a test actually succeeds in testing the competencies that it is designed to test' (Wass et al., 2001, p.946)*. Reliability can be considered as a *'measure of the reproducibility or consistency of a test'* and often considers consistency in scoring between multiples assessors of a candidate or between the scores of different candidates (Wass *et al.*, 2001, p.946) Finally, feasibility can be considered the extent to

25

which an MSF tool is able to be implemented based on its cost, time and rates of response (Donnon *et al.*, 2014).

A number of systematic reviews have demonstrated MSF to be a valid, reliable and feasible method of performance assessment (Al Ansari *et al.*, 2014; Al Khalifa *et al.*, 2013; Andrews *et al.*, 2013; Donnon *et al.*, 2014). However critics continue to cite concerns around important issues that may undermine the assessment validity of MSF (Archer & McAvoy, 2011; Bullock *et al.*, 2009; Burford *et al.*, 2010). Past reviews have focussed on specific areas of assessment validity, largely the statistical and psychometric properties, or have explored the validity of feedback instruments in regards to particular medical specialities (Al Ansari *et al.*, 2015; Al Khalifa *et al.*, 2013; Andrews *et al.*, 2013; Donnon *et al.*, 2014; Ferguson, Wakeling & Bowie, 2014; Miller & Archer, 2010; Overeem *et al.*, 2007). In order to better understand the ability of MSF to reliably and accurately assess aspects of medical performance, a systematic review of reviews was conducted as part of this PhD project (Appendix 1).The review by Stevens *et al.* (2018b) provides an up-to-date synthesis of the MSF validity literature, using the APA framework of assessment validity to provide a comprehensive and holistic analysis of the validity evidence (Downing, 2003). In summary, this review demonstrates the existence of substantial validity evidence supporting the statistical and psychometric properties of MSF, alongside sufficient evidence supporting the feasibility of MSF in terms of time, financial costs and response rates. However, evidence to support the validity of MSF was identified as lacking in the following three areas:

1) How best to ensure MSF tools measure what they intend to measure (content validity)
2) How best to maximise positive impacts on practice (consequential validity)

3) How to ensure the process of assessment delivery is rigorous, robust, and free from bias (response process validity).

In order to ensure that MSF assessments can best identify the strengths and weaknesses of doctors' clinical practice, more research is required to fill the identified gaps in validity evidence. This study therefore looks to provide new evidence in response to one highlighted area of concern for MSF assessment validity, namely that of the process of selecting raters.

2.5 Rater Selection

2.5.1 Selecting Raters

The procedure of rater selection has long since been recognised as an area of concern for the validity of MSF (Overeem *et al.*, 2007; Overeem *et al.*, 2010; Saedon *et al.*, 2012), especially for those involved in 'high-stakes' MSF assessments (Edwards *et al.*, 2011). Early work by (Ramsey *et al.*, 1993) investigating the validity of peer feedback to assess medical performance concluded that ratees selecting their own raters does not substantially bias MSF results. This result was echoed by Lurie *et al.* (2006) for medical students completing MSF assessments within their training, with the process of rater selection today influenced by these early studies. Proponents of the self-selection model argue that assessment validity is increased as the ratee will know which colleagues are best placed to assess their abilities (Lurie *et al.*, 2006). The practicality and feasibility of self-selecting raters (vs. third party selection) is also highlighted as a benefit of this method (Archer & McAvoy, 2011; Lurie *et al.*, 2006). However, the notion of self-selection being the most valid method of rater selection within medicine has since been challenged, with a number of authors citing concerns that self-selecting raters may substantially bias results

27

(Archer & McAvoy, 2011; Bullock *et al.*, 2009; Burford *et al.*, 2010; Hill *et al.*, 2012; Trebble *et al.*, 2013).

2.5.2 Rater Selection - Bias

A general principle guiding the selection of raters across any sector or discipline is that:

'Raters should be selected based on some work-related interaction; there should be strong guidance against selecting them just because they know that person well (i.e., are simply friends with no work-related interaction)' (Church *et al.*, 2019, p.287)

Although many would agree that colleagues whom are selected to provide performance feedback should be familiar with a ratees performance, a number of studies have explored whether social familiarity is also a factor in how raters are selected (Brown *et al.*, 2014; Burford *et al.*, 2010; Cohen, Farrant & Taibjee, 2009; Ingram, Anderson & Pugsley, 2013; Sargeant, Mann & Ferrier, 2005).

Firstly, Burford *et al.* (2010, p.173) demonstrate in a study exploring MSF for postgraduate medical trainees, that after knowing raters have *'experience of my work'*, the second highest reported factor influencing a doctor's rater selection choices was to *'get on with them well as a person'*. Although perceived validity and practical considerations were features reported as affecting rater selection choices, the authors conclude that interpersonal relationships clearly *'play a part'*.

Secondly, when exploring attitudes towards the self-selection of raters by postgraduate medical trainees, Brown *et al.* (2014, p.1000) demonstrates that trainees acknowledged they often choose *'assessors who they had a positive relationship with'* and *'who will give favourable results'*. This bias in the selection of raters by trainees was confirmed by consultants who agreed that trainees

28

nominated colleagues whom they have *'positive relations with'* and felt that trainees *'actively avoided those potential [raters] they may have had conflict with'.* Trainees recognised that self-selection could positively bias their results by avoiding potentially negative assessments.

In two further studies exploring the attitudes towards MSF of postgraduate trainees, a significant number of trainees reported fears of victimization from certain raters, with MSF an opportunity for these raters to *'attack'* them (Cohen, Farrant & Taibjee, 2009). In such instances, it may be reasonable to suggest that trainees may 'game' whom they nominate to mitigate the likelihood of receiving negative feedback (Ingram, Anderson & Pugsley, 2013). Trainees also demonstrated a tendency towards gaming in their choice of raters, particularly where MSF was used to serve summative outcomes, where for trainees, *'obtaining sufficient scores was the sole or main objective'* (Ingram, Anderson & Pugsley, 2013, p.840)

Finally, research exploring the experience of rural and urban GP's undertaking MSF assessments in Canada, highlighted the difficulties present in selecting a suitable number of *'unbiased'* raters (Sargeant, Mann & Ferrier, 2005, p.500). In this instance, the practice setting, whether urban vs. rural, solo vs. group practice, did not independently determine the ability to select raters who knew the participants, whereas the practice context and professional relationships did. Working in a hospital or nursing home enhanced the *'number and richness of relationships'* (p500), increasing the pool of colleagues able to assess performance. Surprisingly, those working in urban settings reported finding it harder to identify raters, as unlike their rural counterparts, they did not have close

29

relationships with other healthcare professionals (e.g. pharmacists, physiotherapists etc.) due to the size of the workforce in these roles.

2.5.3 Rater Selection - Impact on Assessment Outcomes

Alongside attitudinal focused studies exploring rater selection choices from the doctor perspective, two studies have explored the extent to which rater selection choices may impact on feedback scores (Archer & McAvoy, 2011; Bullock *et al.*, 2009). Investigating MSF assessments for medical trainees, Bullock *et al.* (2009, p.519) demonstrated that average colleague feedback scores vary significantly between colleagues of the same staff group. Although not clear why this phenomena occurs, one factor may have been that doctors *'collude to give each other favourable results'*.

Furthermore, research exploring rater selection in MSF assessments for doctors involved with the National Clinical Assessment Service (NCAS) highlight further concerns with the self-selection of raters. NCAS (known today as NHS Resolution) support doctors and healthcare organisations where concerns are raised about a doctor's performance. Results of a quantitative study by (Archer & McAvoy, 2011) demonstrate significant differences occur in the feedback results of ratee nominated vs. third party nominated raters. After controlling for factors previously understood to affect differences in feedback provided by colleagues (e.g. rater age, gender, length of working relationship etc. (Crossley *et al.*, 2008; Davies *et al.*, 2008), Archer and McAvoy highlight that the *'practice of choosing one's own raters is likely to lead to more favourable results'*, regardless of the background characteristics of the raters (Archer & McAvoy, 2011, p.891). This finding is echoed by Archer, McGraw and Davies (2010) who state that where

significant differences exist between assessor scores, ratee selection of more lenient assessors is often the perceived cause of disparity.

2.5.4 Rater Selection - MSF within Revalidation

A small number of studies have discussed issues surrounding rater nomination biases in the context of Revalidation. In a qualitative study exploring the use and acceptance of MSF assessments for GP's involved in Revalidation, self-selection of raters was highlighted by GP's and appraisers as a concern that "*intentionally or unintentionally…may influence the feedback given*" (Hill *et al.*, 2012, p.317). One GP commented that the process of self-selection is *"flawed",* as *"you're going to select people [colleagues] that are going to give the answers that you want. Maybe not deliberately but because they're the people that you know"* (p317). This finding echo's that of the studies discussed previously and highlights a potentially significant concern for the validity of MSF within Revalidation.

Furthermore, a recent governmental review of Revalidation by Sir Keith Pearson (Pearson, 2017, p.45) has highlighted that in its current form, MSF may not *"consistently identify doctors…whose behaviours are 'disruptive'"*, and that in doing so *"could translate into the quality and safety of care provided to patients"*. Pearson states that allowing doctors to choose their own assessors might undermine the validity of feedback, where "*colleagues sometimes lack the necessary objectivity, honesty and candour" (p.45)*. Inconsistency between organisations in the way rater selection is carried out has also been highlighted as *"at present, some organisations allow doctors to choose which of their colleagues are approached to complete feedback questionnaires, while others have the choice made for them"* (p.45). Finally, self-selection of raters for MSF

within Revalidation is criticised as Pearson states *"colleague feedback works better when the appraiser approves or recommends which colleagues are sampled, rather than the doctor selecting their 'friends'"* (p.45).

2.5.5 Summary

Despite the positive evidence supporting the use of MSF in medicine (Al Alawi *et al.*, 2013; Al Ansari *et al.*, 2015; Al Khalifa *et al.*, 2013; Donnon *et al.*, 2014), rater selection arguably remains a threat to assessment validity (Archer & McAvoy, 2011; Archer, McGraw & Davies, 2010; Brown *et al.*, 2014; Bullock *et al.*, 2009; Burford *et al.*, 2010; Ingram, Anderson & Pugsley, 2013), particularly for doctors undertaking MSF within the framework of Revalidation (Hill *et al.*, 2012; Pearson, 2017). However, the majority of research to date has involved medical trainees, with many of the studies not exploring MSF in the context of Revalidation. Furthermore, existing research relies on attribute-based data often collected through surveys or semi-structured interviews. No study to date has provided an empirical exploration of the social relationships between colleagues in a healthcare setting and the possible impacts these relationships may have on the rater selection choices of doctors for MSF.

In order to identify the extent to which doctors are 'creative' and 'game' in the way they may be selecting raters and whether a friendship bias exists when completing MSF assessments within Revalidation, a relational approach to this research is arguably preferable. Hafferty *et al.* (2013) and Michalec *et al.* (2016) suggest that in order to understand the peer nominations made by doctors within MSF, a social network analysis (SNA) approach would be well suited, with SNA largely absent from the peer assessment and medical education literature more

widely. This study therefore seeks to provide a beneficial addition to knowledge in the fields of peer assessment, medical education and regulation.

2.6 Theoretical Perspectives

2.6.1 Social Network Analysis

SNA is an established approach in social science research used to map, measure and analyse the social relationships between individuals, groups and organisations (Scott, 2017). SNA uses relational data, in order to explore the contacts, ties and connections that relate one agent to another, where this data cannot be reduced to properties of the individual agents (Scott, 2013). SNA is a common approach to exploring relational data as the units of analysis are not the individual agent themselves, but are the relational systems built up through connected pairs of interlocking agents (Scott, 2017). SNA today provides both a research approach as well as a method to explore relational data throughout the social sciences.

Developed significantly since the 1970's, the popularity of network analysis has risen in recent years due partly to the increased importance of 'networking' within management sectors and the proliferation of 'social networking' sites such as Facebook and Twitter (Scott, 2013). Initially created to study community and kinship relations, SNA approaches have since been applied to explore relations between a diverse set of actors across range of settings. SNA was chosen as the preferred perspective for this study due its ability to i) both quantify and qualitatively assess the connectivity between actors for multiple tie types, ii)

conduct inferential analyses for predictive purposes and iii) consider the differing contexts of multiple networks within a healthcare environment.

2.6.2 SNA and Healthcare Research

SNA has a long history within health care. One of the first social network theorists (Jacob Moreno, 1889-1974) applied network theory within a public health setting to explore how an epidemic spread so quickly throughout a New York school (Moreno, 1934). His exploration of friendship amongst children was the first to graphically represent the relations between students and their social position with each other. From this early work, theoreticians applied mathematical formulae and graph theories to describe and understand the complexity of individuals and organisational relationships (Wasserman & Faust, 1994). The literature surrounding SNA within healthcare has increased rapidly in recent years. SNA has been used to explore health behaviour, health prevention, organisational management and group behaviour, with most studies falling within one of two streams (Valente, 2010):

1. Epidemiological studies exploring disease spread/disease control interventions and population health

2. Organisational network studies exploring the quality, safety and effectiveness of healthcare

In order to understand the suitability of a SNA approach to explore rater selection processes for MSF within Revalidation, the following section will focus on a number of theoretical concepts used to explore staff interactions within healthcare networks.

2.6.3 SNA and the Quality, Safety and Effectiveness of Healthcare

Through mapping the network structures of healthcare teams, network analysis can help to identify how and where improvements can be made to the quality,

34

safety and effectiveness of healthcare. Staff teams within healthcare organisations can be understood as a set of social actors and the social rules which govern the relations between them (Quinlan & Robertson, 2010). The role of networks has become ever more crucial in the delivery of healthcare throughout the 21st century, due partly to advancements in technology and a recognition that hospitals are no longer the unique place where healthcare is delivered (Greenhalgh, 2008). Healthcare managers and policy makers have become more aware of the role other actors play in providing effective multiscale and multidisciplinary team working practices within primary, secondary and community care settings (Atkinson, 2002; Bloom & Standing, 2008) from both medical and non-medical, public and private sectors (Blanchet & James, 2012).

Social network research is based on the foundation that actors are embedded within networks of social relationships (Coleman, 1988; Granovetter, 1985) and these networks have key behavioural, perceptual and attitudinal consequences (Knoke & Kuklinski, 1982). Based on this assumption, two key theoretical strands provide differing explanations for the mechanisms underlying the consequences of networking (Borgatti & Foster, 2003). These are the social influence and social capital perspectives. Both of these theories have been adopted previously to inform social network research in the quality, safety and effectiveness of healthcare literature. Table 1 below highlights where these theories are commonly adopted within this area of research.

Table 1. Social Capital and Social Influence in the Quality, Safety and Effectiveness of Healthcare

Research Area	Social Capital	Social Influence
Diffusion of Innovation	x	x
Dissemination of Information	x	x
Employee Turnover	x	
Social Support and Physician Burnout	x	
Job Satisfaction	x	
Advice Seeking	x	x
Prescribing Behaviour	x	x

2.6.4 Social Influence

Although often regarded as a perspective or theoretical viewpoint for understanding the patterns of behaviour within a network, social influence (and social capital) are both also discussed within the healthcare networking literature as a network measure, feature or theme (Bae *et al.*, 2015; Chambers *et al.*, 2012; Cunningham *et al.*, 2012). From a social influence perspective, social networks are perceived as the avenues through which actors can influence the behaviour of alters, and where mechanisms of social control and behavioural norms develop and are implemented (Ingram & Roberts, 2000). Based on this premise, studies drawing on the social influence perspective within healthcare largely look to examine social relationships to explain homogeneity of behaviours (Creswick, Westbrook & Braithwaite, 2009; Fattore *et al.*, 2009; Wensing *et al.*, 2011) and understanding the diffusion of new ideas and practices (Mascia & Cicchetti, 2011; Vanderveen *et al.*, 2007; Zappa & Mariani, 2011).

Measuring social influence is examined by the extent one's network engages in a behaviour. There is a common assumption within the social influence

perspective that an actor's network influences their behaviour if the actor believes that alters engage in the same behaviour (Valente, 2010).

Many of the key studies to explore the impact of social influence within healthcare team networks are linked to the 'diffusion of innovation' literature (Coleman, Katz & Menzel, 1957; Fattore *et al.*, 2009; Keating *et al.*, 2007; West *et al.*, 1999; West & Barron, 2005; Zheng, Padman & Johnson, 2007; Zheng *et al.*, 2010). The majority of these studies do however explore social influence through formal communication and interaction channels within the healthcare environment. Some studies have found however that peer influence through personal friends can be a more significant factor in the adoption of new innovations compared with interactions in professional settings (Zheng, Padman & Johnson, 2007; Zheng *et al.*, 2010).

2.6.5 Social Capital

Alongside understanding network behaviours from the social influence perspective, behaviours within a network can also be explored using the theory of social capital. The central tenet of social capital theory is that by:

'making connections with one another, and keeping them going over time, people are able to work together to achieve things they either could not achieve by themselves, or could only achieve with great difficulty' (Field, 2008).

Social capital has a rich history within the sociological and political science literature, popularised through a number of core theorists. Bourdieu (1986, p.248) was one of the first to discuss social capital theory, defining it as:

'the aggregate of the actual or potential resources which are linked to possessions of a durable network of more or less institutionalised relationships of mutual acquaintance or recognition'

Bordieu's view of social capital focusses on the individual resources or 'profits' that actors can accrue through participation in a network. This ego-centric view of social capital differs however from the work of Coleman (1988) and Putnam (2000), who understand social capital as a way of solving collective problems through a sense of community and trust.

The concept of social capital has gained further attention more recently through the work of Robert Putnam. Putnam, like Coleman (1988), views social capital beyond the level of individual actors as:

'*features of social organisation, such as trust, norms and networks, that can improve efficiency of society by facilitating coordinated actions*' (Putnam, 1993, p.167)

Putnam describes the core idea of social capital being that '*social networks have value*' (Putnam, 2000, p.18), with his work popularising the concept of social capital today and leading to greater interest into the analysis of networks.

With regard to health care research, social capital theory has been used extensively to explore the impact of social integration on individual or population health worldwide (Ahnquist, Wamala & Lindstrom, 2012; Buzzelli, 2007; Elgar *et al.*, 2011), although only a limited number of studies have adopted network analysis techniques (Abbott, 2009).

Few studies have explored social capital in terms of quality, safety and effectiveness of care in healthcare research. Ommen *et al.* (2009) demonstrate that organisational social capital, in addition to professional experience, can predict overall job satisfaction of hospital employees. They suggest interaction and cooperation should be encouraged from the top down to maintain high levels

of individual and organisational social capital. Recognising the first signs of weak organisational social capital and low job satisfaction could also help identify the early signs of stress or burnout in hospital staff. Fattore *et al.* (2009) also explore whether social capital was a useful mechanism for predicting medication advice/prescribing behaviour. They conclude that social influence was a better predictor of prescribing behaviour than social capital, with centrality of the network having a small but insignificant effect on a GP's ability to meet prescribing targets.

2.6.6 Trust

Trust (like many sociological concepts) is difficult to define and is interpreted differently across numerous disciplines and theoretical perspectives. At its most simple, trust has been considered in terms of reliance on another (Jones, 2001), however some argue that trust is more complex than purely reliance (Baier, 1986). Glanville and Paxton (2007, p.230) define trust as the '*expectation of good will in others',* where it can be understood to be a psychological state (McAllister, 1995), as a choice behaviour (Dasgupta, 1988) or as a relational attribute sometimes incorporating both aspects (Mayer, Davis & Schoorman, 1995). Trust is often measured using reciprocity as a functional indictor (Koniordos, 2005) when exploring networks (e.g. where person A nominates B, and B also nominates A), as reciprocated ties are often viewed as stronger. Social science research has generally demonstrated that reciprocal social relationships are more close (Almaatouq *et al.*, 2016; Buhrmester, 1990; Gershman & Hayes, 1983; Vaquera & Kao, 2008), provide greater emotional support (Stanton-Salazar & Spina, 2005), and form a superior resource of social capital (Lazega & Pattison, 2001; Vaquera & Kao, 2008) when compared to those that are not reciprocated.

Marques (2005) demonstrates however that although in some cases reciprocity can be an adequate proxy for trust, a more considered approach is required as these two notions are not identical.

The concept of trust features often within healthcare research that draws on the theory of social capital. Bordieu's (1986) theory of social capital has no explicit mention of 'trust', however Coleman's (1988) later definition of social capital includes trustworthiness of the social environment to be a resource alongside information, norms, obligations and effective sanctions. This more abstract definition arguably led to the many differing concepts put forward by later scholars under the label of social capital (Portes, 1998). Unlike Coleman (1988), many later theories of social capital viewed trust as an antecedent, component or consequence of social capital (Field, 2008), with Putnam's (1993) theory becoming the most cited within public health research (Moore *et al.*, 2006).

Putnam (1993) describes trust in terms of 'bonds' and 'bridges', whereby trust can be understood as the 'glue' that brings a single network together, and the 'lubricant' that supports the interrelationships of external social networks. In this sense a causal link is identified between high degrees of trust, increases in civic participation and enhancements in socio-economic development, however the validity of such a causal link between trust and social capital has been widely debated (Koniordos, 2005). This debate is pertinent within epidemiological network analysis studies, where trust is often used as a proxy for one's social capital (Fujiwara & Kawachi, 2008; Moore *et al.*, 2011; Sapag *et al.*, 2010). Carpiano and Fitterer (2014) demonstrate however that although correlated, trust is a) conceptually distinct from social capital b) measures of trust

40

are inadequate proxies to social capital and c) these proxies may only capture aspects relevant to, but not indicative of, social capital. Recent analysis also demonstrates the direction of causality between levels of trust, health status and social capital to be complex and not unidirectional as previously understood (Giordano & Lindström, 2016).

Unlike the epidemiological healthcare literature exploring the concept of trust within social networks, few network studies have explored trust in relation to the quality, safety and the effectiveness of healthcare. Barrera and van de Bunt (2009) explore a longitudinal analysis of trust at the individual level by investigating the effects of developing interpersonal trust relations within a clinical team at a Dutch hospital. The authors conclude that actors in the network learn to trust (or distrust) from their own past experiences as well as from information received through colleagues. At the organisational level, network studies have explored competency trust among healthcare providers supporting immigrant families in primary care (Isaacs *et al.*, 2013). Isaacs *et al.* (2013) demonstrate how competency trust towards other providers of healthcare increased their commitment to work together, while lack of competency trust created avoidance. Varda and Retrum (2012) also studied organisational trust by exploring the quality of interactions and perceptions of trust within a public health collaborative. Both of these studies demonstrate how increases in trust between organisations improves collaboration and the quality of care and access to services for patients.

2.6.7 Social Relationships

As discussed previously, the field of SNA emerged as a result of Moreno's (1934) work exploring social relationships between high school students. Since this time, exploring social relationships between actors has remained a core focus of network research activity across a multitude of academic disciplines. Social relationships however have to date received limited attention within the quality, safety and effectiveness of healthcare literature.

Where social relationships within healthcare teams have been explored, healthcare practitioners, like many individuals who share similar characteristics, attitudes or behaviours, have been demonstrated to form homophilous relationships with individuals of the same occupation. Based on the patterns of social relationships within an Emergency Department in Australia, Creswick, Westbrook & Braithwaite (2009) demonstrate that healthcare practitioners socialise 'tribally' by job roles, a phenomenon thought to exist due to the distinct collective professional identities that form within training and last throughout practitioners' careers (Holden *et al.*, 2012). Although the identification of these networks increases our understanding of the patterns of social relationships that form within a secondary care setting, the impact of these relationships on the individuals or the workforce is not explored in Creswick, Westbrook and Braithwaite's (2009) research.

Yousefi-Nooraie *et al.* (2012) provide a further study exploring social relationships within a healthcare setting, in this instance within a public health department in Canada. The research looked to understand information seeking for evidence informed decisions, using both practitioners, managers and experts as actors

within the sample network. The existence of occupational homophily is not reported in this study, however a substantial number of cross-departmental friendship ties are observed. Similar to the findings of Creswick, Westbrook and Braithwaite (2009), a lack of information surrounding the impact of this friendship network on information seeking behaviours contributes little to understanding the impact of social relationships within the healthcare setting.

Finally, as discussed above, Zheng et al (2007, 2010) demonstrate that when looking to maximise the adoption of new healthcare innovations, targeting individuals in key friendship roles can be more beneficial compared with identifying individuals based on professional interactions. Direct communication had no significant impact on the uptake of innovation, demonstrating the importance of considering social influence through friendship within the healthcare setting.

2.7 Aim, Objectives and Research Question

Aim

Identify, measure and understand the factors that influence rater nomination choices, including social relationships, made by UK GP's in MSF assessments for Revalidation.

Research Question

To what extent do social relationships within healthcare teams impact the rater nomination choices made by UK GP's?

Objectives

43

1. Define and measure the networks of social relationships within healthcare teams at GP practices in the South West of UK

2. Assess how social relationships impact, if at all, on the rater selection choices made by GP's

3. Identify factors underlying rater nomination choices from the ratee perspective

4. Identify factors influencing rater nomination choices made by doctors and likelihood of responding to feedback requests from the rater perspective

2.8 Definition of Terms

For this study, the term MSF is used to be inclusive of colleague/peer feedback but not that of patients. In the framework of Revalidation, as in other areas of its use, colleague feedback and patient feedback are used as two distinct instruments, providing a strong rationale for this distinction (General Medical Council, 2012a)

In terms of the MSF process itself, focal doctors undertaking an MSF assessment are termed ratees within this study, with those colleagues whom provide feedback to the focal doctor termed raters. The terms rater selection and rater nomination are used synonymously to describe the process of a focal doctor choosing the colleagues whom they would like to received feedback from.

The term 'healthcare team' is used to describe employees that work within a general practice setting in either clinical or administrative roles. The inclusion of both clinical and non-clinical staff is necessary as under current guidance from the regulator as both of these groups may be asked to provide feedback to a GP through a MSF assessments for Revalidation (General Medical Council, 2012a)

Finally, the term doctor and GP are used synonymously when describing the qualified medical professionals within GP practices who participated in the study.

CHAPTER. 3 METHODS

Conducted from a social networks perspective, this study adopted a case study design utilising a mixed methods approach. The study involved an online survey to map the social relationships between staff within primary healthcare teams, alongside exploring the rater nomination choices made by doctors within these teams at their most recent MSF assessment for Revalidation. In-depth interviews with a sample of staff within these teams were also conducted in order to contextualise the quantitative findings and understand the professions attitudes towards the rater selection process from both the doctor and wider healthcare team perspective. This chapter will now explore the methodological considerations for the study.

3.1 Critical Realism

An important consideration for any social research study is the philosophical assumptions underpinning it. From an ontological perspective, this study is conducted from the viewpoint of critical realism, often viewed as a 'third way' between empiricism and positivism on the one hand, and interpretivism and social constructionism on the other (Sayer, 2000). Critical realism challenges the concept that causality occurs through a regular succession of structured events, concluding that identifying causal relationships requires a more nuanced approach that takes into consideration the circumstances and context of the research. When researching within open systems, as is the case when exploring MSF assessments for doctors, a realist perspective requires us to interpret

findings within the context of their systems (Bhaskar, 2013)[1]. As Sayer discusses, *'given the presence of multiple systems and causes in the things we study and the possibility of different causes producing the same effects, there is always a risk of misattributions of causality'* (Sayer, 2000, p.20). There are likely to be multiple 'mechanisms' at play within the rater nomination process, depending on factors including: GP's attitudes towards MSF and its role within Revalidation; their concerns about the validity or accuracy of the assessment; alongside their attitudes towards receiving critical feedback (Shrivastava, Shrivastava & Ramasamy, 2014). Intensive approaches often focus in detail on small numbers of specific cases, utilising a qualitative framework of analysis and multiple methods of data collection (Sayer, 2000). To this end, an 'intensive' approach was deemed most suitable for this study by allowing causal processes to be traced through both their *'qualitative nature as well as their number'* (Sayer, 2010, p.20).

3.2 Epistemology

In terms of epistemology, SNA as a perspective has often been closely attributed to structuralism, the way we come to know the social world by studying its societal structures (Prell, 2012). However, the interactionist roots of SNA have arguably been overlooked in recent years, due to rapid advances in complex statistical analysis techniques for networks (Crossley, 2010). SNA has been criticised in the past for its focus towards structure over agency, however some network analysts strongly argue the focus for sociologists is not on the voluntaristic actors, but on structural constraint (Wellman, 1983). However, it is increasingly accepted that

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[1] Open systems are those in naturally occurring social environments, not under 'lab' conditions

47

SNA can take account of both social structure and individual agency, combining structuralist and interactionist perspectives, through the choice of methods adopted (Crossley, 2010; Dominguez & Hollsteing, 2014). For Crossley (2010), networks should be viewed as 'social worlds' that are built up through meaningful interactions, not just abstract structures. This approach to understanding social networks, that promotes both the quantitative mapping of network structures, alongside qualitative narratives to contextualise and bring meaning to the interactions, closely aligns with a critical realist ontology as adopted for this research.

3.3 Case Study Design

Aligned with the use of an intensive critical realist approach, this study will adopt a case study design. Case studies have historically been associated, though not exclusively, with qualitative research where there is little prior knowledge or understanding of the topic being researched (David & Sutton, 2011). This research design provides the researcher the opportunity to intensively analyse a single (or multiple) cases, where a 'case' could compromise for example a group of people, an organisation or a geographic location (Bryman, 2012). Depending on the purpose of the study, different types of cases can be chosen (e.g. extreme cases, revelatory cases, typical cases etc.) (Yin, 2013), with different approaches available to undertake the research (including intensive, longitudinal and comparative) (Bryman, 2012). These designs have been successfully used within projects adopting network perspectives in healthcare environments previously, further warranting their adoption (Cadarette et al., 2016; D'Andreta, Scarbrough & Evans, 2013).

Table 2. Case study design

	Case 1	Case 2	Case 3
No. of GP's	High	Medium	Low
Rurality	Urban	Semi-Rural	Rural

This project adopts a comparative case study design influenced by a study by Scott *et al.* (2005) who have demonstrated the benefits of SNA studies when looking to explore commonalities or differences among different general practices. Each of the three GP practices that are recruited into this PhD study were identified in an attempt to be variable in practice size and geography (Table 2).

Although general practice teams are often smaller than those of secondary care settings, the size of healthcare teams throughout General Practice can vary widely due largely to new models of primary care delivery becoming ever more popular (NHS England, 2016). General practice is starting to move away from smaller, single site GP practices towards multisite models, often in the form of federations and super partnerships, in order to increase efficiency by combining resources and centralising administration.

The geographical location of the practice may also impact the structures and patterns of social relationships within healthcare teams, with staff within rural practices potentially forming closer ties as the number of staff within healthcare teams is reduced. Although the structure and locality of GP practices was not seen to be a key factor influencing rater selection in a study within Canadian General Practice (Sargeant, Mann & Ferrier, 2005), the differing healthcare systems and models of general practice in the UK warrant exploring the impact

of rurality on the research. Practices in rural vs. urban localities will be identified using the ONS Rural-Urban Classification for Small Area Geographies (ONS, 2011).

A higher number of GP practices within each case would further increase the transferability of the findings, however with the qualitative nature of the study and the number of research activities involved this was not possible.

3.4 Research Methods

In terms of data collection methods, this study adopts a convergent mixed methods approach (Creswell & Clark, 2017). Mixed methods approaches have risen in popularity within healthcare research (Tariq & Woodman, 2013), due to the recognition that using a single method alone can lead researchers to miss important elements of a story. Mixing methods usually involves a combination of qualitative and quantitative methods that, when used together in a single study, have *'the potential to harness the strengths and counterbalance the weaknesses of both approaches'* (Tariq & Woodman, 2013, p.3). Although the benefits of mixed methods research is widely cited, it is still recognised that using multiple methods is still liable to many of the same considerations and constraints that impact validity of studies not adopting multiple methods of data collection (Bryman, 2012).

In terms of a convergent approach to mixing methods, data was collected using each of the research methods concurrently at each case. Once collected, the data from each method of data collection were analysed individually using methods of analysis described from page 69. The findings were then integrated,

with qualitative data used in part to contextualise and support the interpretation of the quantitative findings. Corroborating findings in mixed methods research is conventionally conducted through a process of triangulation, the aim being to provide a reduction in bias by integrating the *'theories, methods and data sources'* in order to better capture a '*unified social reality*' (Modell, 2009, p.209) . When adopting a more functionalist paradigm, this approach to validating data findings can be considered defensible (Modell, 2009). However, from a critical realist viewpoint, where reality is considered multidimensional and subjectively construed, the convergence of competing ontologies to form social 'truths' becomes problematic (Modell, 2005). This study therefore adopts a method of internal validation known as abductive reasoning, a form of internal validation that, in line with critical realist modes of enquiry, allows for context-sensitive theorising within mixed methods research (Downward & Mearman, 2006; Mingers, 2006). Abductive reasoning provides an opportunity to draw together the findings of different methods, whilst considering different theoretical perspectives that may best explain any causal patterns identified within the data. It is however recognised that *'mixed methods research combined with abductive reasoning can never lay claims to having exhausted all possible causal explanations'* (Modell, 2009, p.61), and therefore all theories formed from the data must be treated with caution.

There are three research methods employed for this study, each selected to best meet the proposed research objectives (see Table 3).

Table 3. Research methods mapped to objectives

	Research Objectives	Survey	Rater Nomination Data	In-Depth Interviews
1.	Define and measure the networks of social relationships within healthcare teams at GP practices in the South West of UK	✓	-	✓
2.	Assess how social relationships impact, if at all, on the rater selection choices made by GP's	✓	✓	✓
3.	Identify factors underlying rater nomination choices from the ratee perspective	-	-	✓
4.	Identify factors influencing rater nomination choices made by doctors and likelihood of responding to feedback requests from the rater perspective	-	-	✓

3.4.1 Online Network Survey

3.4.1.1 Purpose

In order to meet the first two objectives of the study (Table 3), an online survey method was designed and hosted on the online platform Lime Surveys (LimeSurvey Project Team / Carsten Schmitz, 2012). Staff were able to complete the survey on most internet enabled devices (laptop, tablets, smartphones etc.). Surveys provide a common method of data collection within social research, with digital advances and a wider access to technological devices increasing the popularity of hosting surveys online (Bryman, 2012). Online survey approaches also provide respondents the opportunity to complete the survey at a time and place convenient to them, often increasing response rates (De Vaus, 2013). Throughout the social sciences, surveys are typically used to collect self-reported attitudinal or behavioural data from large volumes of responses in what is often termed 'attribute' data. To explore the connections between individuals, rather than attributes of the individuals themselves however, required a 'relational' approach to survey design (Scott, 2013). Relational approaches to survey design have been core to the systematic collection of data within social network analysis studies historically and remain a major source of relational data collection for both egocentric and whole network approaches today (Marsden, 1990).

3.4.1.2 Survey Question Design

In order to collect relational data this survey adopted a name generator approach, a common method of collecting network data within the quality, safety and effectiveness of healthcare literature (Burt *et al.*, 2012). Name generators are survey items which ask participants to provide the names of a certain number of actors with whom they share a given type of social relation (Burt *et al.*, 2012). When adopting a nominalist approach to the boundary of a network study, as is the case for this research, it is common however to favour a prompted recall or a roster approach over a name generator. Roster methods provide participants with a list of actors in which to select from, providing the benefit of stimulating recall but increasing the likelihood of survey fatigue if the roster list is too large (Butts, 2008). Although rosters can suffer from the converse issue of over reporting, they are generally preferred over name generators where the list of potential alters is not too large (Burt *et al.*, 2012). A name generator approach was adopted for this study due to challenges with acquiring up to date lists of employees at each of the participating GP practices prior to data collection. It must also be recognised however that regardless of how the alter names are collected in the survey, usual issues surrounding the participant interpretation of the questions exist as with any standard questionnaire based technique with the social sciences (Scott, 2013). The issue of question interpretability may be particularly pertinent in the case of social relationship based research where ones interpretation of social relations may vary.

3.4.1.3 Demographics

The first section of the survey collected demographic data of the respondents. This demographic data was used in the social network analysis of the survey and

rater nomination data as 'attributes' of actors within the networks. The demographic characteristics included:

- Gender
- Age
- Ethnicity
- Occupation
- Full/Part time employment
- Duration of Employment

These six demographics were chosen for two reasons. Firstly, each were considered to be factors potentially influencing the structure and formation of social relationships within the healthcare team. These characteristics help to identify the extent to which homophilous patterns of social relationships form within the teams, a finding previously identified within the healthcare workforce literature (Creswick, Westbrook & Braithwaite, 2009; Scott *et al.*, 2005).

Secondly, alongside exploring how background characteristics relate to the formation of social relationships, these characteristics were also explored in relation to the rater selection choices made by doctors for MSF. Each of these factors (apart from full/part time employment) have been shown in previous studies to impact the performance feedback doctors received for MSF (Archer & McAvoy, 2011; Crossley *et al.*, 2008), however limited research to date has objectively explored the extent to which the background characteristics of colleagues relate to rater selection choices. For each participating doctor, this study therefore triangulates rater nomination choices against the demographic characteristic of these colleagues, alongside the existence of a social relationship in order to best understand the existence of rater selection bias.

3.4.1.4 Network Questions

As Burt *et al.* (2012) demonstrates, the validity of a network survey is increased if all potential actors thought to be impacting a particular social process are identifiable to a respondent in the questions asked. Relying on one single name generator can lead to what Laumann, Marsden & Prensky (1983) term the 'partial system fallacy', where a network structure may be misleading due to the non-collection of relevant established connections. Therefore, in order to understand the extent to which social relationships may impact or influence the rater nomination process for doctors, two name generators were selected in order to increase the likelihood of accurately capturing the existence of social ties between staff.

Initially, a single name generator was considered to simply ask respondents to identify which colleagues they consider to be their 'friend' at work. When piloting the survey with academic colleagues whom are also GP's however, concerns were raised with the interpretability of 'friend' and how this could differ depending on each respondent. In order to limit variability in how respondents interpreted the question therefore, two name generators were selected which related to the concepts of trust and socialising, which together were considered to more reliably capture the existence of a social connection between two colleagues.

In order to measure trust, an amended version of the commonly used trust question from the US General Social Survey was adopted (Bailey & Marsden, 1999; Burt, 1984). The question was worded as:

From time to time we discuss important matters about our personal lives with people that we trust. Please list the colleagues at this practice whom you have trusted to discuss important personal matters with over the past 6 months.

In order to understand if there were also individuals whom colleagues within the healthcare team spent time with socially, but whom they did not necessarily trust to discuss personal matters, an amended version of the socialising name generator used by Burt *et al.* (2012) was adopted and worded as:

Think about the people with whom you spend your free/leisure time. Over the past 6 months, name the colleagues that you regularly attend informal social activities. (e.g. lunch, coffee, dinner, drinks etc.)

Finally, alongside naming the colleagues relevant to these two social tie types, respondents were asked to rate the strength of the social connection for each of the alters they named within either of the two name generator questions:

Please think about each of the colleagues you have nominated in the previous three questions and consider how socially close you feel to them based on the following categories:

4 - Colleagues whom you feel socially closest to
3 - Colleagues whom you feel less socially close to
2 - Colleagues whom you feel least socially close to
1 - Colleagues whom you do not feel socially close to

Rating the social distance for each of the alters provides additional data about the social tie which is valuable in understanding how social ties may relate to rater selection. It also noted as adding valuable data to better interpret networks that contain missing data due to non-response (i.e. where person A nominates person B but person B does not complete the survey) (Krackhardt, 1987).

Finally, the number of alters each respondent could enter for the and trust name generators was chosen in an attempt to i) sufficiently capture all actors relevant to the social tie type, ii) be reflective of the number of actors a doctor would choose for an MSF assessment, whilst iii) not over burdening the respondent and causing survey fatigue. When selecting raters for MSF assessments using the

CFET tool, doctors need to nominate around 15 people in order to get a minimum of 12 to meet the validity requirements of the tool.

Therefore, the survey initially asked respondents to nominate up to 12 people whom they socialise with outside of the workplace. Of these 12, respondents were asked if they also trusted these individuals to discuss personal matters. Next, respondents were asked to nominate up to six colleagues whom they may trust but did not socialise with. Finally, of the up to 18 colleagues they had nominated, respondents were asked how close they felt socially to each. Respondents could nominate more colleagues whom they trusted (up to 18) compared with socialised (up to 12), as trust to discuss personal matters was considered the most important indicator of a social relationship and the most likely factor to influence rater selection. Although previous studies highlight the likely impact of social relationships on rater selection, the concept of trusting others not to give bad feedback has also been previously cited in research with doctors (Hill *et al.*, 2012).

3.3.2 Rater Nomination Data

3.3.2.1 Purpose

Rater nomination data was used to explore how the networks identified within the online survey relate to the rater selection decisions made by GP's for MSF. To understand if a GP's workplace-based social network impacts on their rater nomination choices, access to each participating GP's most recent rater nomination data for medical Revalidation was collected. To gather this data accurately and to avoid bias through self-reporting, only GP's who used the administrative support service CFEP UK Surveys took part in this research

activity. CFEP provide validated online questionnaires, collecting patient and colleague feedback for thousands of healthcare professionals in primary and secondary care settings across the UK and Australia. CFEP kindly agreed to support the research with no financial reimbursement from the study.

To obtain the data, CFEP (with consent from each GP involved) released the names of each individual that was nominated by participating doctors at their most recent MSF assessment, the names of those colleagues that responded with feedback and the dates that they responded. No data evaluating the performance of the doctor was requested or collected. As the names of individuals who respond with colleague feedback is anonymous to the doctor, this data was held by the research team but kept strictly confidential from the participating doctors.

3.3.3 Semi-Structured Interviews

3.3.3.1 Purpose

Semi structured in-depth interviews were an important element of this study. The in-depth interviews provided an opportunity to contextualise the social relationships detailed in the survey responses, allowing participants to explain the importance (or unimportance) of social relationships within the healthcare team and the extent to which all participants believe that these relationships may impact rater selection decisions. This latter point is important when adopting a critical realist perspective as exploring the nature of relationships qualitatively increased opportunities to identify causal processes. To carry out the interviews, staff were asked to take part in a face-to-face interview of 30-40 minutes, at a

time convenient to them. Interviews were audio recorded on a Dictaphone and transcribed verbatim by the researcher or a suitably qualified third party.

3.3.3.2 Interview Schedule Design

Two semi-structured interview schedules were designed for the doctor and the wider healthcare team at each practice. Interviews with GP's focussed on issues surrounding 1) rater nomination and the factors impacting their decisions, 2) as their attitudes towards MSF and Revalidation and 3) how these attitudes feel this may impact their choices. Interviews with the wider healthcare team focussed on understanding what affects their decision to provide feedback when requested by a GP, and how these decisions may be affected by their social relationship to the doctor. All participants were asked about their attitudes towards the current rater selection process and how they believe it should be impemented going forward. The interviews were piloted with one doctor and one administrator at the first GP practice, with the interview schedule subsequently refined and finalised (Appendix 5 & 6).

3.3.4 Different data collection methods that were considered

An additional method was considered for this study in order to measure biases in the nomination of raters. One psychological method of measuring implicit biases in humains is the Implicit Association Test (IAT) which is found to provide more accurate levels of attitudes in comparison with explicit measures (Greenwald & Banaji, 1995; Greenwald, McGee & Schwartz, 1998; Poehlman *et al.*, 2004). Implicit bias tests are a computerised visual sorting task commonly used within social psychology to uncover the true nature of individual biases, (Stier & Hinshaw, 2007) as explicit measures of bias are frequently subject to issues of

social desirability and often therefore inaccurate in determining biases. An IAT was developed to explore the unconscious bias of 'friendship' on rater selection, however this method of data collection was not pursued due to challenges with designing a visual sorting exercise with sufficient reliability and validity for this purpose.

3.5 Sampling

The sampling strategy within this project was not a straightforward process and involved a number of different layers and approaches. This section will discuss a number of important considerations made when sampling for social network research that differ from more traditional approaches, including key issues surrounding the boundary of networks. It will also discuss the different sampling strategies adopted for the individual research methods utilised within the study and the process adopted to recruit both GP practices and their staff into the study.

3.5.1 Sampling in SNA

The standard approaches to sampling within social sciences research often rely on theories of probability, however this approach to the selection of participants is largely incompatible with social network approaches. Selecting random samples often elicits data that lacks meaning from a social network perspective, as the likelihood for respondents to nominate different actors than the other respondents sampled in the study is high. As Scott (2000b) discusses, this tendency towards a lack of relations between actors within a random sample means the connectivity within the sample is likely to be very low, causing many 'holes' in the data. Methodologically this is a concern as the lack of observable connectivity is likely to be a product of the sampling approach, as opposed to a

60

genuine phenomena of low connectivity between actors. To overcome this issue, network studies often adopt a population based approach, where populations can themselves be sampled and the results compared.

3.5.2 Ego networks vs. Whole Networks

To design any network study, one of the first decisions to be made is whether to adopt an egocentric or whole networks approach. No one approach is better than the other when it comes to networks research, however each have their own strengths and weaknesses, working best for different purposes. The 'population' under observation using both an egocentric or whole networks approach differs depending focus of the analysis. Egocentric or actor-centred network analyses are focussed around a certain social actor (e.g. a business, a human or a government). Egocentric analyses are focused on the relations that this actor (ego) has with others (alters), as well as the connections between these alters (Crossley *et al.*, 2015). Based on a wide variety of tie types including friendship, information sharing, advice seeking etc., egocentric analyses are popular when the purpose of the research is focussed around a number of focal actors who are not generally connected to each other (however this is not always the case). In this situation, each ego's network is its own population, with these focal actors able to be sampled using random approaches if it is of particular benefit to the research. Often however, focal actors in egocentric analyses are selected based on a particular criteria (e.g. have a certain disease, operate a business in a certain sector etc.) following a purposive or convenience sampling approach (Marsden, 1990).

61

Whole network analyses on the other hand look to explore the connections between a whole set of actors in a given population. The aim of a whole network analysis is to collect data from as many of the actors within the population as possible in order to draw to conclusions around the structure and patterns of tie formation that exist. Like egocentric analyses, whole networks can look at an equally wide variety of tie types between actors, however a key consideration for whole network approaches is the boundary around the actors that determines the population.

From an egocentric perspective, this study could have used doctors undertaking MSF assessments as focal actors. However although requiring fewer participants and less time to complete, an egocentric approach neglects the opportunity to 1) observe the structures of social relationships present throughout the healthcare team beyond the focal actors ego network and 2) to explore the network of rater nominations made by all participating doctors. Therefore a whole network approach is adopted in order to obtain a more complete picture of the patterns of social relations and the impact on rater nomination choices at the structural level.

3.5.3 Network Boundary

The next important step to consider is the boundary surrounding the population under observation. Various approaches exist in order to define where the boundary of a network exists. Taking an informed approach to selecting the actors included within the boundary of a network is critical if a whole network approach is to provide meaningful results. This study adopts a 'nominalist' or 'positional' approach to defining the network boundary (Laumann, Marsden & Prensky, 1989; Scott, 2013), selecting participants whom assume a defined

position as a member of staff within a participating GP practice. Based on this approach, it is the attribute of employment within a particular organisation recruited to the study that defines an actors inclusion within a population.

However, it is recognised that in terms of the types of ties this study explores (social relationships and rater nominations), a boundary based on employment within an organisation is an artificial boundary that restricts actors to nominate only those within their workplace. It is reasonable to believe that members of staff within a practice workforce may have social relationships with colleagues in similar occupations outside of their workplace, especially pertinent for doctors due to the transient nature of medical training (Oxtoby, 2015). Based on the rater nomination process for MSF assessments that this study aligns with, doctors are able (and even encouraged) to nominate colleagues whom are familiar with their performance outside of their workplace (Appendix 2). However, when piloting the study at the first of three GP practices recruited for this research, the rater nomination data demonstrated less than 2% of raters were nominated outside of the GP practice in which a focal doctor worked. It was therefore decided that bounding the network by the GP practice was a feasible and reliable method to best answer the research question, however it is recognised that missing social and rater nomination ties from outside of the practice are a limitation of the design.

3.5.4 Sample for Online Survey

The online survey adopted a population approach for all members of staff employed within the recruited GP practices whom met the study eligibility criteria for participation (page 55). When conducting network research using a nominalist

approach, it is imperative that a high percentage of eligible participants within the boundary of the network complete the survey (Scott, 2013). Large 'holes' in the network form when eligible actors do not participate in the data collection exercise, making the interpretation of network measures and visualisations challenging. This is particularly the case for measures of density, reciprocity and centrality where inferences on the structure of a network can be significantly misinterpreted if many eligible actors are missing. To overcome this issue, a substantial effort was made to encourage staff within the recruited practices to participate in the research, using the approach discussed below.

3.5.5 Sample for Rater Nomination Data & In-Depth Interviews

The sampling strategy for the interviews adopted a 'typical case sampling' (TCS) approach. TCS is a type of purposive sampling that is a non-probabilistic technique where participants are selected as they are likely to share similar characteristics and be 'typical' of the wider population (Ary *et al.*, 2013). Within this study, interview participants were selected to provide a range views on the rater selection process from different occupational roles. The occupational roles of interviewees included doctors, nurses, healthcare assistants, practice managers, research staff, secretaries, reception staff and administrators.

3.4.6 Recruitment

3.4.6.1 Recruiting GP Practices

The recruitment of GP practices to participate in the study was very challenging. Unlike secondary care, the majority of GP practices are privately owned organisations that are contracted to provide services to the NHS. General practice is often cited as being under increasing pressure from large workloads

within the UK (Roland & Everington, 2016), and as a result obtaining access to conduct research with the practice workforce was difficult. Therefore n order to recruit therefore, the study relied on prior contacts with GP practice staff from within the research team, alongside receiving support from the Peninsula Clinical Research Network for Primary Care (CRN). With their close relationship with over 100 research active GP practices in the Southwest, the CRN distributed details of the study to practices within the South West of UK and facilitated meetings between the researcher and the GP practices.

3.4.6.2 Recruiting Staff

Once a GP practice agreed to be involved in the study, staff were then contacted and offered the opportunity to participate. Participation was voluntary in line with ethical requirements and staff were initially invited to complete the online survey via an email drafted by the researcher and sent with approval via the Practice Manager. A reminder email was sent at two and four weeks following the research commencing to remind those that had yet not participated. Alongside the email invitation, the PHD candidate spent between 4 and 6 weeks at two out of the three participating GP practices in order to promote participation in the survey, as well to recruit and conduct interviews with staff and request rater nomination data from doctors. Due to restrictions with time and funding, the third GP practice recruited participated only in the survey and rater nomination aspects of the research. No interviews from the third GP practice is a recognised limitation of the study. Finally, in order to maximise participation in the survey and avoid large holes in the network data, participants were offered an incentive of being entered into a prize draw. The prizes consisted of online shopping vouchers with a value

of 1st Prize £100 and 2nd Prize £50. Prize winners were drawn by selecting survey participant ID numbers using a random number generator in Microsoft Excel.

3.4.7 Eligibility Criteria

The overarching eligibility criteria for the study was staff employed within a GP Practice in the South West UK, currently employed within one of the following roles:

- GP Partner
- GP Salaried
- GP Locum
- GP Registrar/Trainee
- Physicians Associate
- Nurse/Practice Nurses/Nurse Practitioner/Advanced Nurse Practitioner)
- Allied Health Professional (e.g. pharmacists, physiotherapists etc.)
- Dispensary staff
- Practice Manager
- Secretary
- Receptionist, Administrative and Support Staff

These staff categories were selected because they accounted for the majority of roles assumed by staff within GP practices in the UK. No staff were working at any of the recruited practices that did not fall into to one of these categories. Secondly, the MSF tool that doctors completed (CFET survey by CFEP surveys) recommends that members from each of these staff categories are entitled to provide performance feedback within MSF assessments for Revalidation (Appendix 2). Any employee or volunteer within the practice assuming the role of cleaner or maintenance were excluded due to the inability to provide performance feedback using the tool, as well as medical students due to the highly transient nature of their training. No participating doctor in the study had nominated a cleaner or medical student in their MSF assessment.

66

3.6 Study Setting

3.6.1 General Practice

General practice was chosen as the study setting for this research for a number of reasons. Firstly, unlike most other medical specialities, GP's generally work in smaller healthcare teams than specialities within the secondary care setting. In secondary care, medical specialties are typically more integrated when providing treatment within the proximity of their workplace (e.g. surgeons may work with surgeons of various other specialities, anaesthetists, theatre and recovery nurses, ODP's etc.) Subsequently, doctors working within a hospital setting have a greater number of colleagues to choose from for MSF assessments whom are aware of their ongoing performance (Sargeant, Mann & Ferrier, 2005). Mapping the social and rater nomination networks within a general practice setting was therefore more practicable and feasible for this study than a secondary care setting. Secondly, adopting general practice as the study setting provides the opportunity to explore commonalities in the findings of previous qualitative studies exploring the utility of MSF for Revalidation (Hill *et al.*, 2012), including issues of bias in the selection of raters.

3.6.2 Region

The study was conducted in the South West UK firstly as this was the most feasible area to conduct the research, and secondly due to the ability to recruit GP practices from a variety of urban and rural geographies. Rurality was considered an important consideration for this study as it was hypothesised that doctors may have fewer suitable raters to choose from in more rural GP practices (Sargeant, Mann & Ferrier, 2005), as the workforce may be smaller than in urban practices.

67

3.7 Data Analysis

The overarching data analysis framework of this study is largely interpretivist in nature, however statistical procedures were used to explore social structure. This approach is chosen in order to best understand the constructivist nature of social relationships within the workplace and their potential influence on rater nomination choices made by GP's. The first stage involved an exploration of the whole network of social relationships within each practice. Once the social networks were mapped quantitatively, this data was combined with the archival rater nomination data to begin exploring the association between social relationships and rater nomination choices by GP's. Finally, the qualitative data was analysed to contextualise and better understand the numeric findings, providing a holistic interpretation of how social relationships may relate to rater nomination choices from both the doctor and colleague perspective.

In order to perform the analyses for this study, network measures are calculated and visualisations performed in the software package ORA (Carley, 2018). Inferential analysis is performed in the packages MPNet and XPNet (Wang *et al.*, 2014) for unimodal and multiplex Exponential Random Graph Models (ERGM). Qualitative analysis is performed in the package NVivo 12 (QSR, 2018)

3.7.1 Visualisations

In order to support the interpretability of the network findings, visualisations in the form of sociograms are produced. These visualisations support the descriptive interpretation of the networks, displaying connectivity between actors where textual or numeric description may not be sufficient. To best demonstrate the social structures under observation, visualisations utilised different colours to

demonstrate nodal attributes and tie types. In some instances tie thickness is sized based on the strength of the relationship. Arrows on the sociograms indicate the direction of the tie. Each of the nodes are pseudonymised to protect the anonymity of respondents and labelled by role. The location of the nodes on the sociogram is initially determined by the default positioning algorithm implemented within ORA. However, nodes were occasionally moved on the graphs in order to aid visual interpretation.

3.7.2 Network Measures

To explore the network structures within the socialising, trust and nomination networks of the three cases, a number of descriptive measures are performed. Generally, network measures fall into two groups, that of network level and node level measures. As the names suggest, network level measures provide indications of structures at the network level, whereas node level measures provide numeric evaluations of individual nodes or groups of nodes.

Density - The level of connectivity, also known as cohesiveness, is explored through examining the overall density of each of the networks across the three cases. Density is calculated based on the number of ties in the network, expressed as a proportion of the possible number of ties using the formula n(n-1)/2, where n is the number of nodes (Borgatti, Everett & Johnson, 2018). Density within social networks often varies greatly depending on the type of tie under examination, and is most useful as a tool to compare levels of connectivity between networks of similar ties. As not every actor within the network completed the survey in this study, some scholars make use of the average degree in a network as an alternative measure of connectivity (Borgatti, Everett & Johnson,

2018). Average degree does not take into consideration the potential number of ties as with density provides an alternative measure of connectivity based on averaging the degree values of participating actors for this study. Average degree is therefore calculated alongside the overall density in order to adjust for the possible number of ties based on the number of actors that completed the survey. A second factor to consider when exploring the density of the networks is the questionnaire design (Appendix 3). As discussed above, actors whom completed the questionnaire were able to nominate up to 18 individuals in total, with the potential number of ties an actor could send ranging from 0-12 in the socialising network, and 0-18 in the trust network. Consequently, this variation in the maximum possible ties per ego must be considered when interpreting the level of connectivity between the socialising and trust networks.

Reciprocity – Reciprocity is a core measure used to explore social relationships in network studies and was explored at the network level to understand the extent to which relationships are 'reciprocal' in the network (Friedkin, 1990). Each of the social and nomination networks within this study collected ties that are directed (i.e. A>B and/or B>A). When analysing directed networks, it is possible to consider the extent to which reciprocity (known also as mutuality) features within the network. Reciprocity can be calculated by summing the number of reciprocated ties and dividing these by the total number of ties. As with the density measures above, the rate of reciprocation is affected by the survey completion rate within each case. For example, actor A may send a socialising tie to actor B, however if actor B did not respond to the survey, then we are unaware of whether this tie would have been reciprocated. To provide a more accurate reflection of tie reciprocation within the socialising and trust networks, a reciprocity value for

70

all actors in the network was computed, as well as an adjusted value based only on the responding actors.

Alongside the socialising and trust networks, it is also important to consider reciprocation within the nomination networks. Theoretically, reciprocation within this network could symbolize 1) doctors sending nomination ties to another doctor and receiving a reciprocal nomination to provide feedback for this doctor, and/or 2) doctors sending nomination ties and colleagues reciprocating with feedback in response to the request. This section will focus on the latter approach to reciprocity in terms of receiving responses to feedback requests, however reciprocating nominations between doctors was explored using transitivity measures. Exploring reciprocation through the number of colleagues who provide feedback when nominated is important, as a low response rates to feedback requests will require additional colleagues to be nominated until the doctor reaches a minimum of 12 responses. This will require additional time commitment for doctors and also have a potentially significant impact on a their ability to successfully revalidate, which may therefore influence their rater selection choices in the first instance.

Homophily – When exploring networks of social relationships, homophily theory states that as social actors we have a propensity towards establishing social and professional ties with other actors similar to ourselves (McPherson, Smith-Lovin & Cook, 2001). Often attributed to the phrases *'birds of a feather flock together'*, and *'similarity breeds connection'*, factors that drive the establishment of homphilous relationships between social actors have been identified as including race and ethnicity, age, gender, religion, education, occupation, social class,

71

attitudes, behaviours, beliefs, aspirations and structural positions within networks (McPherson, Smith-Lovin & Cook, 2001). Homophily is suggested to commonly arise for two reasons. Firstly, similarity in connectivity arises through individual's choices because of a preference towards similar attributes. Secondly, homophily arises as a result of the specific structure of the individual's social world, (McPherson & Smith-Lovin, 1987). In other words:

'the creation of homophilous ties can be due to individual preference as well as to social world proposals, even if the latter are the results of choices and opportunities along an individual's life' (Mascia *et al.*, 2015, p.2)

In terms of the socialising and trust networks, individual's professional background may influence the connections to one another, as they are more likely to share similar perspectives and levels of social capital. In this case, 'professional homophily' is explored and can be defined in this study as the likelihood that individuals will establish relationships with other actors who are similar in terms of their occupation (Mascia *et al.*, 2015).

Exploring homophily within the nomination networks is key to begin unpacking the relationships between social relationships and rater nominations. Previous studies have explored the demographic characteristics of those providing feedback to doctors through the MSF process, focussing on differences in scores from raters who are 'similar' or 'different' to the nominating doctor. Factors affecting these scores are known to include seniority, duration of the working relationship, occupation, sharing patients, gender, age and ethnicity, however no previous study has yet explored the extent to which nomination choices are driven by demographic characteristics.

Although not directly a statistical measure of network structure itself, the concept of homophily can be explored through a number of statistical procedures. One such approach is to explore whether groups of nodes within a network that are more densely connected to others in their group compared to those outside of the group. By exploring the attributes of the nodes within these subgroups, it is possible to identify the differing characteristics that may have influenced the groups formation. Identifying these groups or 'communities' is of high importance when looking to understand the formation and structures of real world social networks (Alamsyah & Rahardjo, 2014), however the definitions of community detection and the statistical procedures of identifying such groups vary. Discussions surrounding the most suitable algorithms for community detection are vast and beyond the scope of this study, however most approaches fall within four broad categories (Node-Centric, Group-Centric, Network-Centric & Hierarchical-Centric) (Alamsyah & Rahardjo, 2014).

In order to identify communities within the network data for this study, the Louvain method of community detection is employed (Blondel *et al.*, 2008). The Louvain method uses a metric known as modularity that, put simply, evaluates how densely connected nodes within a community are compared with on average how connected they would be in an appropriately defined random network. As with all methods of community detection the Louvain method has its drawbacks, however this method is chosen due to its simplicity, efficiency and ease of use which has made it one the most popular methods of community detection for network studies (Blondel *et al.*, 2008).

Transitivity - The network measures discussed within this study thus far have largely focussed on the structure of social networks at the dyadic level (i.e. the connections between an actor A and B). Although this provides the ability to explore differences in how ties are sent between pairs of actors within networks, network analysis *'really begins with triads, for they are the beginnings of a "society" that is independent of the ties between a dyad'* (Kadushin, 2012, p.22). As (Simmel, 1950, p.135) discusses:

'Where three elements, A, B, C, constitutes a group, there is, in addition to the direct relationship A and B for instance, their indirect one, which is derived from their common relation to C'.

Exploring a third member to dyads vastly increases the complexity of relationships within the network. Simmel (1950, p.154) demonstrates that this third actor in the group can be non-partisan and a mediator, but can also be the '*Tertius Gaudens*' (the third who enjoys). This leads to a key theory underpinning the exploration of triads within social networks, that of the balance hypothesis. Just as the homophily metaphor discussed earlier that *'birds of a feather flock together'* is also relevant when exploring triadic relationships, so balance theory can be understood by the phrase *'a friend of my friend is a friend of mine'* and *'an enemy of my friend is an enemy of mine'*. Put formally, '*in the case of three entities, a balance state exists if all three relations are positive in all respects, or if two are negative and one is positive'* (Heider, 1946, p.100)

Using an example from the trust network within Case 1 of this study (Figure 3), balance theory would postulate that a trust tie is more likely to exist between Healthcare Assistant 2 and Nurse 2 because they are both connected to Healthcare Assistant 1 (this pattern is termed a transitive triad). Using the principles of Gestalt psychology, Heider (1946) maintains that there is always a

74

tendency towards balance over time and that if a non-balanced state exists (i.e. if Healthcare Assistant 2 was not connected to Nurse 2), then forces towards that state would arise unless change was not possible, in which case a state of imbalance will likely produce tension.

Figure 3. Example triad – Case 1 Trust

Nurse 2

Health Care Assistant 1   Health Care Assistant 2
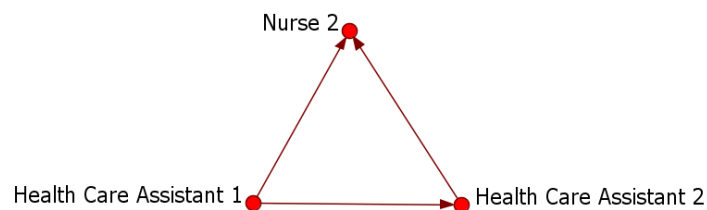
Two methods of characterising the network using a triadic approach are to explore the proportion of transitive vs. intransitive triads within the network. Firstly, a transitivity index is calculated to explore the proportion of triads that are transitive using the formula transitivity index = no. of transitive triads/no. of potential transitive triads within the network (Kadushin, 2012). Secondly, a triad census is performed to explore the frequency of each of the possible 16 triadic parameters that can feature within a social network. Conducting a triad census is particularly beneficial for studies looking to conduct inferential analyses using a random graph approaches as it provides an indication of the structural patterns likely required to be controlled for in the model.

Degree Centrality - Degree is a commonly used measure which examines the number of links to an actor (in-degree) and from an actor (out-degree). Often used to identify opinion leaders (Valente, 2010), degree centrality is explored in this study in order to explore the extent to which popularity of actors within the socialising and trust networks is related to popularity in receiving requests to

75

provide MSF by doctors. No study to date has explored how social popularity may relate to the likelihood in receiving requests for feedback, potentially providing an a unique contribution to the rater selection literature.

Summary

Each of the network measures described above provide a descriptive account of the social structures for this studies networks. However, in order to explore the extent to which the observed structures in these networks have occurred by chance, or are alternatively the result of hypothesised social processes impacting the formation of the networks, inferential network analysis techniques are employed.

3.7.3 Inferential Network Analysis

Unlike conventional social research methods that use statistical tests often based on a normal distribution, inferential SNA techniques do not rely on the same principles. Hypothesis testing is possible with bespoke methods of analysis designed for network data, however it should be highlighted that it is *'extremely difficult to establish causality through the use of statistical tools when network data are analysed'* (Olsen & Morgan, 2005, p.102). Olsen and Morgan (2005, p.280) however take a more considered approach discussing that when adopting a critical realist perspective, statistics do have value however they cannot be considered *'accurate or true descriptions of reality'*. Historically, a debate existed within the social network community surrounding the function and purpose of SNA as social scientific approach. Traditionally, the contribution of network analysis was its ability to describe and visualise the structure of networks. Lurie, Fogg and Dozier (2009, p.2) discuss that SNA can produce descriptive statistics

which *'aids the interpretation of the sociogram'*, however the use of inferential statistics and testing hypotheses was not (and still is not for some) the general or intended purpose of SNA. In more recent years however, it has become increasingly accepted that an overreliance on descriptive analyses has been a limitation of network research particularly within the healthcare setting (Chambers *et al.*, 2012), and that the potential for networks research is not being met (Bae *et al.*, 2015). As the technical sophistication of SNA methods has dramatically risen over the past ten years, so has the number of studies using complex inferential statistical techniques to test hypotheses in the healthcare networks literature (Hurley *et al.*, 2014; Lomi *et al.*, 2014; Mein Goh, Gao & Agarwal, 2016). As (Cunningham *et al.*, 2012, p.248) demonstrate:

'existing research provides a foundation for a potentially fruitful yet underexplored research agenda in ascertaining the worth of networks in improving clinical care [and]… further well designed research should examine the relationships between professionals' network structures and health outcomes in a range of different care settings, and how the structural aspects of health professional networks can be leveraged to improve quality of care and patient outcomes'

This study therefore embraces the use of inferential methods in an attempt to improve the quality and safety of patient care by exploring potential threats to MSF assessment validity. The use of such inferential methods provides a unique contribution to the MSF literature, with inferential network approaches absent from not just from this literature but also largely absent in the medical education literature more widely. The next section will explore the two methods of inferential analysis adopted within the study.

3.7.3.1 Quadratic Assignment Procedure (QAP)

Compared with standard statistics, the assumption of independence of observations is violated within network data as the nodes within the network are highly interdependent. The QAP technique is therefore a form of hypothesis

77

testing for network data that controls for these interdependencies through a form of permutation testing, providing the ability to conduct correlation and regression analyses on relational data (Dekker, Krackhardt & Snijders, 2007; Krackhardt, 1988). Within this study, the QAP procedure is employed to explore the extent to which the socialising and trust networks are correlated, in order to determine the extent to which these two social processes may be considered ubiquitous. In order to explore the potential co-existence of social ties with nomination ties however, the QAP procedure was not suitable as it is not able to control for social structures. To explore if social structures within the networks (such as reciprocity, transitivity etc.) are significantly different than what you would expect to see in a random network, and to identify the interplay between social ties and nomination ties, exponential random graph models (ERGM) are employed.

3.7.3.2 Exponential Random Graph Models (ERGM)

Based on general linear models from standard statistics, ERGM models have important modifications to deal with the fact that edges in a network are interdependent, therefore breaching the usual assumption of independence. Using the observed network, ERGM models simulate thousands of new networks based on the same number of actors and ties within the observed network, changing the links between actors in each model (Lusher, Koskinen & Robins, 2013). These models can compare the observed network to the multitude of 'randomly' created networks, in order to conclude the probability of the structures in the observed network having occurred by chance (Lusher, Koskinen & Robins, 2013).

One significant advantage of ERGM models over similar methods of inferential network statistics (e.g. QAP), is their ability to control for exogenous factors that potentially impact the structures present within an observed network. These factors (or parameters), can be either a type of network structure or can be attribute based. Selecting which of the wide variety of parameters available to include a model is theoretically driven, based on descriptive statistics and visualisations of the network. There are also patterns that commonly occur within social networks of a similar type which should be controlled for in the model. Whilst building the model, the combination of parameters is changed until the all of the necessary parameters available to include in the model appear to have been controlled for.

In order to examine the social structures present within the socialising, trust and nomination networks for each case, unimodal ERGM models were performed. Unimodal models analyse structures within a single network, allowing the researcher to control for both endogenous (network structure) and exogenous (actor attributes and relational attributes) factors. To explore the extent ties present in the socialising and trust networks co-exist with the sending or receiving of nomination ties however, multiplex models are employed. Multiplex models analyse the intercept between two networks of the same actors, providing evidence of a positive or negative tendency towards nomination ties coexisting with social ties between actors. To take into account the fact that actors within each case were not permitted to nominate colleagues from the other case, ties between actors within the different cases were fixed using 'structural zeros' (Lusher, Koskinen & Robins, 2013). Once the models were performed, a Goodness of Fit (GOF) test was conducted for each model to ensure that they

were adequate in model fit. Based on the goodness of fit results, the models are refined through an iterative approach until adequate model fit is reached.

In order to model these networks using ERGM's, a number of parameters are included. Historically, after the use of dyadic parameters, ERGM models were reliant on the use of Markov graph parameters consisting of 2-stars, triangles, 3-stars plus others. Alone however, Markov graphs have difficulty with estimation, as they do not control for the more complex patterns of tie formation present within many social networks. Developments in ERGM modelling mean it is now possible to use 'higher order' parameters, more complex parameters that often include the Markov graphs within their structures (Snijders *et al.*, 2006). This study utilises these advances in model specification by included higher order parameters in order to improve estimation and accuracy. In order verify the inclusion of an ERGM approach to analysing the data, the method and results were cross examined by scientific peers at the Centre of German and European Studies, St Petersburg and at academic conferences (Stevens *et al.*, 2017; Stevens *et al.*, 2018a).

3.7.4 Network Inference

Alongside deciding on suitable network measures to perform in order to explore social structures, a decision is also required surrounding the level of intended inference as a result of the analysis. Levels of inference within social network studies broadly fall within three categories (Butts, 2008). Firstly, personal or egocentric measures focus on explaining the networks of individual and do not seek to generalise beyond the egos local structure. Secondly, a more challenging goal is to make general network inference based on a detailed analysis of an

entire population. Finally, a third level of inference involves an attempt to estimate cognitive social structures (Krackhardt, 1987) (i.e. an understanding of the complete social network of a given population as understood by every actor within the network). This study aims to meet the second level of inference by making general network inference through comparing and contrasting the results of the three cases. Attempting to understand cognitive social structures would be preferable in order to best answer the research question, however this level of inference required time and resources that were beyond the scope of this study.

3.7.5 Interview Analysis

In order to analyse the qualitative interview data, the study adopts a thematic framework analysis approach (Ritchie J & Spencer L, 1994). Thematic analysis is a commonly used method of qualitative analysis to identify themes (Fereday & Muir-Cochrane, 2006), however framework analysis provides a structure to chart and compare thematic results between different demographic groups as well as between the cases where interviews took place (Gale *et al.*, 2013). The stages of thematic analysis were followed chronologically in the first instance, however an iterative approach was adopted including exploring the network data alongside. The stages were:

1) *Familiarisation with the data* - this involved the reading and re-reading of transcripts and making summaries of ideas and themes.

2) *Identifying a thematic framework* - this involved the identification of key and recurring concepts and themes in the data. These were identified with reference to the aims and objectives of the study, the findings from the network analysis and the topics raised by the respondents themselves.

3) *Indexing* - this involved applying codes to the data systematically, using the thematic framework to guide the process. Nvivo 12 was used to conduct this coding exercise, with codes added, merged or deleted throughout the iterative process of analysis.

4) *Charting* - this involved organising data into charts. Verbatim text was summarised, using the same language as the respondents. The charts were organised with key themes in the columns and each respondent was assigned a row in the chart with their views or perceptions inserted under the appropriate theme heading. Charts were arranged by case study - one for each site - and organised in Microsoft Excel.

5) *Mapping and interpretation* – the charts were used to examine data by case study sites (e.g. looking for differences and similarities between GP and pharmacist views at the site) and also across the four case study sites (e.g. similarities and differences between sites). They were also utilised to aid examination of similarities and differences within and across the two professional groups. In conjunction with the network analysis, which identified individuals with different levels of centrality and tie strength, these charts enabled an examination of the views and perceptions of those in these different positions, looking for possible explanations for their network position.

The researcher was conscious to recognise and consider their own potential biases and assumptions when analysing the qualitative data, adopting an ongoing process of reflection (Verdonk, 2015). Not being from a medical background meant that the researcher had no previous insight into how social relationships form within a GP practice, nor how rater nomination decisions may be formed by doctors. No researcher can be truly objective however throughout

the research process, hence any findings from this research must be considered as potentially impacted by the researchers interpretations.

3.7.6 Handling missing data

As discussed above, the validity of network research is threatened with low response rates and missing data. SNA methods are more sensitive to missing data than many other methods (De Brún & McAuliffe, 2018), with a response rate of 75% typically required for SNA data to be considered reliable (Borgatti, Carley & Krackhardt, 2006). The use of incentives to participate in the study, regular communications and reminders and the physical presence of the researcher in the GP practices to answer questions all helped to maximise response.

When conducting the descriptive analyses of the network data, a table of participating actors is presented in order to aid the reader in highlighting non-response in the network visualizations (Appendix 4). Network measures for density and reciprocity are also calculated to adjust for missing data in order to improve the interpretability of the findings.

3.8 Reliability, Validity and Generalisability

Adopting a case study approach within a largely interpretivist framework of analysis, this project focusses less on meeting traditional positivistic approaches of appraising research quality and generalisability, instead looking to Lincon and Guba's (1985) evaluative criteria of research trustworthiness. Credibility and confirmability of the findings are sought through auditability of the research data and analytical processes, as well as attempting to be as object and value free as possible throughout the research process. It is recognised however that

83

maintaining objectivity as a researcher is always challenging, regardless of the research topic or methodological approach adopted (Letherby, Scott & Williams, 2012). Dependability is achieved through adhering to a clear research protocol throughout the project and utilising structures and replicable data collection tools. Finally, in terms of transferability, (Vincent & O'Mahoney, 2018, p.215) demonstrate that:

'Knowledge obtained about a single case study is thus not confined to the boundaries of the case itself but is theoretically transferable across a class of cases'

Therefore, findings may be transferable to doctors completing MSF assessments for Revalidation throughout the wider general practice setting, however the results may also be transferable to the use of MSF in other medical specialities and for non-regulatory purposes.

3.9 Ethical Considerations

This study has obtained ethical and regulatory approval from the Plymouth University Faculty Research Ethics Committee (FREC) for Health and Human Sciences (No15/16-632) and The Health Research Authority (HRA) (No. 17/HRA/0040) (Appendix 7 & 8). All respondents received an information sheet and gave consent (Appendix 9 -12).

CHAPTER 4 – OVERVIEW OF CASE STUDY SITES

This chapter provides an overview of the case sites included in the study. It provides a description of the geographic characteristics and patient list size of the cases at the time of data collection. It also provides a profile of the staffing level at each case, as well demographic data on the study respondents and non-respondents.

4.1 Description of the sites

As discussed previously, GP practices were identified for recruitment based on the urban/rural locality of the practice and the size of the workforce in terms of employed GP's (Table 4). The study originally considered a list of GP practices in the region and targeted those where more than one GP had completed an MSF for Revalidation in the previous three years. The study planned to recruit four GP practices, two from urban settings and two from rural settings. Six practices were initially contacted and expressed an interest to participate in the study. However, due to the challenges to recruitment outlined in Chapter 3, the study was only able to recruit three of these practices to participate, with those declining to participate siting capacity concerns and no funding provided. It is recognised that an additional practice may have improved the extent to which the study findings are transferable beyond the recruited cases, however this was not possible within the time and resource restraints of this PhD research.

Table 4. Demographic and geographic overview of the study sites

	Population Covered by GP Practice (Patient List)[1]	Rural-Urban Indicator[2]	No. of GP's[3]

85

	Case 1	12000	C1	Urban - City and Town	11
	Case 2	12000	D1	Rural - Town and Fringe	9
	Case 3	8500	D2	Rural - Town and Fringe in a Sparse Setting	6

4.1.1 Case 1

The first GP practice recruited into the study resided in urban town setting with a patient population close to 12,000 and 11 GP's. Case 1 had the highest number of GP's of all the three cases, however three of these GP's were registrars in training compared with only one in Case 2 and zero in Case 3. This practice formed the only GP practice recruited from an 'urban' environment based on ONS Rural-Urban Classification for Small Area Geographies (ONS, 2011). Although considered an urban area based on the population density and a 'typical' market town in the SW UK, the town is small and may not therefore be reflective of practices set in larger towns or cities. This practice was not the only GP practice available to patients in the town, and with discussions with GP's throughout recruitment doctors were aware of but did not interact with staff at the other practice(s). The practice was identified via prior connects within the Medical School, with online survey, rater nomination and interview data collection taking place between May 2017 – July 2017. The first doctor and non-doctor interviews at this practice acted as the pilot for future interviews in order to refine the interview schedule.

4.1.2 Case 2

The second GP practice recruited into the study resided again in a town but in a rural setting. The patient population was also close to 12,000 as with Case 1,

86

however this practice drew patients from a much wider radius. Case 2 consisted of nine GP's and was recruited into the study with the help of the clinical research network (CRN). Unlike Case 1, Case 2 and was the only GP practice that served the town and surrounding area. Case 2 participated in all three research activities and these were completed between October 2017 and February 2018.

4.1.3 Case 3

Finally, Case 3 formed the last GP practice to be recruited into the study and was the most rural of the three cases. This practice was the smallest of three that participated and consisted of six GP's and a patient population of close to 8500. Due to challenges with access, Case 3 participated only in the online survey and rater nomination aspects of data collection, which was conducted between June 2018 to September 2018. Although a lack of interview data from Case 3 can be considered a limitation of the study, data saturation appeared to have been reached in the interviews of Case 1 and 2 with little or no new themes emerging in the final interviews of both doctors and non-doctors.

4.2 Summary of Respondents

Despite recruitment proving challenging, partly due to the sensitive nature of the study, the overall response rate to each of the research activities was positive. In terms of the online survey, as discussed previously a target of 75% completion was set in line with reliability requirements for social network data. This target was achieved in Case 3, almost in Case 2 and missed by 9% in Case 1 (Table 4). Case 1 suffered the lowest completion rate mainly due to scepticism from many staff around sensitive nature of the subject and potential implications it might have. The levels of hesitance to participate was perhaps

87

naively not anticipated, particularly from the non-doctor staff whom were not providing any performance feedback related data. These issues had all been considered and addressed within the ethical approval of the study, however on reflection this was not communicated effectively to potential respondents. Challenges in survey recruitment were subsequently addressed for Cases 2 and 3 through additional emails and verbal information to staff reassuring them of the robust collection, storage and reporting procedures for the research.

4.2.1 Online Survey

In terms of the demographic characteristics of survey respondents, distributions were comparable across all three cases (Tables 5 & 6):

- Respondents were on average slightly older in Case 3 compared to Cases 1 and 2, with 33% over 55 years old compared with 12% and 16% in Cases 1 and 2. Based on the level of rurality when Case 3 is situated, an older demographic of the workforce may not be surprising.

- Each of the three cases were dominated by female staff, particularly Case 2 where only 9% of respondents were male. The vast majority of male respondents in all three of the cases were GP's.

- The majority of all respondents had a white ethnicity, with only two out of the total 80 respondents from all three cases from a BME background.

- Variation existed between the cases in terms of working hours of respondents, however confusion in the interpretation of what constitutes full time working within general practice was discussed verbally with a number of respondents. This was particularly the case for some who considered 5 days or more to be fulltime hours, whereas others considered

35 > hours a week to be full time regardless of the number of days. The value of this characteristic for analyses may therefore be limited.

- In terms of occupation, Cases 1 and 2 were comparable in the distribution of staff roles of respondents. Case 3 has fewer receptionist and administration staff participating in frequency and well as a proportion of the total staff employed in these roles, however they were also the only practice to have dispensary staff participating. Case 1 and 2 did not however have any dispensary staff employed at the practice.

- Finally, the majority of participants from all three cases had been employed at the practice for 5 or more years. The distribution of duration of employment was comparable across all three cases, however 28% responses to this question were missing in Case 1 which impacts the interpretability of the result.

Table 5. Survey response

Case 1		Case 2		Case 3	
Healthcare Team Size (n)	Response (%)	Healthcare Team Size (n)	Response (%)	Healthcare Team Size (n)	Response (%)
38	25 (66%)	42	31 (74%)	31	24 (77%)

Table 6. Characteristics of survey respondents

		Case 1 (n=25)	Case 2 (n=31)	Case 3 (n=24)
Age	18-34	6 (24%)	9 (29%)	4 (17%)
	35-54	16 (64%)	17 (55%)	12(50%)
	55-74	3 (12%)	5 (16%)	8 (33%)
	75 Or Over	0 (0%)	0 (0%)	0 (0%)
Gender	Male	5 (20%)	3 (9%)	4 (17%)
	Female	20 (80%)	28 (91%)	20 (83%)
Ethnicity	White	24 (96%)	30 (97%)	24 (100%)
	Non-white	1 (4%)	1 (1%)	0 (0%)
Full/Part time	Full time	8 (32%)	7 (23%)	13 (42%)
	Part time	10 (40%)	24 (77%)	10 (32%)
	Missing	7 (28%)	0 (0%)	1 (3%)
Occupation	Doctor	8 (32%)	8 (26%)	6 (25%)
	Practice Manager	1 (4%)	2 (7%)	1 (4%)
	Nurse	2 (8%)	3 (9%)	4 (17%)
	Healthcare Assistant	2 (8%)	3 (9%)	2 (8%)
	Allied Health Practitioners	0 (0%)	0 (0%)	0 (0%
	Dispensary Staff	0 (0%	0 (0%)	4 (17%)
	Research Staff	0 (0%)	2 (7%)	0 (0%)
	Secretary	3 (12%)	3 (9%)	2 (8%)
	Receptionist/Administrator	9 (36%)	10 (33%)	5 (21%)
Duration at Practice	Less than 6 months	3 (12%)	3 (10%)	3 (10%)
	6 months – 1 year	2 (8%)	3 (10%)	1 (3%)
	1 year – 3 years	1 (4%)	9 (29%)	5 (16%)
	3 years – 5 years	3 (12%)	7 (23%)	2 (6%)
	More than 5 years	9 (36%)	9 (29%)	13 (42%)
	Missing	7 (28%)	0 (0%)	0 (0%)

4.2.2 Rater Nomination Data

The rater selection choices that a doctor made at their most recent MSF assessment for Revalidation was requested from all eligible doctors at each of three cases. Doctors were eligible if they were a fully qualified GP and had been through at least one cycle of Revalidation, therefore registrars and newly qualified GP's that had not revalidated were not eligible. Of those that were eligible, 100% of doctors in Case 1, 63% in Case 2 and 17% in Case 3 provided rater nomination data through CFEP surveys to the researcher (Table 7). Overall, this provided an exploration of the rater selection choices made by 12 doctors. Those that were eligible but did not participate often cited discomfort with providing this data, or the time delay between completing the MSF assessment and participating in this research project was too large.

Table 7. Rater nomination response

Case 1		Case 2		Case 3	
Total Doctors	Response (%)	Total Doctors	Response (%)	Total Doctors	Response (%)
6	6 (100%)	8	5 (63%)	6	1 (17%)

4.2.3 Interview Data

Finally, Table 8 demonstrates the demographic characteristics of the 20 staff members that completed interviews as part of this study. Interviews were conducted at Case 1 and 2 with staff of a variety of ages, genders and occupations. In comparison to the gender profiles of all staff at the GP practices, a higher proportion of males took part in interview compared to females, however this was largely a result of more male doctors at each practice and a need to recruit doctors for interview. Overall, 11 interviews were completed with doctors,

one practice manager, one nurse, one HCA, 2 research staff, one secretary and three receptionist or administrative staff.

Table 8. Characteristics of interview respondents

		Case 1 (n=11)	Case 2 (n=9)
Age	18-34	3	4
	35-54	6	6
	55-74	1	0
	75 Or Over	0	0
	Missing	1	1
Ethnicity	White	10	9
	Non-White	1	0
Gender	Male	5	2
	Female	6	7
Occupation	Doctor	7	4
	Practice Manager	0	1
	Nurse	0	1
	Healthcare Assistant	0	1
	Allied Health Practitioners	0	0
	Research Staff	0	2
	Secretary	1	0
	Receptionist/Administrator	3	0

4.3 Summary of Non-Respondents

Of those that did not respond to the survey, the gender and occupation characteristics are detailed below in Table 9. The proportion of missing respondents was similar to that of respondents with mainly females as employed at the practices. The majority of missing respondents in Case 3 were receptionists or administrators, however there were also a large percentage or nurses in Case 2 and Doctors in Case 1 who did not participate in the survey.

92

Table 9. Summary of non-respondents

		Case 1 (n=13)	Case 2 (n=11)	Case 3 (n=7)
Gender	Male	1 (8%)	1 (9%)	0 (0%)
	Female	12 (92%)	10 (91%)	7 (100%)
Occupation	Doctor	3 (23%)	1 (9%)	0 (0%)
	Practice Manager	0 (0%)	0 (0%)	0 (0%)
	Nurse	1 (8%)	4 (36%)	0 (0%)
	Healthcare Assistant	2 (15%)	1 (9%)	0 (0%)
	Allied Health Practitioners	0 (0%)	0 (0%)	1 (14%)
	Dispensary Staff	0 (0%)	0 (0%)	0 (0%)
	Research Staff	0 (0%)	0 (0%)	0 (0%)
	Secretary	1 (8%)	0 (0%)	0 (0%)
	Receptionist/Administrator	6 (46%)	5 (45%)	6 (86%)

CHAPTER 5. RESULTS

This chapter will begin by exploring socialising and trust connections between staff within participating GP practices. It will compare the network structure of social relationships across the three cases, and explore from the staff perspective the importance (or otherwise) of forming social relationships within the workplace. An exploration of the rater selection choices made by participating doctors will be discussed, alongside discussing the perceived factors influencing rater selection from both the ratee and rater perspective. An inferential network analysis will explore significant network structures between the networks of social relationships and rater selection choices, supplemented by interview data to better understand and contextualise the quantitative analyses. The chapter will conclude by exploring the attitudes of staff towards the current rater selection process for doctors undertaking MSF for Revalidation.

5.1 Social Relationships within GP practices in the South West UK

This section explores the level of contact reported within the socialising and trust networks between staff in the participating GP practices. It begins by identifying the overall connectedness of staff within these networks in order to understand how the density of social relationships differs between the three cases. The establishment of social ties based on the demographic characteristics of participating actors will follow, in order to understand the extent to which homophilous social relationships form. In order to explore the significance of any observed homophily within the network, a subgroup analysis will be performed using the Louvain method of community detection. Finally, a QAP analysis exploring the correlation between socialising and trust networks within each case

will follow, concluding with an exploration of the reported strength of any observed social tie for each alters of an ego.

5.1.1 How Socially Connected are Staff within GP Practices?

Figure 4 provides a visualisation of the socialising and trust networks for each of the three sites. A visual inspection clearly demonstrates differences between the level of connectivity within the Case 1 networks in comparison with Cases 2 and 3. Table 10 demonstrates that Case 1 has a higher number of ties in both the socialising and trust networks compared with Cases 2 and 3, regardless of the lower participation rate within Case 1 compared with the other two cases. Differences are demonstrated by density scores for each case, with lower values for both socialising and trust in Case 2 and 3, compared with more densely connected networks within Case 1. The average degree of the socialising and trust networks also demonstrate these observed differences whilst taking into consideration missing actors, again demonstrating similarly lower average degree scores per actor in Cases 2 and 3, compared with a higher average ties in Case 1. The standard deviation of the average degree in all the cases is high, demonstrating variation in the degree scores of actors. Factors influencing the observed differences in connectedness between staff within Case 1 compared with Case 2 and 3 are not clear, however in terms of socialising, interview respondents within Case 1 more regularly discussed socialising as part of social events organised by the practice. As one doctor discusses:

"in terms of socially outside of work so far it would be with work-based social, so whether it's a Christmas party or a post-quaff get together, well done everybody, so that's where at the moment I would meet people socially" Case 1, Doctor 9

Those in Case 2 also mentioned socialising at a practice organised Christmas party, however the frequency of 'work based' socialising appeared much less

95

frequent at interviews with staff at Case 2 compared with Case 1. Socialising

between staff members was also discussed by one doctor in Case 2 to be

perhaps less frequent today than in the past due to changes in the size of the GP

workforce and the changing role of the general practitioner:

"I don't know if we're typical of practices in the UK or in the South West in general, most of us don't have an awful lot to do with each other outside work …you look at my predecessor generations of GPs [and] they seemed to do a lot more together socially than we do… [as you were] joining a very small team, and the expectation was this was part of your life now, all GPs were full-time, did all their on-call as well, so I think that the home became part of the practice" Case 2, Doctor 1

A wider sample of questioning from current and retired GP's would be needed

to confirm this hypothesis, however it provides a potentially interesting insight

into how the changing nature of general practice may have impacts on the

formation or existence of social relationships.

Table 10. Network level statistics for socialising and trust networks

Measure	Case 1	Case 2	Case 3
Socialising			
Actors	38	42	31
Participation Rate	66%	74%	77%
Ties	184	104	81
Density	0.262	0.121	0.174
Average Degree (std. dev)	7.360 (4.335)	3.354 (3.043)	3.375 (2.668)
Trust			
Actors	38	42	31
Participation Rate	66%	74%	77%
Link count	169	135	99
Density	0.240	0.157	0.212
Average Degree (std. dev)	6.760 (4.589)	4.355 (2.695)	4.125 (4.043)

Figure 4. Overview of socialising and trust networks
Case 1 - Socialising

Case 2 - Socialising

97
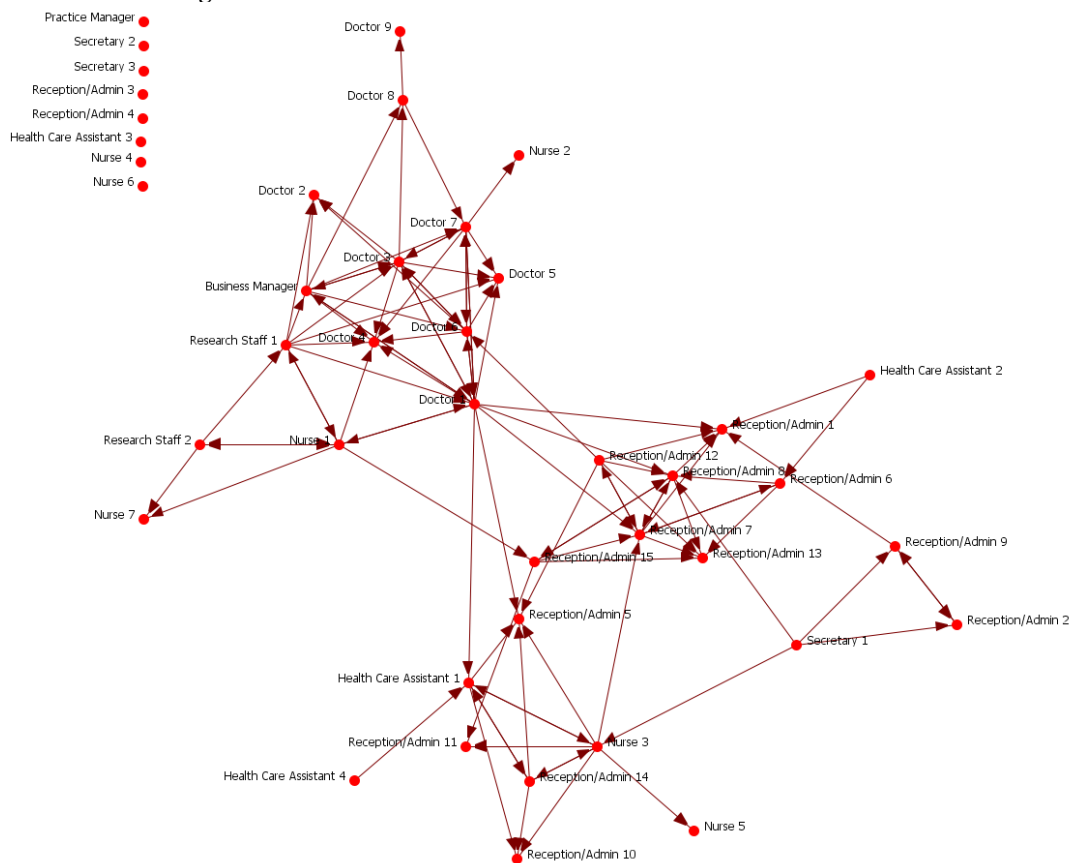
Case 3 - Socialising
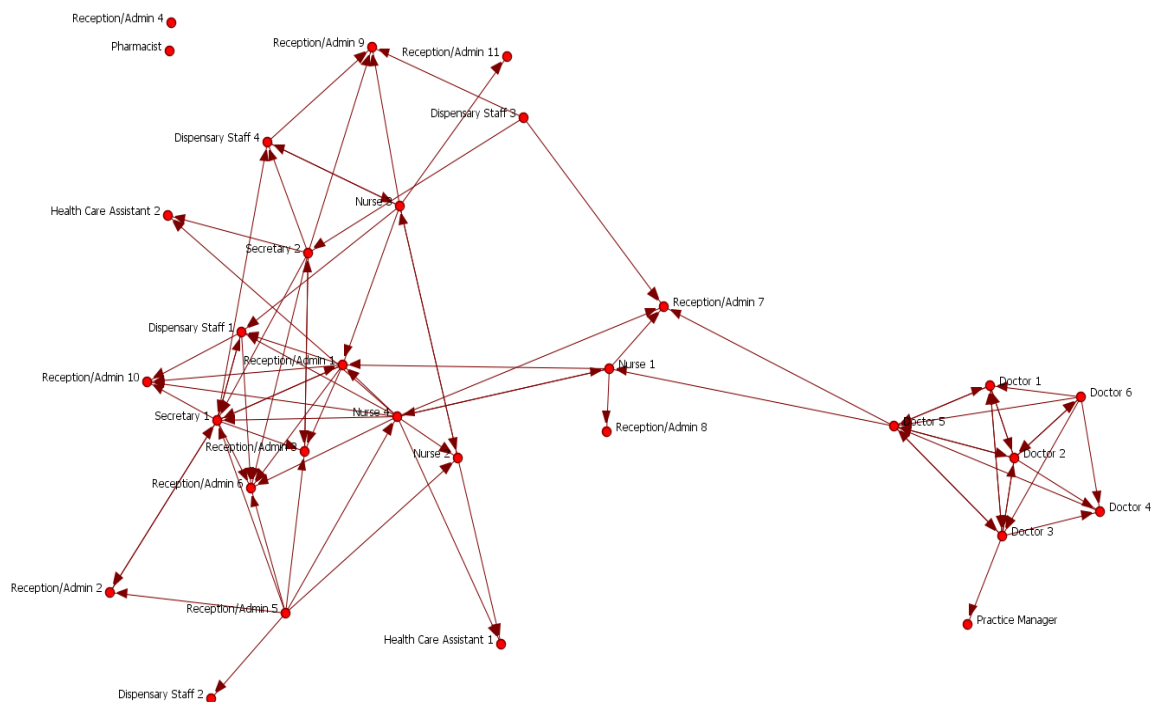
Case 1 - Trust
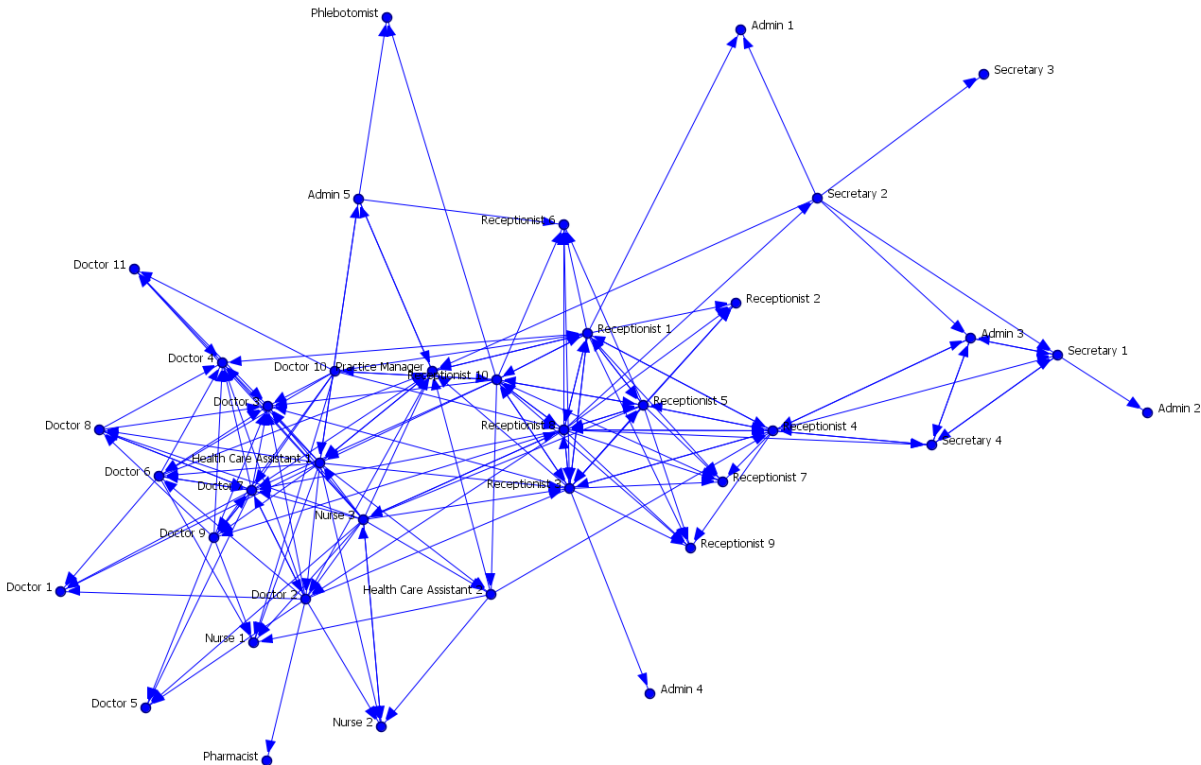
Case 2 - Trust

Case 3 - Trust

99
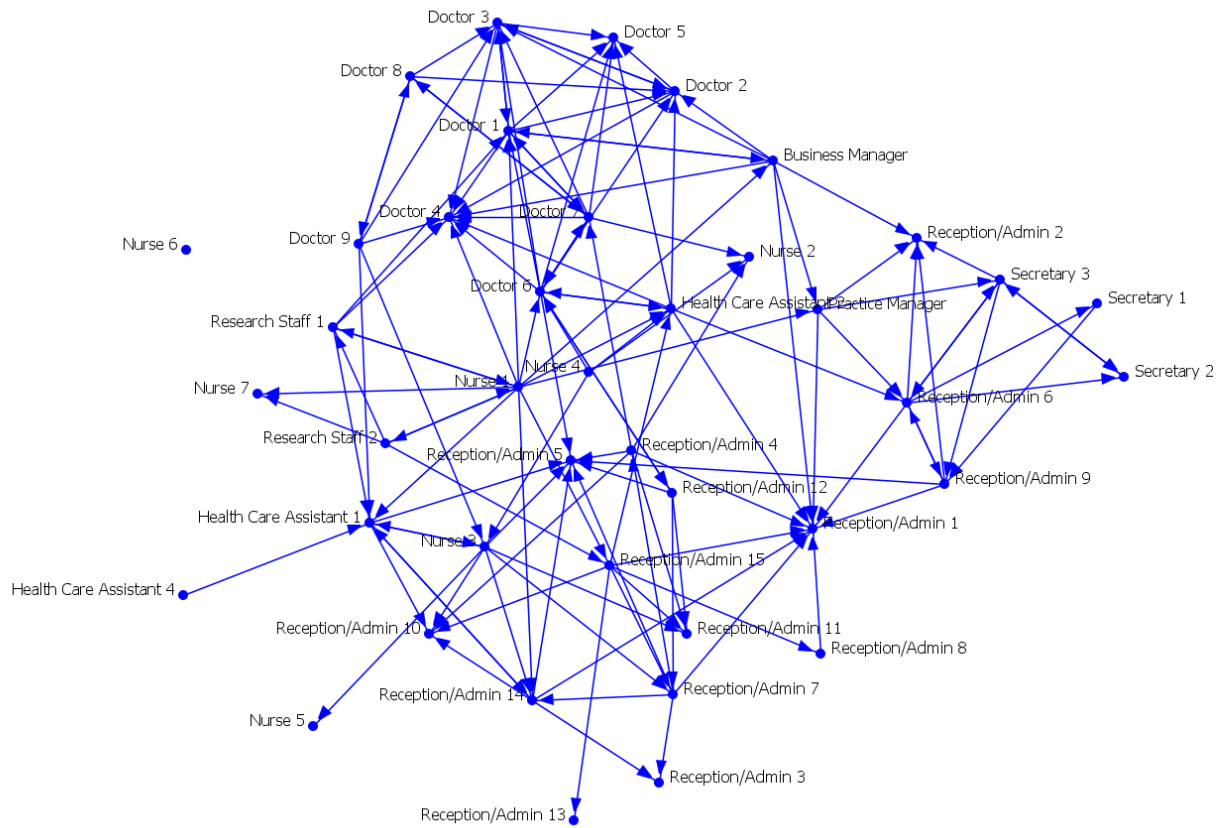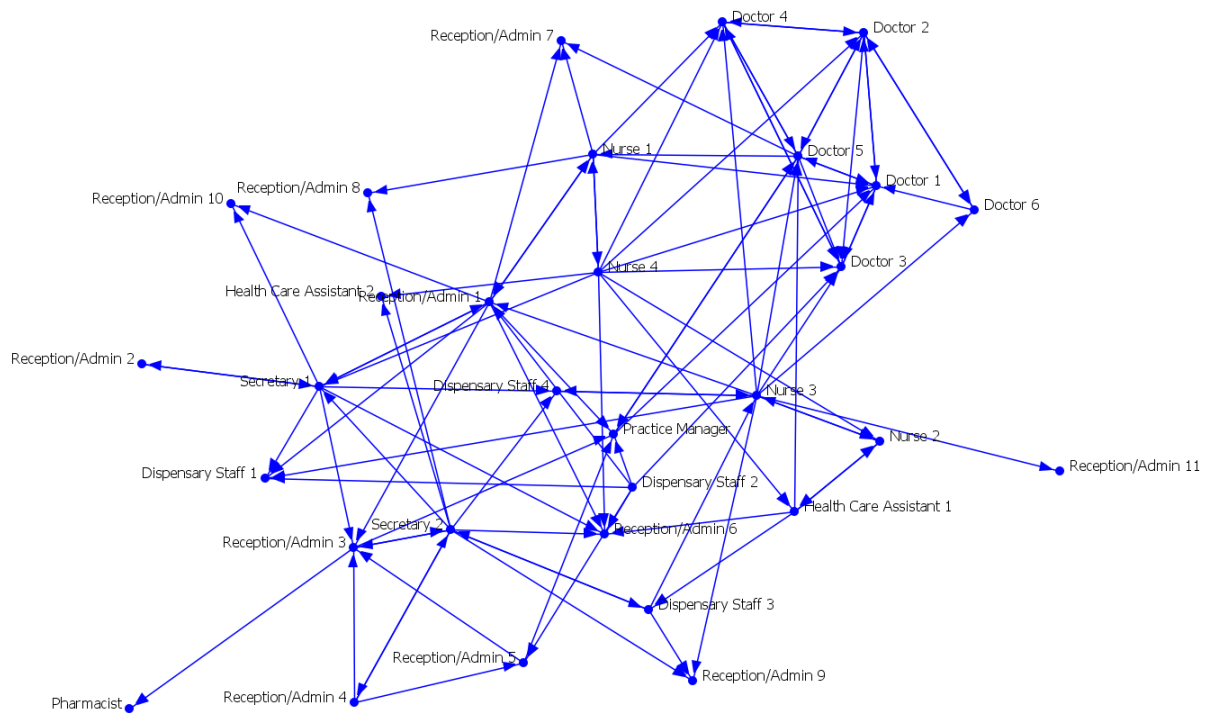
5.1.2 How often are Social Relationships Reciprocal?

As discussed previously, reciprocated ties are often viewed as stronger ties when exploring social networks, with trust often measured using reciprocity as a functional indictor (Koniordos, 2005). Additional to the self-reported tie strength collected for ties between each in the study, exploring reciprocation rates within the socialising and trust networks provides further insight into the 'distance' of social relationships within the cases.

Using adjusted reciprocity for respondents within the socialising network, comparable rates of reciprocation occur across all three cases (Table 11). Case 1 has the highest rates of reciprocation at 37.8% of all ties reciprocated. In terms of trust, Case 1 again contained the highest number of reciprocated ties at 34.5%, with reciprocation values similar for the trust and socialising networks of Case 1 and 3. Case 2 however had substantially less reciprocated ties within its trust network compared with the socialising network (23.7% vs. 33.9%). Although there is no obvious explanation for this phenomenon within the network or interview data, the lower rates of reciprocated trust ties may be an indicator of divisions or increased social distance between staff or groups of staff within the practice compared with Cases 1 and 3.

Table 11. Rates of reciprocation within socialising and trust networks

Measure	Case 1	Case 2	Case 3
Socialising			
Reciprocity (all nodes)	0.252	0.224	0.209
Reciprocity (respondents only)	0.378	0.339	0.298
Trust			
Reciprocity (all nodes)	0.216	0.134	0.237
Reciprocity (respondents only)	0.345	0.237	0.306

Adjusted for the no. of participants that completed the questionnaire

5.1.2 Do Staff Form Homophilous Social Relationships?

Figures 5 and 6 clearly demonstrate the existence of professional homophily within the socialising and trust networks, albeit varying in concentration between the three cases. Homophily is particularly dominant by occupation within Case 1, with staff of most occupational groups appearing to socialise or trust others in the same occupational group compared with those in other occupational groups. Case 2 was slightly more diverse in terms of sending social ties outside of an ego's occupational group, however homphilous ties still clearly formed more frequently within clinical and non-clinical staff groups. Case 3, the smaller workforce of the three cases was the most diverse in terms of professional homophily, however doctors were largely socially connected only to other doctors.

Figure 5. Socialising networks by occupation Case 1

Node colour = Occupation
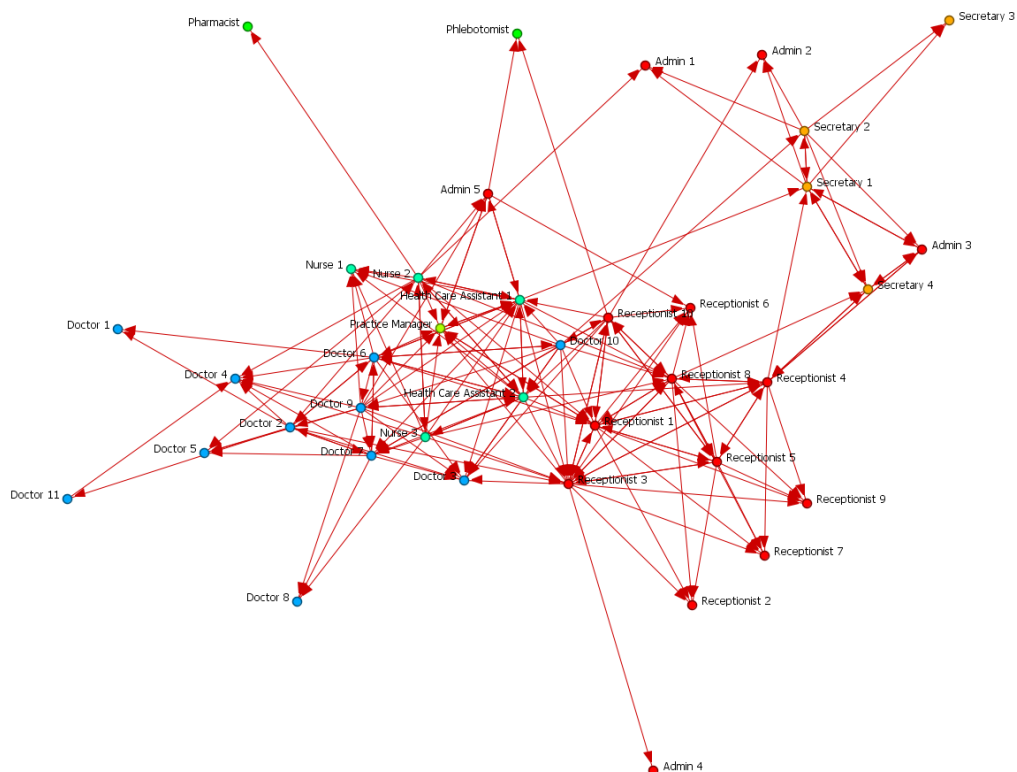
Case 2

Case 3

Figure 6. Trust networks by occupation
Case 1
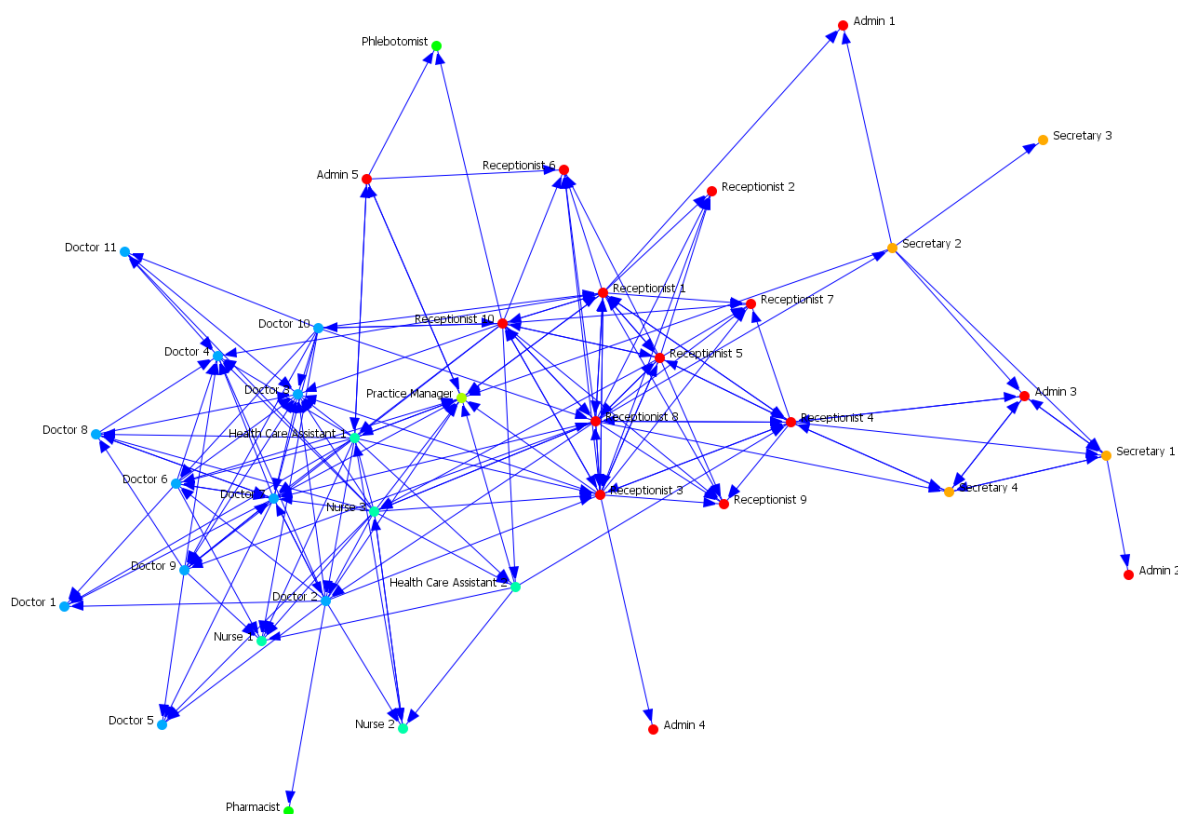
Case 2
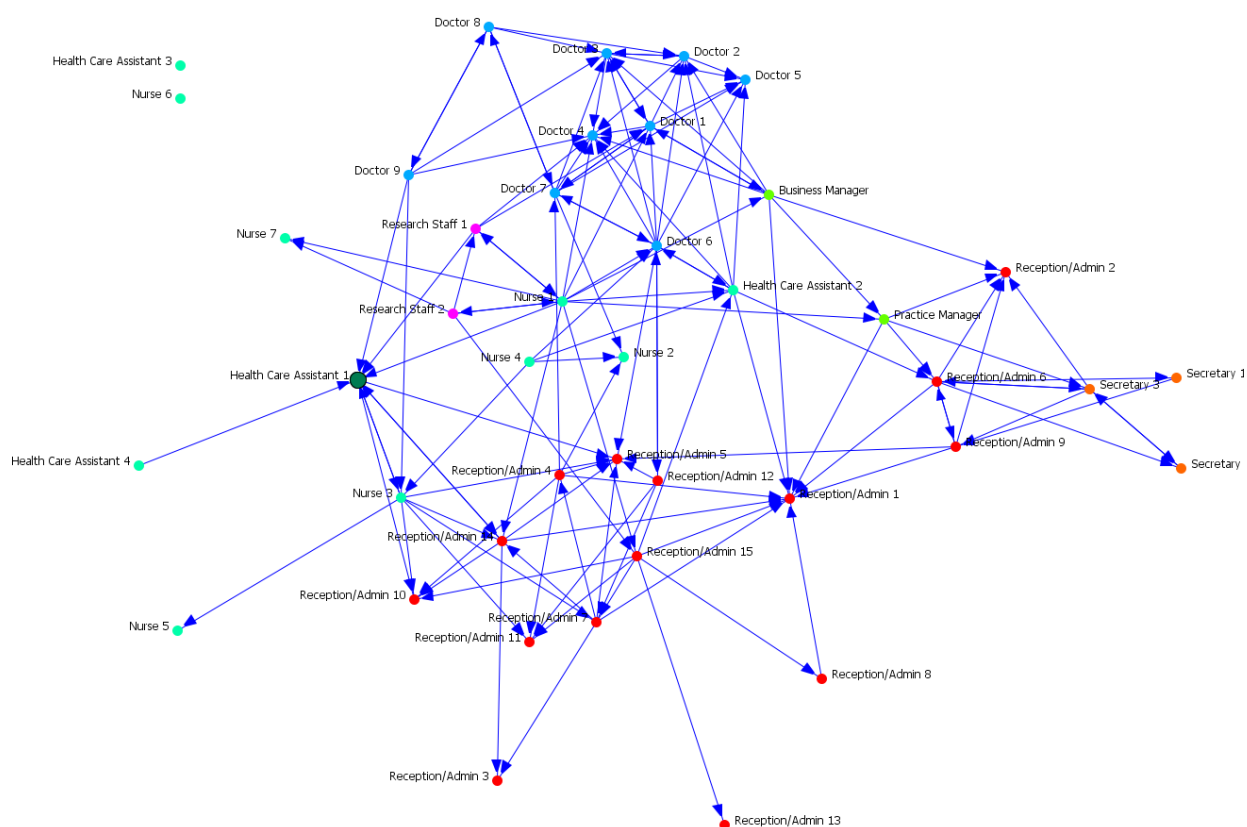
Case 3
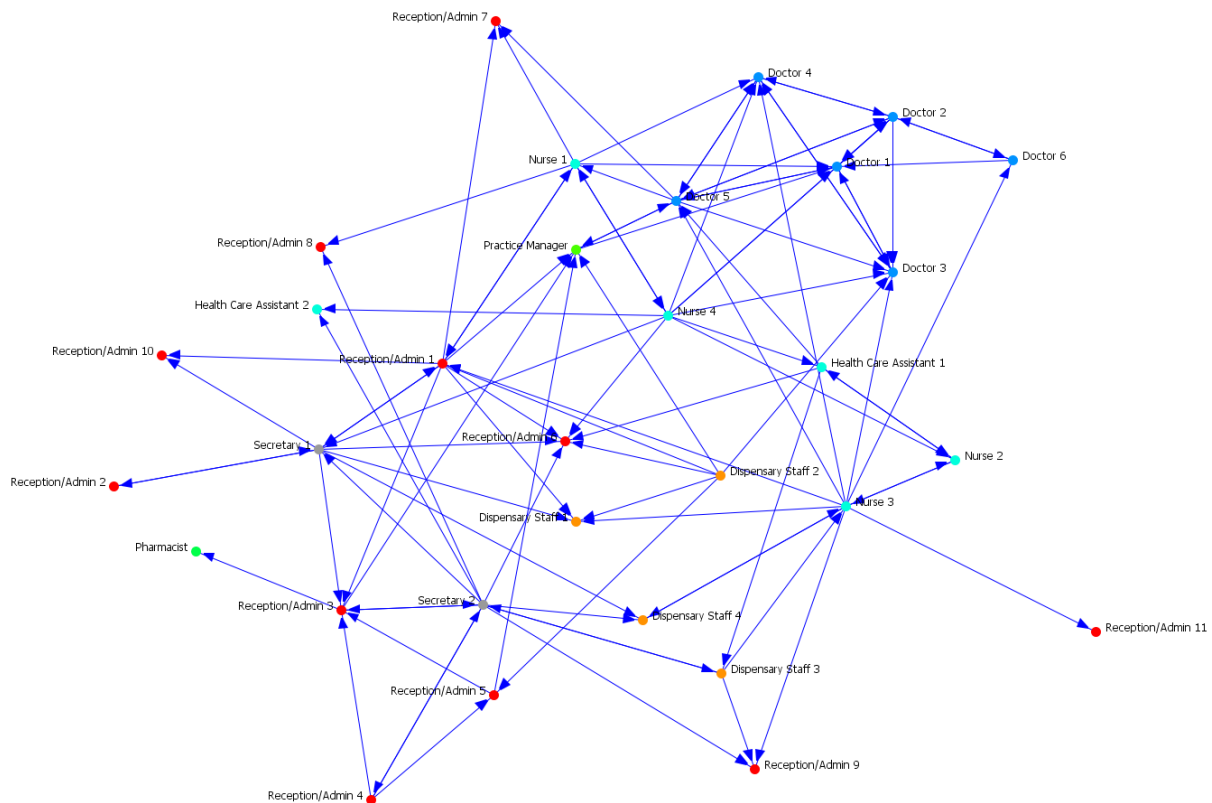
The existence of professional homophily was also a theme that emerged in a number of the interviews, with the existence of frequent social ties forming between doctors a particularly dominant discussion. As one doctor discusses:

"most of my colleagues here, certainly at a doctor level, I get on with very well and feel that I have a social relationship with." Case 2, Doctor 4

Another doctor at the same practice discussed the weekly social lunch that is paid for by the practice and attended only by the medical staff:

"the team go for lunch on a Friday in the pub, and it's a dry lunch, just a glass of Coke or something like that with your food we bring the medical students and the registrars and…chat about what we're doing at the weekend, that sort of thing" Case 2, Doctor 1

This same doctor reinforced the observed professional homophily suggesting:

"I don't go out with the receptionists or with the nursing staff particularly, they've got their own little groups of friendships and they don't want me when they're out" Case 2, Doctor 1

One doctor discussed how the proximity of staff working within the practice may further cement the formation of homophilous ties among professional groups:

"It's quite separated in this building because it's so big, and cos the admin and the call centre is so far away upstairs, sometimes you don't necessarily have that much social interaction with the admin team" Case 2, Doctor 6

Finally, an administrator at Case 1 discussed the professional homphily that she observed in the workplace not to be unique to general practice:

"in any workplace, if you've got like a reception team they work fairly close together so they will have their own little bond [and] the nurse team" Case 1, Admin 5

A surprising result from both the network and interview data however is that apart from professional homophily, there was no evidence of social ties forming around characteristics of age, gender, ethnicity, full/part time working or duration of employment. To confirm the absence of homophily in tie formation for both the socialising and trust networks (other than by occupation), relevant actor attributes are included in the inferential network models below on page 140.

5.1.4 Do Staff Form Sub-Groups of Social Relationships?

As the social network and interview data have demonstrated, staff within the same (or similar) occupation groups appear to be drawn together socially. This finding is validated by applying a statistical procedure of community detection, using the Louvain method. As the visualisations below in Figure 7 demonstrate, the structure and number of subgroups identified within the socialising and trust networks differs across the three cases.

In Case 1, three communities are identified within both the socialising and trust networks. The three communities are very similar in the occupations of staff included between both the socialising and trust networks and are clearly made

up of three distinct occupational groups (with very few exceptions). The first group is made up of clinical staff (doctors, nurses, HCA's etc.) and unlike Case 2 and 3, doctors do not appear to form their own community but include the wider clinical team. The second group is dominated by receptionists who, in this practice, work only at the front desk and are a distinct team aside from other the administrative staff at the practice. The third and final group is made up of the administrators and secretaries.

Unlike Case 1, Case 2 contains a higher number of communities in both the socialising and trust networks, although they are again largely formed around professional roles. The socialising network contains two separate communities of clinical staff, however due to the low participation rate of nurses in the online survey by nurses in Case 2 clinical staff may again like Case 1 have a formed a single community. The Louvain result demonstrates that professional homophily within the trust network is less prevalent than the socialising network, demonstrating that there are not just more trust ties between staff compared with socialising, but that these trust ties frequently bridge clinical and non-clinical boundaries compared to socialising.

Finally, actors identified within the detected communities of Case 3 follow a similar pattern to that of Case 2. Four communities are identified within the socialising network, with doctors forming a tightly connected group (including the practice manager). Like Case 2, the trust network of Case 3 bridges professional boundaries more than the socialising network, however doctors in particular remain reliant on each other when it comes to both socialising and trust.

Overall, utilising a community detection algorithm has demonstrated that within all three cases, staff are more likely to socialise with those in their own occupational groups. However compared with socialising, staff within Cases 2 and 3 are more likely to trust others to discuss personal issues from different occupational groups to their own, often bridging the clinical/non-clinical divide.

Figure 7. Subgroup analysis of socialising and trust networks
Case 1 – Socialising

Node & Line Colour = Louvain Group Membership
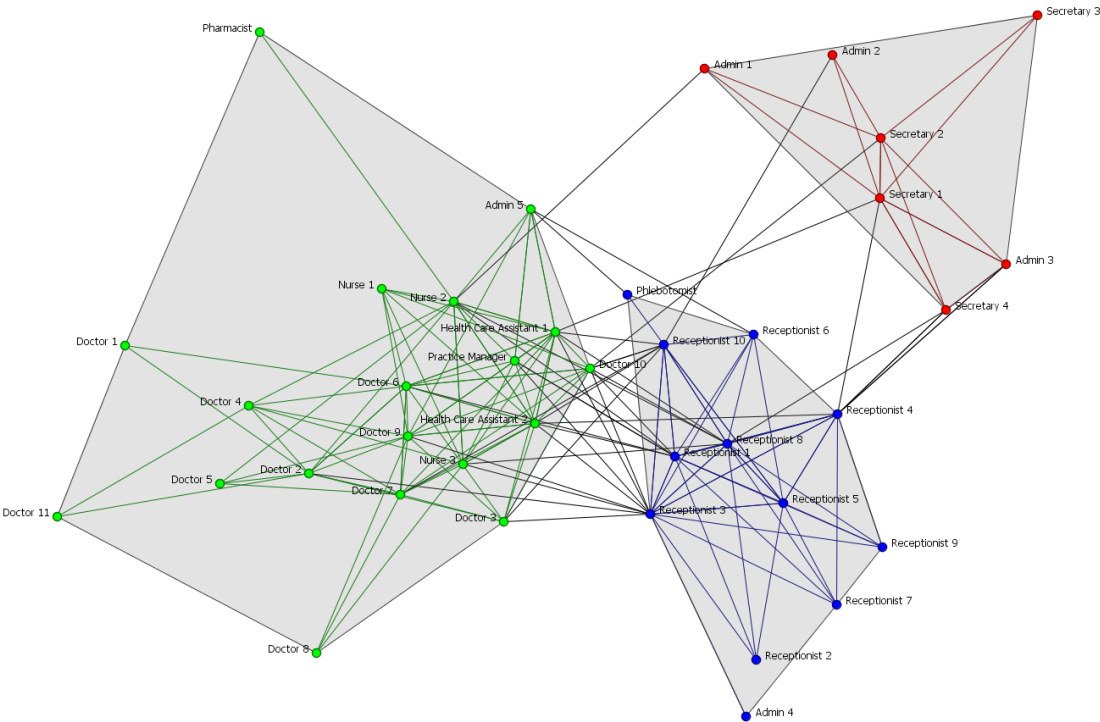
Case 1 – Trust
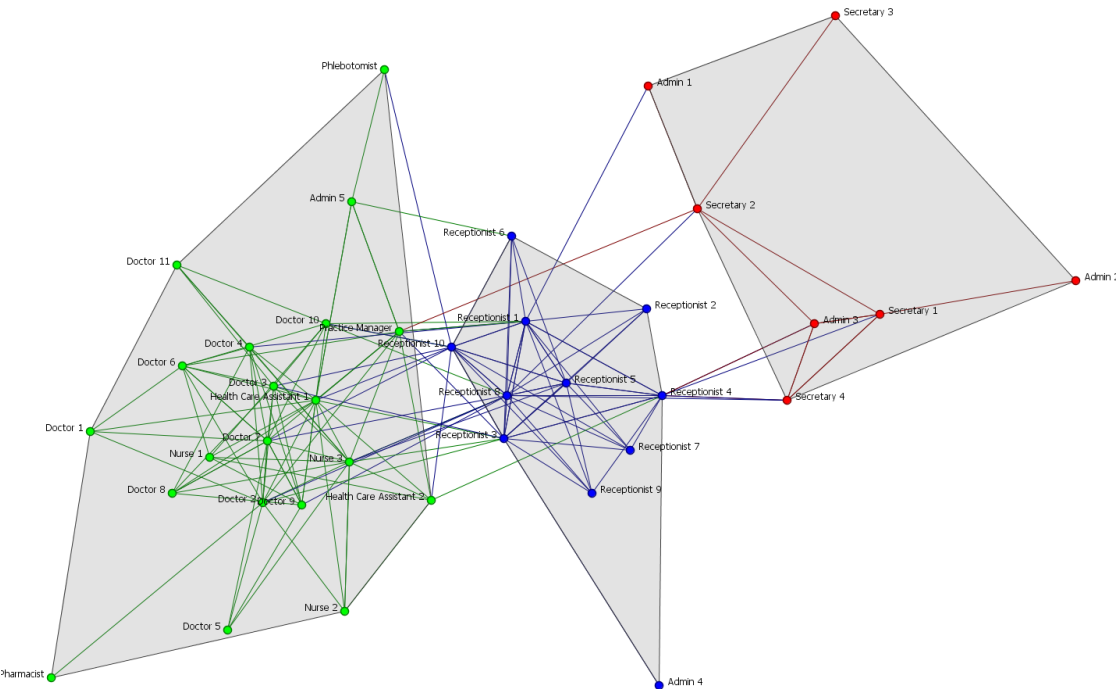
Case 2 – Socialising
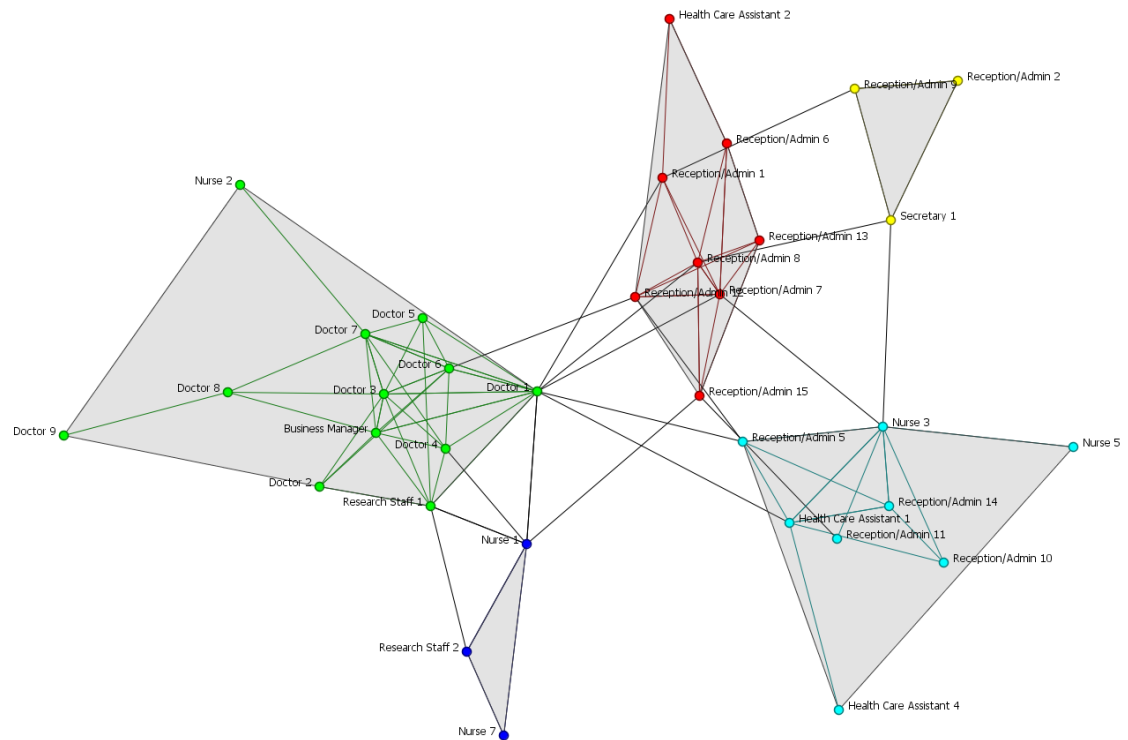
Case 2 – Trust
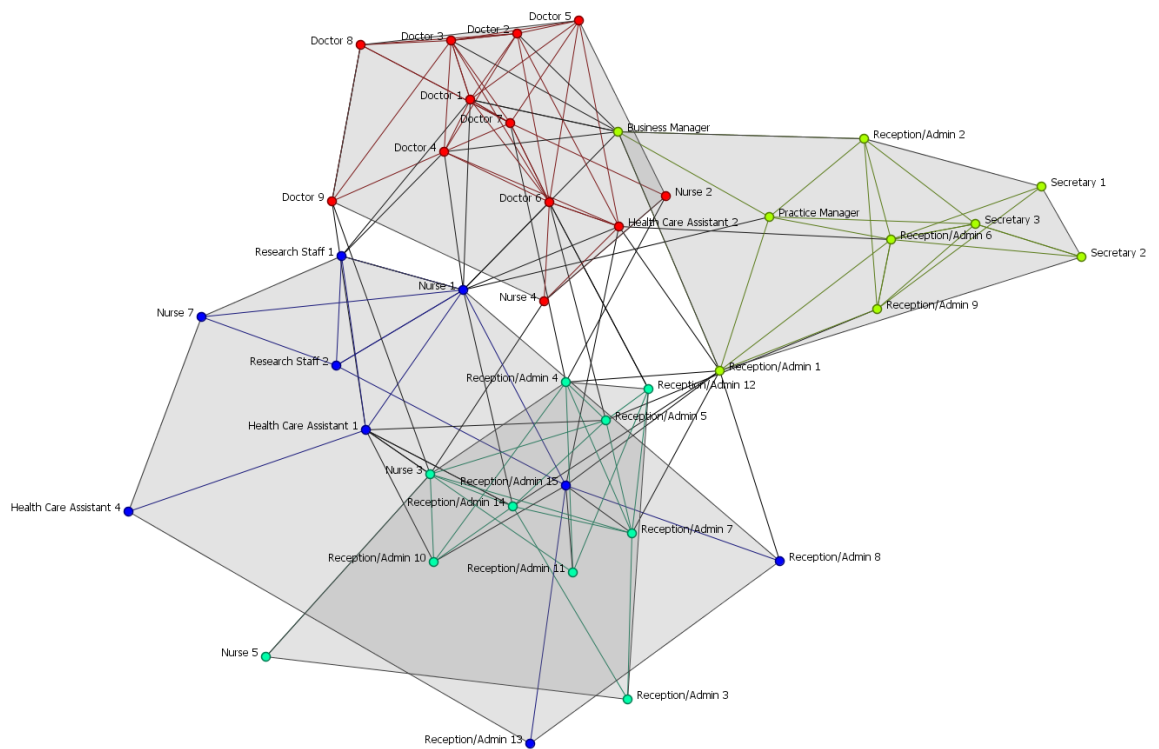
Case 3 – Socialising
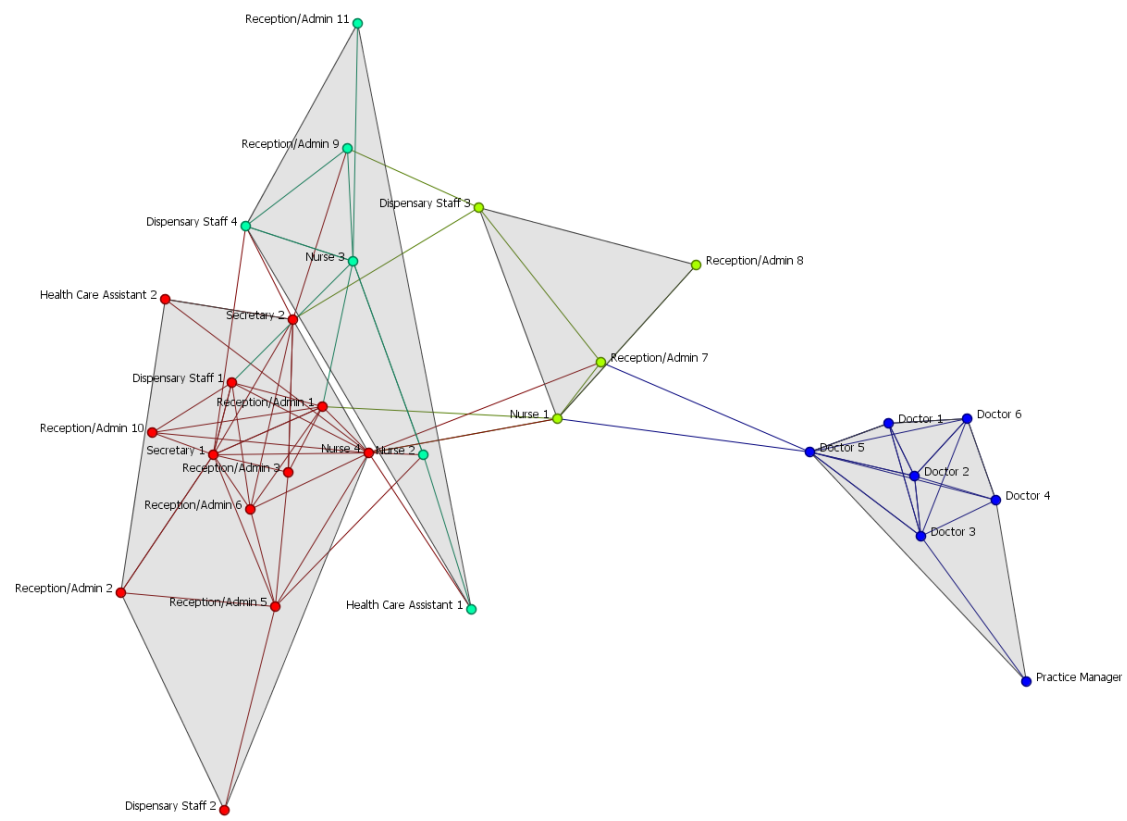
Case 3 – Trust
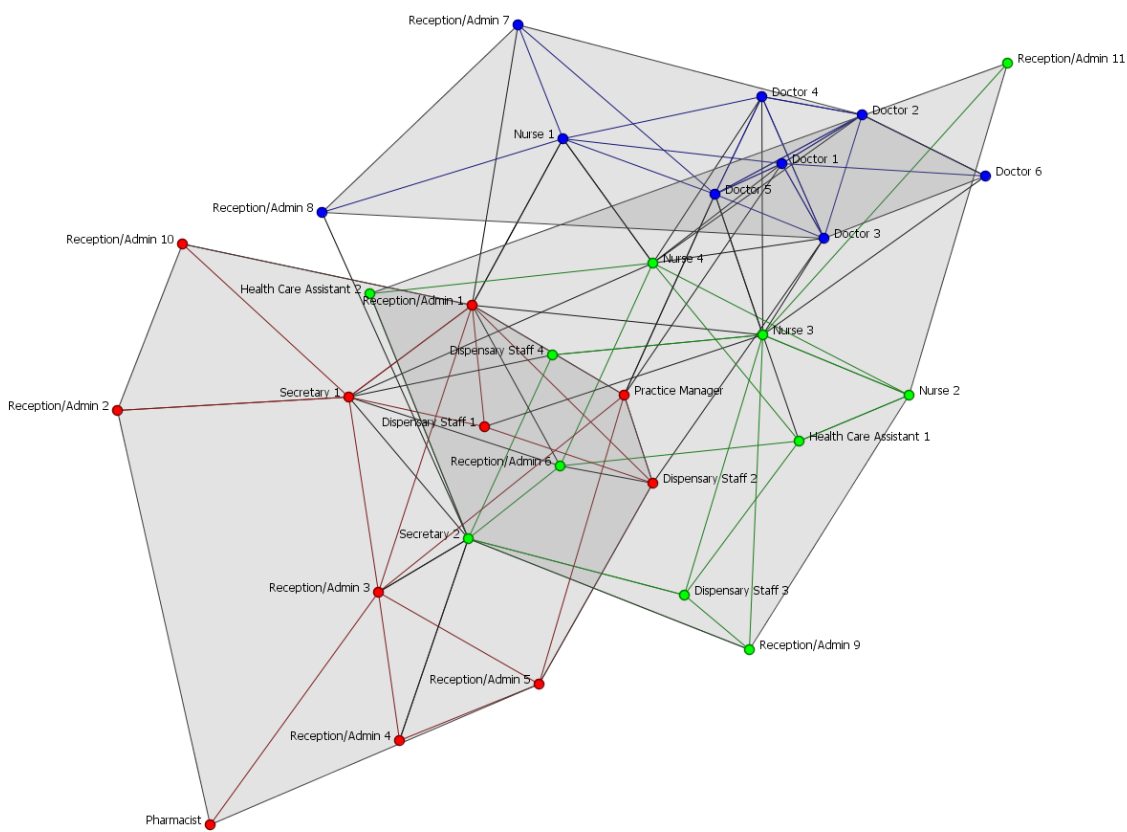
5.1.5 Is Socialising Synonymous with Trust?

In order to explore the influence that social relationships may have on the rater nomination decisions made by doctors, it is important to consider the extent to which alters that an ego socialises with are also those that they trust. It is clear from Table 10 that demonstrable differences exist between the number of actors, network density and average degree of the socialising and trust networks, meaning that at least some differences exist between these networks within each case. To measure the extent to which these networks are similar, a QAP analysis is performed to measure the correlation and associated significance between the socialising and trust networks within the three cases.

Table 12. QAP Correlation of socialising and trust networks

Case	Networks	Pearson's R	P-Value
Case 1	Socialising > Trust	0.758	<0.001
Case 2	Socialising > Trust	0.543	<0.001
Case 3	Socialising > Trust	0.635	<0.001

Table 12 demonstrates that within all three cases in the study, there is a substantial to very strong association between the socialising and trust networks, and the result is highly significant (De Vaus, 2002). The strength of this correlation is perhaps not surprising as, by choosing to socialise with a colleague, it is reasonable to hypothesise that someone may also trust this person to discuss personal matters. However, it is clear from the visualisations in Figure 8 that, particularly within Cases 2 and 3, egos are also commonly sending socialising ties to different alters than those that they trust. This finding reinforces that of the community detection result above that although actors do often send both socialising and trust ties to the same actors, there are many occasions where actors send trust ties to actors whom they didn't send a socialising tie. This finding is particularly a feature of the Case 2 and 3 networks, reflecting the lower

correlation coefficient of the two networks within these cases compared to Case 1. Consequently, the analysis going forward will recognise the similarities between the socialising and trust networks, however they will be treated independently when considering their relation to nominations.

Figure 8. Socialising and trust networks combined Case 1

Red lines = Socialising, Blue lines = Trust
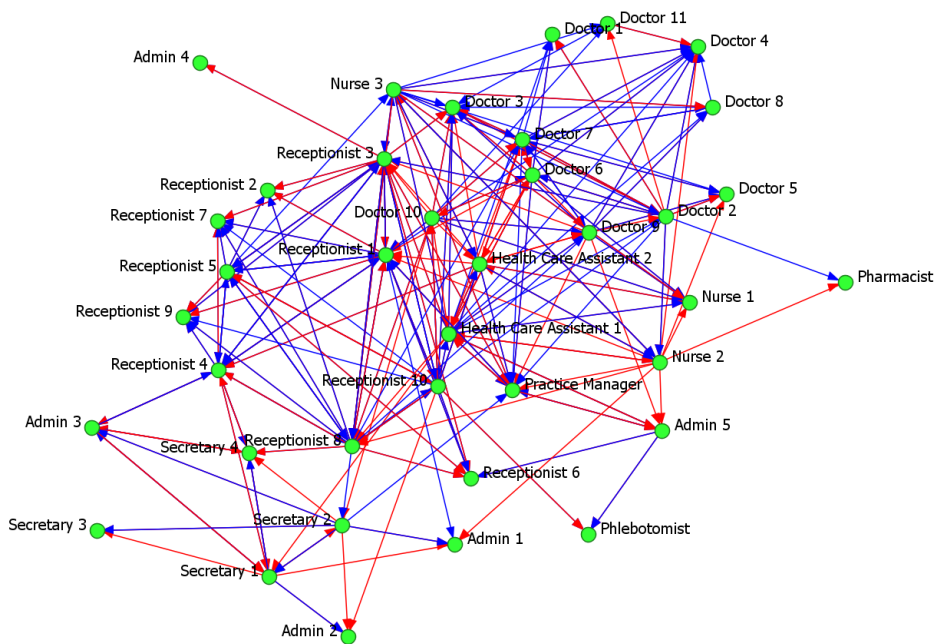
Case 2
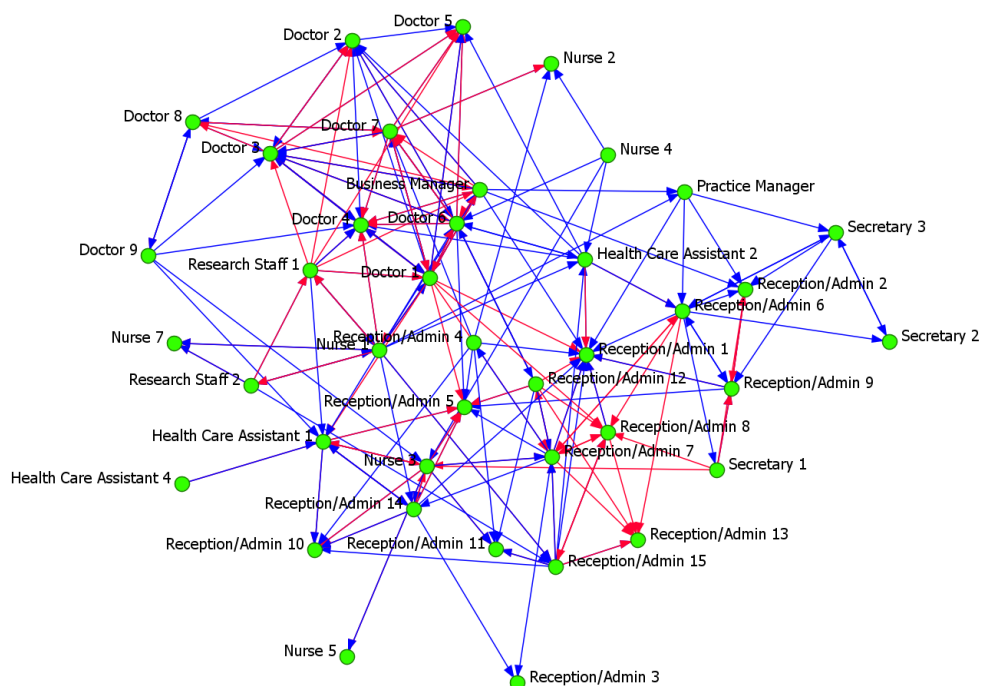
Case 3
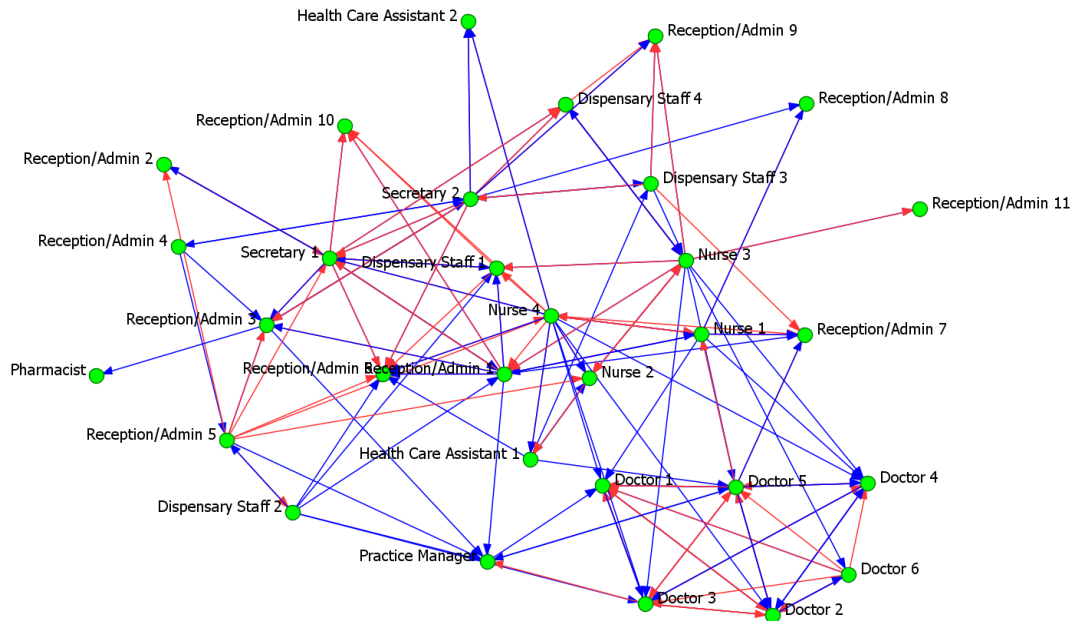
5.1.6 How Strong are Social Relationships within the GP Workforce?

In addition to naming the colleagues that staff within each site socialised with and trusted, the network survey asked participations to indicate how socially close they feel to each of these individuals. The question asked to respondents was as follows:

'Please think about each of the colleagues that you have nominated in the previous questions and consider how socially close you feel to them based on the following categories'

4 - Colleagues whom you feel socially closest to
3 - Colleagues whom you feel less socially close to
2 - Colleagues whom you feel least socially close
1 - Colleagues whom you do not feel socially close to

This question resulted in a valued network of ties between all alters of an ego (whether socialising, trust or both). At the network level, differences in the number of ties within each case are representative of the frequency of ties within the socialising and trust networks above (Table 10). At the ego level, clear differences are visible between the strength of closeness between actors within and across different occupational groups, with these differences consistent across all three

113

cases. Figure 9 demonstrates that of the colleagues that egos' feel closest to (red links), these ties often occur within the same occupational group. These closest relationships are particularly prominent between administrators, receptionists, and secretary's within each of the three cases. There are however a small number of strong ties present between occupational groups (particularly within Case 2). Weaker ties (turquoise and green links) are more prominent between staff within clinical roles in Cases 1 and 3, however links between doctors in all three cases are often higher than those between a doctor and colleagues of another occupational role. See Table 13 for the network level statistics for social distance.

Understanding why social relationships are reported as being much stronger between staff of non-clinical roles compared with those in clinical positions is not clear, however participants did report at interview how establishing good social relations with colleagues within general practice can support morale and team functioning. As one Nurse discussed from Case 2:

"I think [social relationships] improve morale, I think if you can talk to people just generally about your life, about who you are, if you understand people, know a little bit about maybe if they're having trouble at home or that type of thing, that all helps to your empathy, the way you talk to them, the way you might perhaps forgive somebody's grumpiness for example, if you know that they're actually really stressed. So I think it all helps to building a team" Case 2, Nurse 1

A member of the research staff at Case 2 also discussed how getting along socially with colleagues at works affects her personal morale:

"I don't think I'd want to come into work if I didn't like anyone here, or if I would want to come in even less if I thought that no-one liked me, like no-one wants to be somewhere where no-one likes them" Case 2, Research Staff 2

This same member of research staff also discussed the challenges of completing work-based tasks without getting on well with colleagues on a social level:

114

"It'd be harder, especially for running the research trial and stuff if none of the staff liked me, if I asked them to do things they'd be less responsive I think, cos if somebody you likes asks you to do something you probably do it quicker and better than if someone you don't like does it" Case 2, Research Staff 2

The existence of social relationships between staff in a healthcare setting has also been demonstrated to be an indicator of morale and team functioning in healthcare environments (Lurie, Fogg & Dozier, 2009; Swensen, Kabcenell & Shanafelt, 2016), however the strength of these relationships has not been a focus of these studies and warrants further exploration.

In terms of the impact of social relationships on rater nominations for MSF however, Figure 9 clearly demonstrate that within all three cases, doctors are rarely sending or receiving strong social ties. Where they are sending strong ties, they are commonly only to other doctors and not the wider healthcare team. The social distance between actors as measured by this question will not modelled due to challenges of co-linearity with using social distance as a dyadic covariate in the ERGM model. The preceding network analyses will therefore focus on the socialising and trust networks, not taking into consideration tie strength.

Table 13. Network level statistics for social distance

Measure	Case 1	Case 2	Case 3
Social Distance			
Actors	38	42	31
Participation Rate	66%	74%	77%
Ties	213	160	103
Tie Value (Range)	1 not close – 4 closest		

Case 1
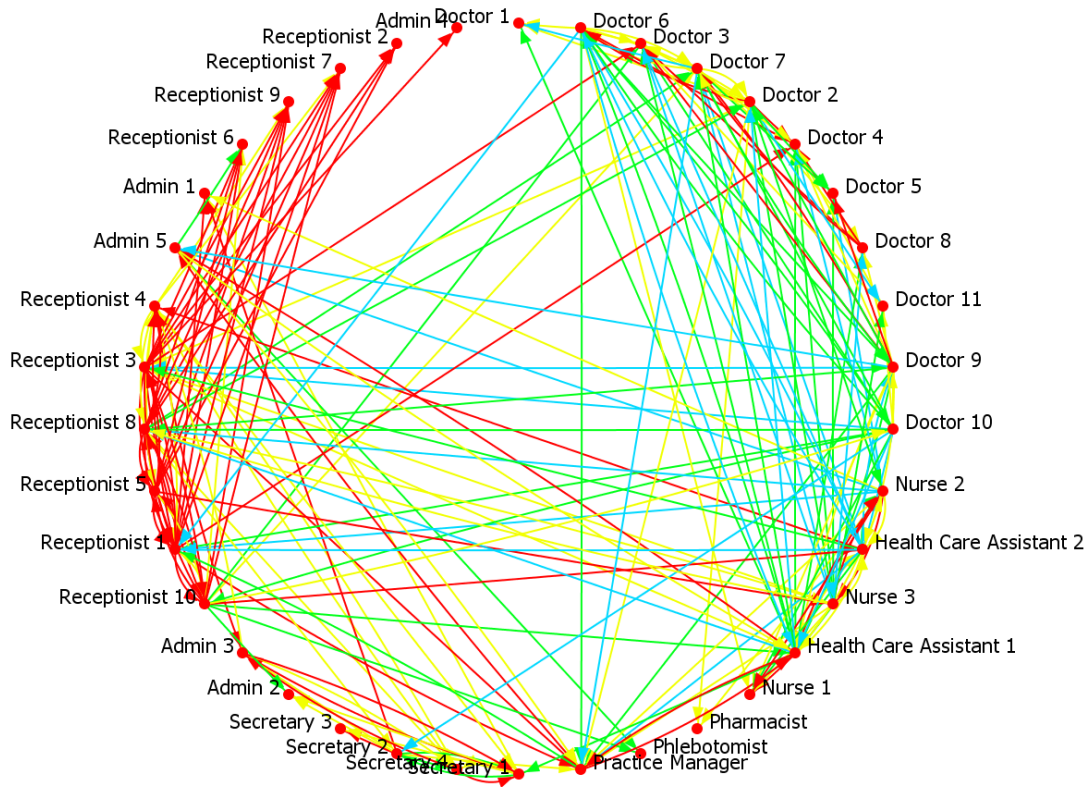
Case 2
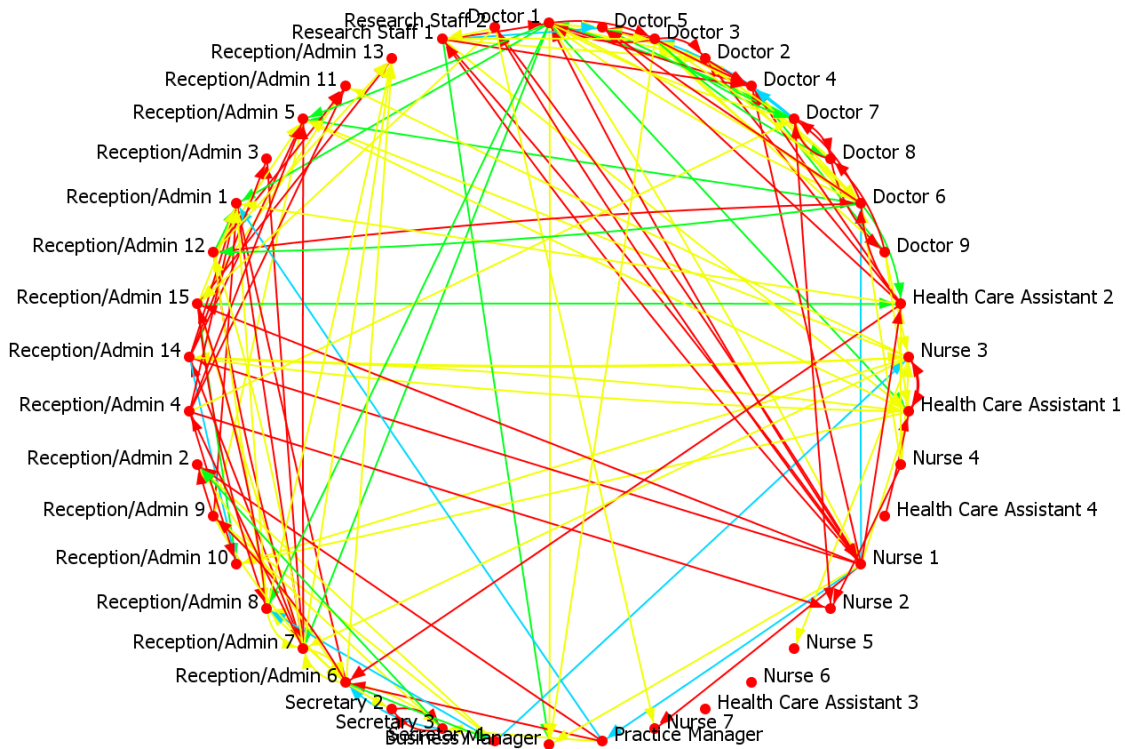
Case 3
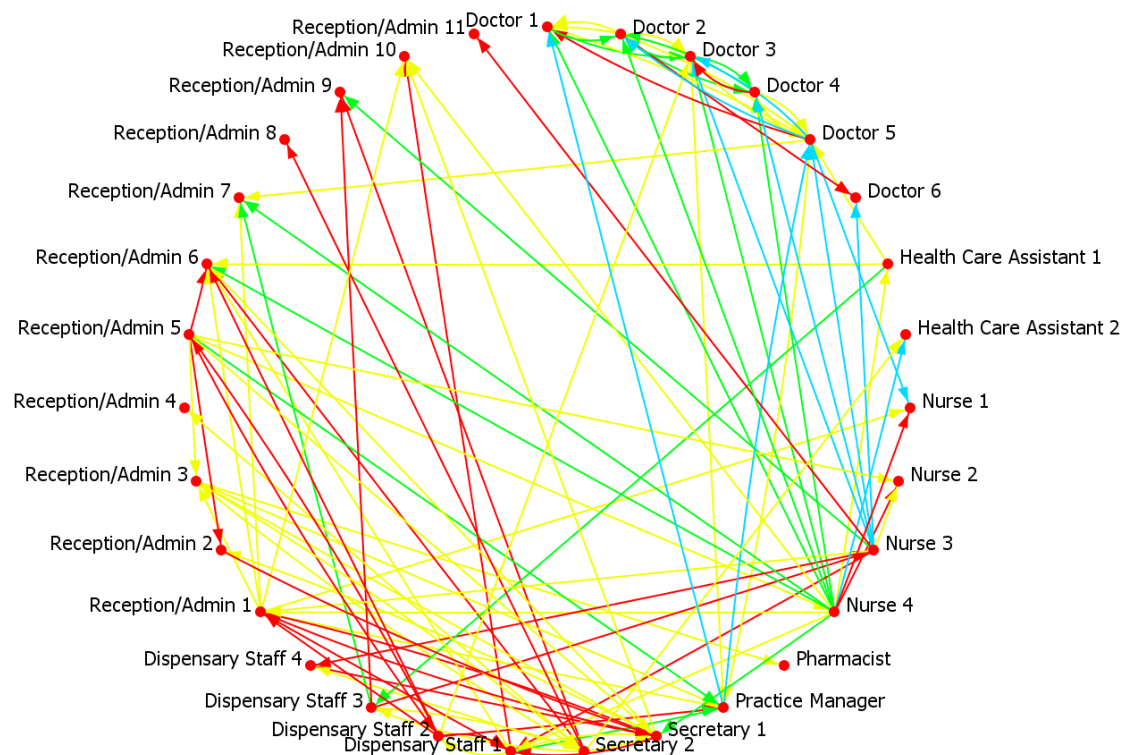
5.2 Who do GP's nominate in MSF Assessments for Revalidation?

Before exploring the potential impact of social relationships on the rater selection choices made by doctors, it is important to first understand what factors affect the selection of raters from the perceptive of doctors themselves. As discussed in Chapter 2, a number of previous studies have explored how the characteristics of ratee's impact the feedback received by a rater, however little research has explored what factors impact rater selection choices from the ratee perspective. This section will explore the rater selection process from the perspective of doctors in the study, beginning with an exploration of doctors attitudes towards Revalidation and how these views may subsequently shape their approach to MSF and rater selection specifically.

5.2.1 What are GP's Attitudes towards Revalidation?

Aligned with previous studies exploring doctor's attitudes towards Revalidation (Curnock *et al.*, 2012; Dale *et al.*, 2016), doctors within this study had mixed feelings towards Revalidation. As one doctors discussed:

"appraisal started off you spend 10 minutes filling out a few blank bits of paper and putting it in and having a little cosy chat, and now it's turned into a beast with Revalidation…you don't want to appear on someone's radar" Case 1 Doctor 1

A second doctor highlighted a lack of faith that Revalidation can achieve the aims as set out by the GMC:

"I don't have a great deal of faith in the Revalidation process, I see it as a political tool to interfere with doctors, I recognise the aim they're trying to do but I don't think it achieves the aim they're trying to do" Case 1, Doctor 10

This same doctor went on to discuss the value of reviewing performance, however believed appraisal should serve a developmental function not overseen by the GMC:

"I think appraisal is important, you can't just for the next 30 years of life hide behind this door and no-one ever look at what you're doing, [however] I don't think it's a role for the GMC to get involved with. I think the GMC should be sticking to dealing with legal aspects and disciplinary cases and that sort of thing." Case 1, Doctor 10

This view was supported by another doctor at Case 1, however this doctor also believed that Revalidation is, but should not be, a summative exercise:

"I think all doctors should have feedback from everybody that they have contact with, however, it should not be a summative exercise" Case 1, Doctor 6

Finally, echoing findings of previous research on attitudes towards Revalidation (Dale *et al.*, 2016; Hill *et al.*, 2012), doctors within this study discussed how, for them, the process of Revalidation is an administrative or 'tick box' exercise that they need to pass:

"Yeah, [Revalidation] feels just like a tick box exercise…its definitely [summative]" Case 2, Doctor 6

"I see it as an exercise, a purely administrative exercise, in other words I'm interested in what people say about me, I'm not that fussed." Case 1, Doctor 10

118

In general, doctors agreed with the need for their ongoing performance to be appraised in order to support their professional development. However some disagreed with the move from a historically informal appraisal process to a formalised regulatory process in the case of Revalidation, viewing the process as a summative assessment and an additional administrative burden to an already overloaded work schedule. These attitudes will be considered when exploring any relationships between social relationships and rater nominations below.

5.2.2 How do GP's Nominate Raters when Participating in MSF Assesments?

When discussing the process that doctors adopt to select raters, all respondents at interview who had previously completed an MSF assessment for Revalidation (n=5) had nominated all of their raters themselves. These doctors provided comments such as:

"I think I nominated all of them" Case 2, Doctor 6

"They were all nominated by myself" Case 1, Doctor 1

When collecting rater nomination data from participating in the study, no doctor discussed nominating raters through any method other than self-selection to obtain their feedback. Although some expressed a desire to collect random feedback in the future, it is likely that the rater nomination data for all participants in this study has been self-selected by the ratee.

5.2.3 How Long do GP's Spend Considering Which Colleagues to Nominate?

When discussing how much thought goes into deciding which colleagues to nominate, doctors overwhelming discussed completing their nominations quickly

and with little concern or anxiety around making their choices. Aligned with the view demonstrated by doctors of Revalidation being an administrative and bureaucratic exercise (page 120), one doctor within Case 2 discussed:

"I'm not like a reflective theorist if you like, I wouldn't spend half a day at it, why would I, it's a process, I know I'm neither the best doctor in the world nor the worst doctor in the world, somewhere in the middle, so it doesn't matter does it" Case 2, Doctor 1

Interestingly, this doctor (Case 2, Doctor 1) associated spending limited time on the 'process' of rater selection because they were confident in their practice. Two further doctors highlighted limited concern or worry surrounding who to nominate for their MSF:

"[I have] virtually no concern and I would choose it almost instantaneously really, I would just list off a bunch of people depending on how many I had to have from each of the departments of the surgery, I'd be able to do that within seconds I think really, it wouldn't plague me in terms of a worry no not at all" Case 2, Doctor 4

"I didn't really give any thought" Case 2, Doctor 6

Overall, the process of selecting raters for MSF was not considered burdensome or a worrisome activity for many of the doctors in the study, as demonstrated next however there were a number of factors highlighting as impacting which colleagues a ratee would nominate.

5.2.4 What Factors Impact GP's Choices of Who to Nominate?

Understanding from the ratee perspective the factors that impact the choices doctors make when nominating colleagues is important in understanding the potential impact of social relationships on rater nomination choices. As outlined below, doctors at interview discussed a range of factors impacting which colleagues they nominate.

5.2.4.1 Frequent Professional Contact and Communication

Firstly, 5 of the 11 doctors interviewed stated frequent professional contact and communication as a factor impacting their nominations. As one doctor discusses:

"I think the main thing for me would be who I see often, who do I spend more time communicating with and discussing things with… that would govern how I would choose who I choose." Case 1, Doctor 9

One reason doctors nominated those that they work and communicate with regularly was that they felt more comfortable approaching these people to request feedback:

"last time I did it there was maybe a GP I that I didn't see very often that I didn't know and I didn't feel very comfortable asking them to do it" Case 2, Doctor 9

However, others would select these colleagues as they believed that they are better placed to assess the ratees performance. As one doctor mentioned they nominate colleagues:

"who could comment accurately on what I do; so if they've see me once or twice then how are they going to know what's going on, so I think it should be someone who roughly knows what I'm doing" Case 1, Doctor 7

Having frequent professional contact in this case was attributed to an increase in accuracy from the raters perspective. Furthermore, related to a desire for accurate feedback for some doctors was a desire for objective and honest feedback.

5.2.4.2 Provides Objective and Honest Feedback

Nominating colleagues in order to receive objective and honest feedback was a factor discussed by a minority of doctors at interview (3 of the 11). One doctor wanted to know the areas of their practice to improve on in the future, however they did also discuss the possibility of suspicion from appraisers if an MSF feedback was overly positive:

"it's not about saying something nice about you, well for me it isn't anyway, it's about choosing people who would be objective… it's good if someone's giving

you something to work on, so I don't want a shining glowing amazing report, that's almost suspicious in its own right" Case 1, Doctor 10

A second doctor, also from Case 1, discussed nominating colleagues whom would be honest, but also those whom would consider the purpose and potential consequences of the feedback provided:

"*I wanted to pick people who would be honest but not over critical… I'll nominate my practice manager cos she's known me for a long time and I knew she would be honest without being damning" Case 1, Doctor 1*

Alongside considering the consequences of the feedback provided, actually providing feedback when asked was another factor highlighted by doctors.

5.2.4.3 Provides Feedback when Nominated

Almost half of the doctor's interviews (6 of the 11) discussed nominating colleagues whom they know will likely respond when nominated. As one doctor discussed:

"there's people you know that are just going to do it, that's what it boils down to" Case 2, Doctor 9

A second doctor mentioned that, for them, one of the most important factors when nominating raters is simply:

"someone who'll reply" Case 1, Doctor 7

In terms of considering who these colleagues are that will be more likely to respond when asked, two doctors mentioned that those colleagues whom they had a social relationship with are likely to those that are more likely to respond:

"so trying to think would I be more inclined to nominate people who I had a social relationship out of work, possibly, is that because I then know that they would do it" Case 1, Doctor 11

"at the end of the day I'm asking them to do me a favour, they've got to log in, read all the questions, and they've got to do all that on top of their normal work" Case 2, Doctor 9

This leads to the most frequently discussed factor impacting whom doctors nominate, that of those colleagues with whom a rater has a social relationship.

122

5.2.4.4 Social Relationships

Of those interviewed, 10 of the 11 doctors at the two cases suggested that social relationships could or did impact the nominations that they make. In terms of the process of selecting raters for MSF, one doctor discussed how the process of self-selection will always lead to nomination biases towards those whom a doctor is socially connected with:

"there is that element of 'I have a good rapport and relationship with that person, I'll send it to them', there is bound to be an element of that when you self-select" Case 2, Doctor 4

Furthermore, as the social network data on page 103 demonstrate, although doctors appear more likely to form social relationships with other doctors, it is still common for doctors to have a number of social ties with non-doctor colleagues in the practice. Two doctors highlighted at interview that these social relationships with non-clinical staff particularly impacted their nominations of this professional group:

"[social relationships] definitely shaped it, absolutely, certainly with the non-clinical stuff, with the clinical staff I would say it did particularly because I chose all of them, the non-clinical staff it definitely did" Case 1, Doctor 6

"I probably chose all doctors and then chose the rest of the support staff for people that I knew had contact with me and therefore, a social relationship" Case 1, Doctor 6

One doctor from Case 1 discussed how, for the very few colleagues that are nominated from outside of the doctors place of work, these colleagues were more likely to be 'friends' with the doctor:

"the ones I picked from outside here probably are more likely to be friendly as opposed to critical workers probably…I mean I chucked in a mate of mine who's a consultant who I go mountain biking with" Case 1, Doctor 1

Finally, as one doctor discussed, the colleagues whom are most likely to provide positive feedback are those where a social relationship exists between rater and ratee:

123

"most of us try and choose friends and tame people, tame's a bad word it means ineffectual, but people who you know wouldn't screw you over" Case 1, Doctor 1

Selecting those whom are likely to provide positive feedback was the final factor impacting nomination choices discussed by doctors in the study.

5.2.4.5 Receiving Positive Feedback

Ensuring that those whom raters nominate provide sufficiently positive feedback in order to Revalidate was discussed by 4 or the 11 doctors interviews. As one doctor in this study discussed:

"people want to obviously come out of [an MSF assessment] looking good, or at least fair or reasonable" Case 1, Doctor 1

This tendency towards nominating colleagues whom are socially close to a ratee in order to receive more positive feedback was echoed by other doctors, with one suggesting:

"you're not going to nominate people who you don't have good relationship with, because of the idea that they wouldn't then write something nice about you" Case 1, Doctor 11

And another suggesting the likelihood of receiving positive feedback being the key factor influencing their nomination choices:

"[choosing] someone who wouldn't stiff you, that's the prime quality I think" Case 2, Doctor 1

The need to receive positive feedback in order to, or at least not receive feedback that would highlight significant performance issues:

[Revalidation] is potentially a career ending process if you get it wrong…you don't want to stitch yourself up by being somebody who might be a loose cannon, somebody might have a grudge against you, somebody you've had cross words with…you wouldn't probably choose somebody like that cos there's an unknown there. Case 1, Doctor 1

However, as highlighted above, doctors in the study often discussed Revalidation in terms of a bureaucratic exercise required to 'pass' successfully. Although fewer doctors explicitly described a desire for positive feedback as a factor impacting

124

nomination choices, selecting colleagues whom are socially closer and whom may be more likely to provide positive feedback, may be an indicator of a more implicit or unconscious factor impacting nominations for some doctors.

Summary

Overall, doctors who participated within the interviews identified a variety of factors impacting their nomination choices. Many doctors wanted to nominate colleagues who they felt were competent and 'qualified' to provide feedback, understood the MSF process and had regular professional contact and communication with the ratee. A small number of doctors demonstrated a developmental desire to nominate colleagues whom will provide objective and honest feedback on performance, however the vast majority (10 out of 11 doctors) highlighted social relationships to be a factor impacting their nominations. Doctors discussed a tendency towards nominating colleagues where a social relationship exists as they 1) feel more comfortable to ask those they have a social relationship with, 2) believe socially close raters are more likely to respond and 3) anticipate positive feedback as a result of the social relationship.

5.2.5 Who did GP's Nominate in this Study?

Nomination data was requested from doctors across all the three cases. The feedback tool required each doctor to nominate fifteen colleagues in order to provide them with feedback, with a minimum of twelve responses required to provide statistically reliable results.

125

Across the three sites, a total of 12 doctors provided their rater nomination data (Table 14), with six doctors providing data from Case 1, five from Case 2 and one from Case 3. In terms of the number of feedback requests each doctor sent to their colleagues, the number of outgoing ties ranged between twelve and eighteen. However, in order to explore the relationship between social relationships and nomination choices, only nomination ties sent to current employees at each site are included in this study. As a result, the number of ties sent from the 12 participating doctors ranged from six to 15, with an average of ten, fourteen and twelve ties sent respectively by doctors within Cases 1, 2 and 3.

Each member of staff at the three cases meeting the study eligibility criteria had a chance of being sent a nomination request. Of these staff receiving a nomination, the number of requests each staff member received ranged from zero to five. Within Case 1 and 2, the average nomination requests received by an actor was 3, however due to only one doctor sending ties in Case 3 actors received a maximum of one request. A number of staff members did not receive any feedback requests, ranging from around 61% in Case 3 to 38% in Case 2. Differences in the number of actors not receiving a feedback request may be influenced by a wide range of factors including 1) colleagues not working at the practice at the time nominations were sent, 2) the number of doctors sending nominations and 3) closer working relationships with particular members of staff.

In order to analyse any common structures and actor-based characteristics in how nomination ties are sent by doctors, as well as how these structures and characteristics might relate to structures within the socialising and trust networks,

126

a network of nominations for each site was created. A nomination network was developed by taking the ego network of each doctor sending nomination ties and combining these ego networks to form a whole network for each case. Each whole network consisted of every doctor within the site that sent nomination ties, and every colleague at the site that received at least one nomination request. Actors within the socialising and trust networks that did not receive any nomination ties are isolates within nomination networks and were removed. These nomination networks consisted of 21, 26 and 13 actors respectively for Cases 1-3 (Table 15) and are visualised below in Figure 10.

As demonstrated in the feedback tool guidance documentation (Appendix 2), doctors should send feedback requests to *'staff from within your organisation and some from outside your organisation'*. In terms of analysing the structure of the nomination network and characteristics of those receiving feedback requests, nomination ties sent outside of the egos practice provides an issue for this study. The roster of staff at each participating site was provided by the practice manager and each doctor had a chance to provide their nomination data. Personal characteristics, potential nomination requests and social ties of these alters were not available for feedback requests sent to any actor outside of the participating sites.

Nomination ties being sent outside of the practice had little impact on the study as only 1.67% of the total 180 feedback requests that were sent by participating doctors were sent to actors outside of the practice (Table 17). The largest impact on the study in terms of the nomination data however was the date that doctors completed their nominations. Table 17 demonstrates the dates that doctors made

127

their rater nominations, as well as when the social network data collection took place at each site. Case 1 has the biggest time discrepancy between the completion of rater nominations and network data collection, with gap of around three years between the two activities. After preliminary analysis and informal discussions with network scholars in London (UK) and St Petersburg (Russia), it was decided that such a significant time discrepancy between these two activities could see potentially significant changes to the structure of the socialising and trust networks within each case due to the mobility of the workforce. As a result, the subsequent two sites were targeted for recruitment into the study with a time discrepancy of no more than six months between nomination completion and network data collection, with network data collection starting directly after nominations were sent at Case 2 and nominations completed three months after network data collection took place within Case 3.

Table 14. Participating doctors whom provided nomination data

Case 1	Case 2	Case 3
Doctor 1	Doctor 1	Doctor 1
Doctor 2	Doctor 2	-
Doctor 3	Doctor 3	-
Doctor 4	Doctor 4	-
Doctor 5	Doctor 7	-
Doctor 6	-	-

Table 15. Nomination network characteristics

Measure	Case 1	Case 2	Case 3
Nodes	21	26	13
Link count	60	69	12
Doctors sending nominations	6	5	1
Minimum no. of nominations sent (ego)*	6	13	12
Maximum no. of nominations sent (ego)*	13	15	12
Average no. of nominations sent (ego)*	10	14	12
Received a nomination	55.26%	61.90%	38.70%
Did not receive a nomination	44.74%	38.10%	61.30%
Minimum no. of nominations received (alters)	0	0	0
Maximum no. of nominations received (alters)	5	5	1
Average no. of nominations received (alters)	3	3	1

The number of nominations sent by an ego is adjusted to include only alters that 1) are employees at the site (not employed externally) and 2) are working at the site at the time of data collection

Table 16. Nominations inside vs. outside ratees practice

	Ties sent within the egos practice (employed at time of network data collection)		Ties sent within the egos practice (no longer employed at time of network data collection)		Ties sent outside of the egos practice		Total	
	n	%	n	%	n	%	n	%
Case 1	60	60.61	36	36.36	3	3.03	99	100.00
Case 2	69	100.00	0	0.00	0	0.00	69	100.00
Case 3	12	100.00	0	0.00	0	0.00	12	100.00
Total	141	78.33	36	20.00	3	1.67	180	100.00

Table 17. Dates of completing nominations vs collection of social networks

	Nominations Sent	Social Network Data Collection
Case 1	May 2013 – Jun 2014	Jun – Jul 2017
Case 2	Nov – Dec 2017	Nov 2017 – Feb 2018
Case 3	December 2018	Aug – Sept 2018

Case 1

Case 2

130
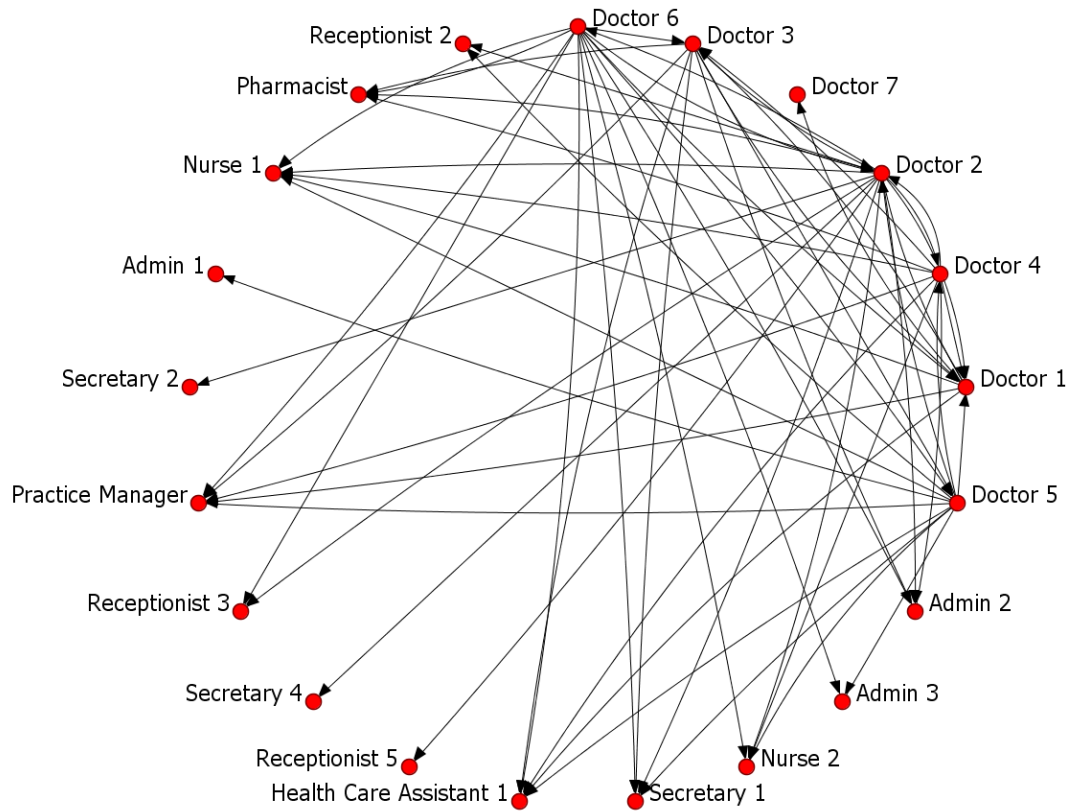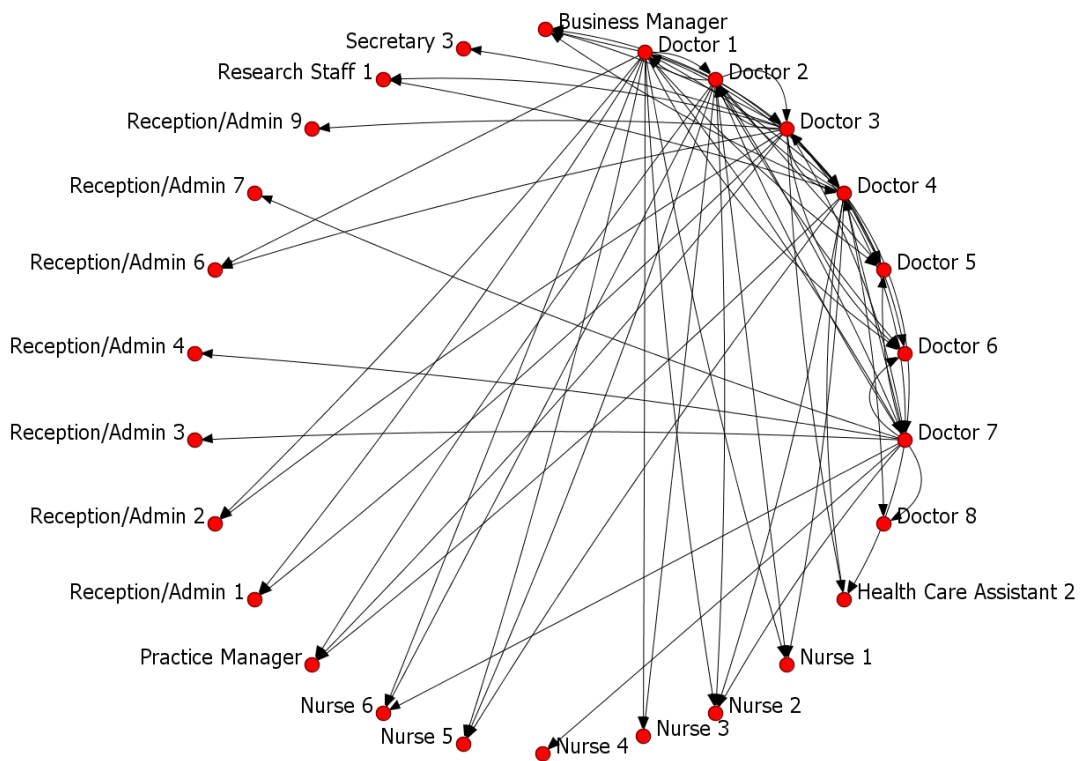
Case 3
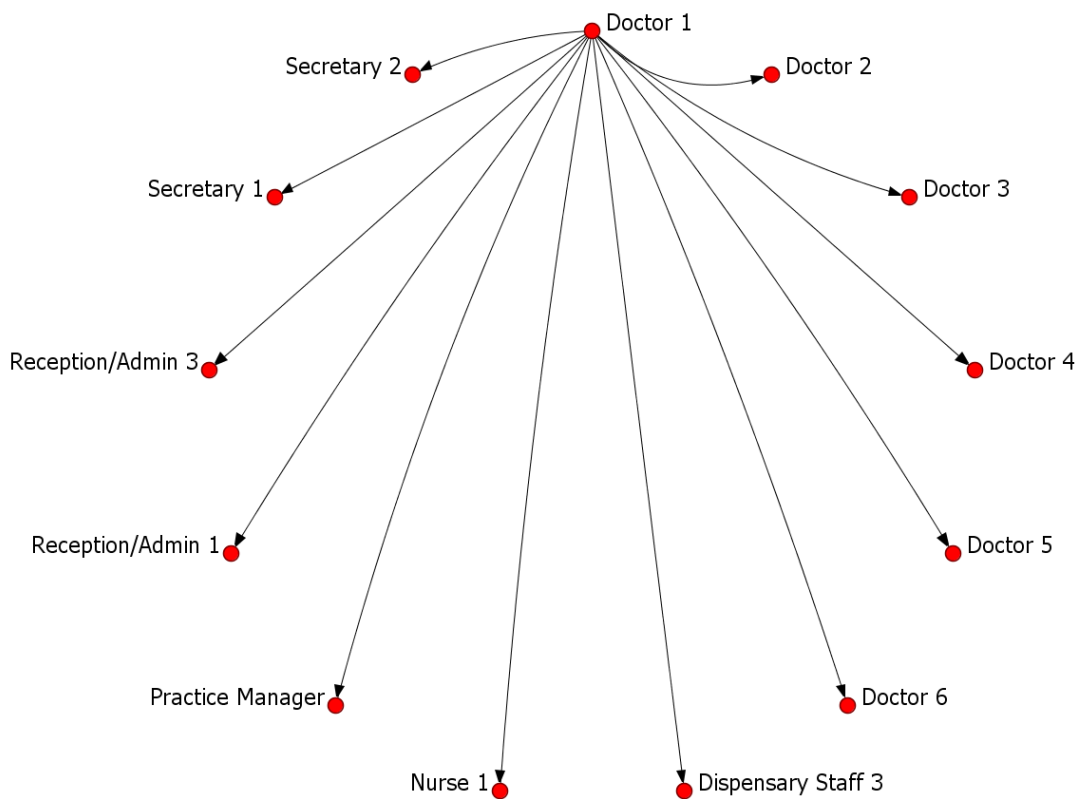
5.2.6 How likely are GP's to receive feedback from the colleagues nominated?

When using a networks perspective, the frequency that nominated colleagues respond to provide feedback can be demonstrated using a reciprocity measure. Reciprocity in this case calculates the number of nomination ties reciprocated with a response. Exploring reciprocation through the number of colleagues who provide feedback when nominated is important, as a low response rates to feedback requests will require additional colleagues to be nominated until the doctor reaches a minimum of 12 responses. This will require additional time commitment for doctors and also have a potentially significant impact on their ability to successfully revalidate (a factor already highlighted to affect which colleagues a doctor nominates). Across all cases, the lowest percentage of reciprocated ties for a doctor was 56% (Case 2, Doctor 1), however 9 of the 12

131

doctors providing nomination data across all cases had over 80% of nomination ties reciprocated (Table 18). The average number of feedback requests reciprocated with a response for all 12 doctors is 87.6%, clearly demonstrating that when nominated to provide colleague feedback, the vast majority of those nominated usually respond. The next section will now explore the extent to which doctors send reciprocal nominations to one another when completing an MSF assessment.

Table 18. Reciprocity scores for colleagues providing feedback

Case 1	Reciprocity	Case 2	Reciprocity	Case 3	Reciprocity
Doctor 1	1.000	Doctor 1	0.563	Doctor 1	0.800
Doctor 2	0.857	Doctor 2	0.917	-	-
Doctor 3	1.000	Doctor 3	1.000	-	-
Doctor 4	1.000	Doctor 4	0.929	-	-
Doctor 5	1.000	Doctor 7	0.846	-	-
Doctor 6	1.000	-	-	-	-
Case Average	0.976		0.851		0.800
Combined Average			0.876		

Figure 11. Nomination vs. response networks

Case 1   Black lines = Nomination, Blue lines = Provided feedback

132
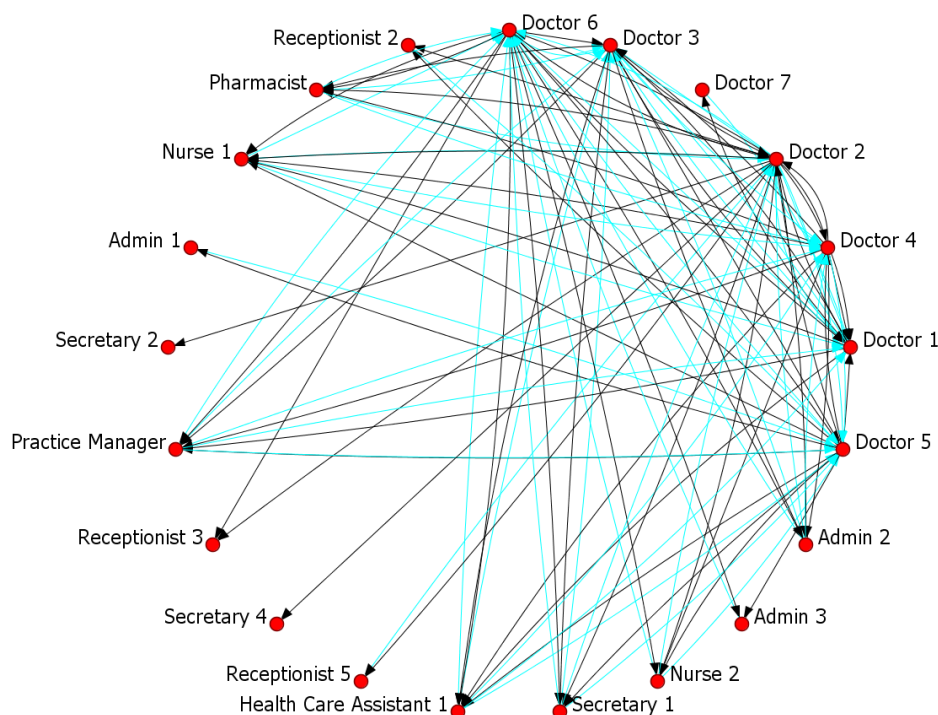
Case 2
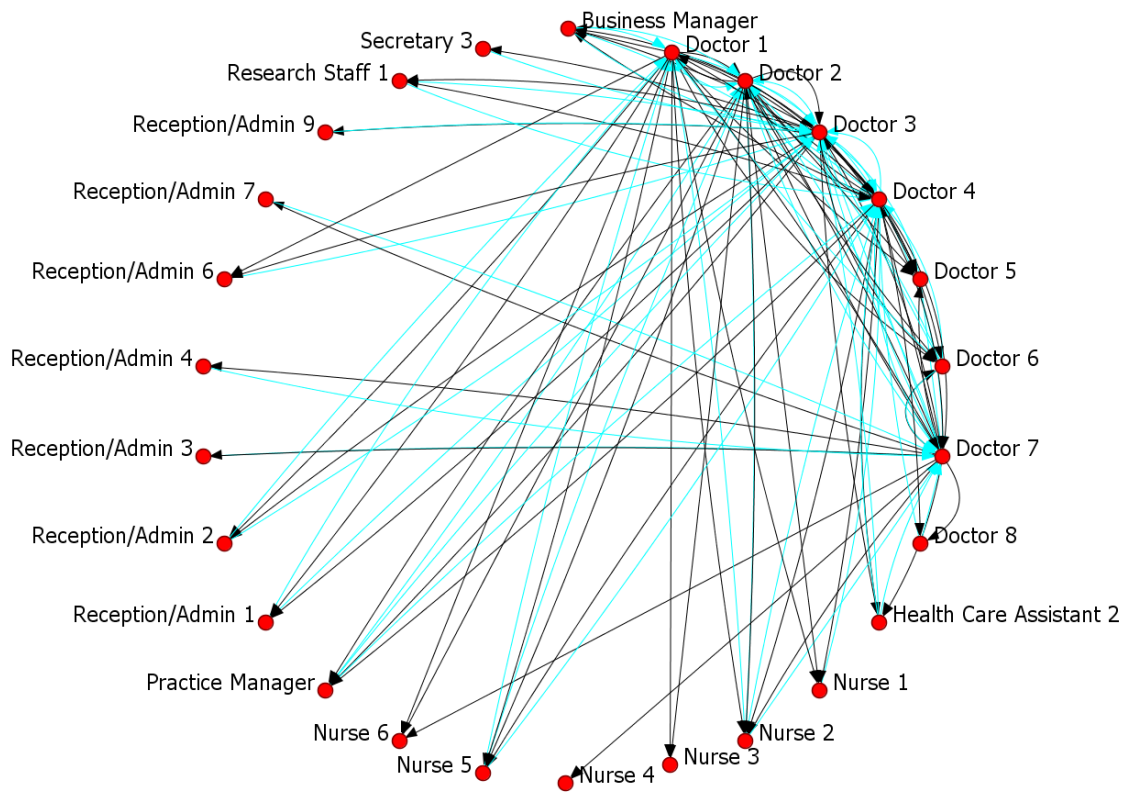
Case 3
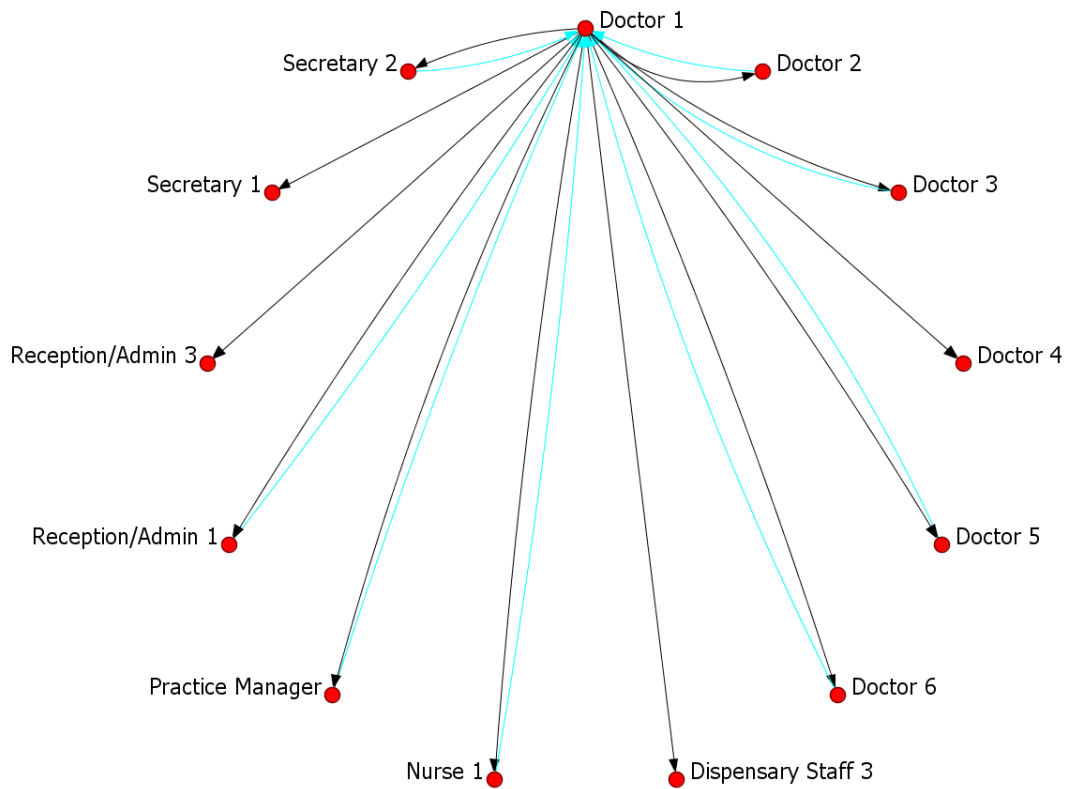
5.2.7 Do GP's Nominate other Doctors whom Nominated Them?

All doctors licensed to practice medicine in the UK have to Revalidate, and therefore each doctor must complete MSF assessments at least once every five years (General Medical Council, 2012a). As this study findings have shown, doctors within the study are more likely to be friends with other doctors than colleagues of other occupations, and social relationships were highlighted by many doctors at interview as influencing their nomination choices. What may also be interesting to explore however is the extent to which doctors reciprocally nominate one another when completing MSF assessments. As (Bullock *et al.*, 2009, p.519) previously highlighted, when nominating ratees for high stakes MSF assesments, doctors may be prone to *'collude [in order] to give each other favourable results'.* There is no direct evidence within this PhD study that collusion occurs. However, as with the reasons suggested for nominating colleagues that are socially close to a ratee, reciprocal patterns of nominations between doctors may, as Bullock *et al.* (2009) hypothesise, be indicative of a bias towards expecting favourable results.

In order to measure the extent to which reciprocal nominations between doctors occur, a simple reciprocation calculation at the dyadic level could be performed. However, exploring the structure of tie formation within the nomination networks at the triadic level provides additional benefits by understanding the extent to which reciprocal nominations may be influential beyond the dyadic level.

Transitivity Index

The transitivity index for the nomination networks are is displayed below in Table 19. For these networks, the transitivity index corresponds only to the nodes within

the network that sent or received (or both) a nomination tie (i.e. isolate nodes are remove). Transitivity is high within the nomination networks of Cases 1 and 2, with triads more likely to be transitive within these networks than intransitive (Case 1 = 54.3%, Case 2 = 60.9% transitive triads). Case 3 has a transitivity score of zero for the nomination network as only one doctor sent nominations (therefore, all triads must be intransitive). The values for Cases 1 and 2 are particularly high considering only 55.26% actors received a nomination in Case 1 and 61.90% in Case 2, demonstrating that of those that receive a nomination, they often receive nominations from more than one doctor. All doctors sending nominations within Cases 1 and 2 are connected to one another either unidirectionally or reciprocally, however this result may not be surprising due to the small number of doctors employed at each site in comparison to a large multisite GP practice or secondary care facilities for example.

Table 19. Transitivity scores within nomination networks

Measure	Case 1	Case 2	Case 3
Transitivity	0.543	0.609	0.000

Triad Census

Figure 12. Triad census diagrams (Batagelj and Mrvar, 2001)
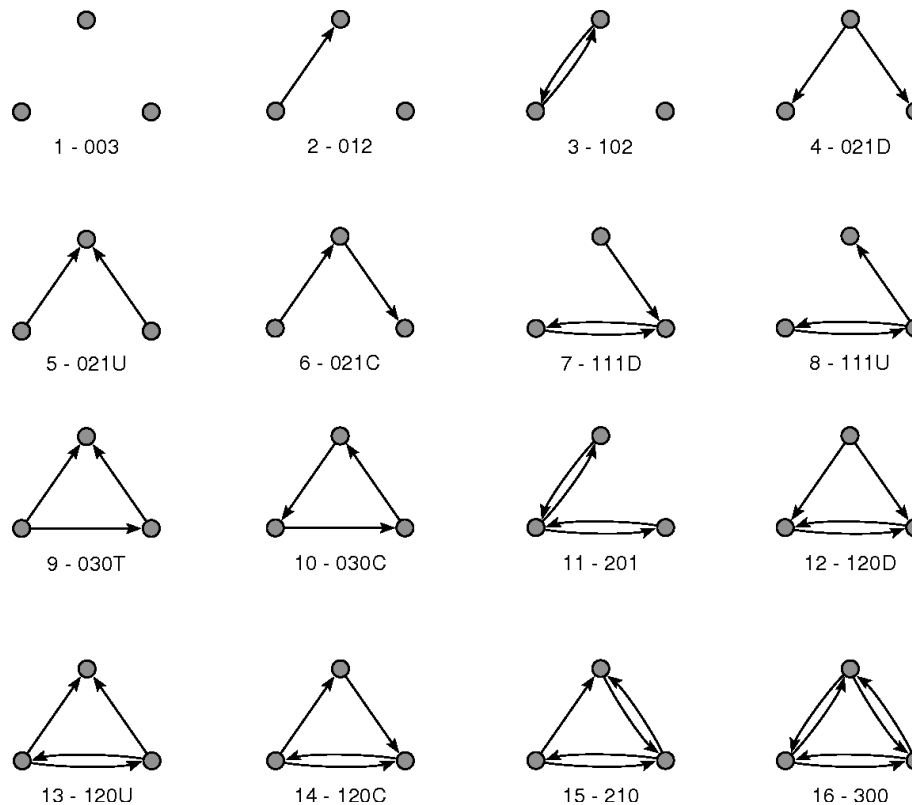
Adapted from Batagelj, V., & Mrvar, A. (2001). A subquadratic triad census algorithm for large sparse networks with small maximum degree. Social Networks, 23, 237-243.

Figure 11 demonstrates that due to only one nominating doctor available in Case 3, the nomination network contains only unidirectional ties and therefore reciprocal nominations are not able to be explored. For both Cases 1 and 2, it is unsurprising that are large percentage of empty triplets or triplets with a single tie in the networks (triplet states 003 and 012), as the majority of actors in these networks could not send ties to each other (except for doctors sending nominations) (Figure 12, Table 20). What is of interest however is the triplet states with reciprocal ties. Case 1 contains no completely connected triplets (state 300)

136

but does consist of four near complete triplets (state 210). However Case 2 in comparison contains nine nearly complete or complete triplets, demonstrating that for those doctors sending nomination ties in Case 2, it was highly common for three doctors to reciprocally nominate each other. This differing findings between Case 1 and 2 may be affected by the time delay in the collection of social ties and nominations at Case 1, or the date at which each doctor completed their MSF (Case 2 completed the nominations simultaneously).

In order to explore the extent to which social relationships may relate to the rater nomination choices made by doctors, a probabilistic approach is adopted using exponential random graph models (ERGM).

Table 20. Triad census of nomination networks

Triadic State	Case 1		Case 2	
	Count	%	Count	%
003	643	48.35	1596	61.38
012	362	27.22	557	21.42
102*	15	1.13	50	1.92
021D	175	13.16	248	9.54
021U	8	0.60	0	0
021C	27	2.03	11	0.42
111D*	0	0	0	0
111U*	32	2.41	75	2.88
030T	42	3.16	10	0.38
030C	1	0.08	0	0
201*	1	0.08	0	0
120D*	4	0.30	1	0.04
120U*	13	0.98	43	1.65
120C*	4	0.30	0	0
210 *	3	0.23	4	0.15
300*	0	0	5	0.19

Triadic states with reciprocal ties

137

5.3 The Impact of Social Relationships on Rater Selection Choices

The results thus far have explored descriptively the social and nomination networks for each of the three cases in the study, whilst exploring qualitatively the attitudes towards Revalidation and the factors impacting nomination choices from the perspective of doctors. A number of factors have been discussed by doctors as influencing their nomination choices, with the majority of doctors highlighting social relationships to be a factor. This final section will now explore statistically the relationship between socialising, trust and nominations using ERGM models. By modelling the network structures and nodal attributes of the actors within the study, this section advances knowledge surrounding nomination biases for MSF assessments by identifying the extent to the which social and nomination ties coexist between equivalent actors in the study beyond what would be expected randomly.

The socialising and trust networks from all three practices are modelled and reported below. An overview of the parameters included in the final models can be seen in Figure 13 with the parameter estimates and associated significance detailed in Table 21. The models for each case were developed and refined until a good model fit was reached.

5.3.1 Socialising Models

In terms of socialising, the structural configurations demonstrated strong similarities across each of the three cases. Firstly, where ties do occur in the networks, there is a significant positive tendency for these ties to be reciprocated. All cases demonstrate significant clustering within the networks, with a significant negative tendency towards open triangles (simple 2-path) and a significant

positive tendency towards transitive closure. A negative tendency existed towards cyclic closure within each of the three cases, however this configuration was not significant for Case 3. The out degree of actors within the model varied, however this variation was not significant. In terms of popularity, there was a negative tendency towards in-degree variation, marginally significant only at Case 1.

Unlike the structural configurations within the model, the attribute based configurations demonstrated variation between the three cases. Consistent across each model was a highly significant and positive tendency towards actors sending ties to alters of the same occupation, and a negative tendency towards sending ties alters of the same gender (significant only in Case 2). Case 1 and Case 3 demonstrated a negative tendency towards sending ties to alters of the same age group, however a significant positive tendency towards homophily by age existed within Case 2. Finally, a similar duration of an employment within a case had little impact on the structure of tie formation within all three models, with again a positive tendency in Cases 1 and 3 but negative tendency within Case 2.

5.3.2 Trust Models

Much like the socialising models, ties again were significantly more likely to be reciprocated than non-reciprocated. All cases demonstrate significant clustering within the networks, with a significant negative tendency towards open triangles (simple 2-path) and a significant positive tendency towards transitive closure. A negative tendency existed towards cyclic closure within each of the three cases, however this configuration was only significant at Case 1. The out degree of actors within the model varied, with this variation significant at Case 1 and 3. In

139

terms of popularity, there was a neutral to negative tendency towards in-degree variation, however this was not significant in any of the cases.

Similar again to the socialising models, the attribute-based configurations of the trust models demonstrate some variation between the three cases. Consistent across each trust model was a highly significant and positive tendency towards actors sending ties to alters of the same occupation. A negative tendency towards sending ties to actors of the same gender was present in Case 1 and 2, however a positive tendency towards gender homophily existed in the Case 3 model (all not significant). Case 1 demonstrated a negative tendency towards sending ties to alters of the same age group, however a positive tendency towards homophily by age existed within Case 2 and 3 (significant in Case 2). Finally, again like the socialising models, a similar duration of an employment within a case had little impact on the structure of tie formation within all three models, with a neutral tendency in Case 1, marginally significant negative tendency in Case 2 and a positive but non-significant tendency in Case 3.

Summary

Overall, the ERGM models demonstrate close similarities in terms of network structure for the socialising and trust networks within cases. This result is perhaps unsurprising based on the QAP results on page 113 demonstrating medium to strong correlation between the socialising and trust networks within each practice. What is also of interest is that despite differences in the size and locality of the GP practices involved in the study, network structures were similar across the three cases. A significant positive tendency towards reciprocity, transitivity and occupational homophily was consistently observed in all of the socialising and trust networks. This result clearly demonstrates how the formation of close
140

social subgroups formed around occupation roles observed descriptively on page

107 are significantly different to what you would expect to see in a random

network.

Figure 13. Overview of the patterns included in the one-mode socialising and trust ERGM (p* Model)
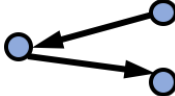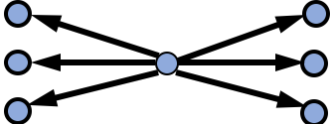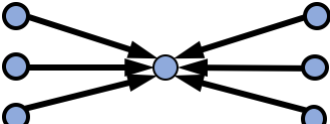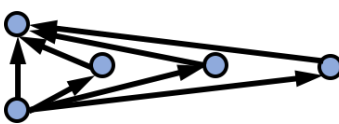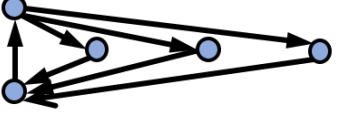
Parameter	Pattern	Interpretation
Structural effects		
Edge		Baseline tendency for actors to build ties with colleagues
Reciprocity		Tendency for actors to build ties with reciprocating colleagues
Simple 2-path		Basic tendency for actors to both send and receive ties
Alternating k-out-star		Tendency for actors to be active i.e. send ties to many colleagues
Alternating k-in-star		Tendency for actors to be popular i.e. receive ties from many colleagues
Transitive Closure		Tendency for actors to build ties with colleagues of colleagues
Cyclic Closure		Tendency of managers to build ties with colleagues in small groups without any expectation of being reciprocated
Attribute patterns (black nodes indicate actor with attribute)		
Homophily (Occupation)		Tendency for reciprocated ties to occur between actors of the same gender
Homophily (Gender)		Tendency for ties to occur between actors of the same gender
Homophily (Age)		Tendency for reciprocated ties to occur between actors of the same gender
Homophily (Duration of Employment)		Tendency for reciprocated ties to occur between actors of the same gender

141

Table 21. Maximum likelihood estimates of one-mode socialising and trust ERGM (p* Models)

Case 1 – Socialising

Variables	Model 1 Parameter (S.E)	Model 2 Parameter (S.E)	Model 3 Parameter (S.E)
Edge	-1.82 (0.11)***	-2.59 (0.71)***	-2.72 (0.76)***
Reciprocity	1.94 (0.25)***	1.85 (0.54)***	1.83 (0.55)***
Simple 2-path	-	-0.13 (0.03)***	-0.11(0.03)***
Alternating k-out star	-	0.21 (0.30)	0.30 (0.32)
Alternating k-in star	-	-0.71 (0.32)**	-0.63 (0.33)*
Transitive Closure	-	1.64 (0.15)***	1.45 (0.16)***
Cyclic Closure	-	-0.31(0.15)**	-0.30 (0.15)**
Homophily (Occupation)	-	-	0.80 (0.14)***
Homophily (Gender)	-	-	-0.11 (0.16)
Homophily (Age)	-	-	-0.08 (0.16)
Homophily (Duration of Employment)	-	-	0.05 (0.13)

Case 1 – Trust

Variables	Model 1 Parameter (S.E)	Model 2 Parameter (S.E)	Model 3 Parameter (S.E)
Edge	-1.84 (0.10)***	-3.09 (0.74)***	-3.24 (0.80)***
Reciprocity	1.77 (0.27)***	1.61 (0.46)***	1.58 (0.48)***
Simple 2-path	-	-0.16 (0.46)***	-0.15 (0.03)***
Alternating k-out star	-	0.61 (0.32)*	0.68 (0.33)**
Alternating k-in star	-	-0.29 (0.30)	-0.23 (0.31)
Transitive Closure	-	1.16 (0.15)***	0.97 (0.16)***
Cyclic Closure	-	-0.09 (0.15)	-0.10 (0.14)
Homophily (Occupation)	-	-	0.94 (0.15)***
Homophily (Gender)	-	-	-0.05 (0.18)
Homophily (Age)	-	-	-0.08 (0.18)
Homophily (Duration of Employment)	-	-	0.00 (0.15)

Case 2 – Socialising

Variables	Model 1 Parameter (S.E)	Model 2 Parameter (S.E)	Model 3 Parameter (S.E)
Edge	-2.82 (013)***	-3.92 (0.47)***	-3.58 (0.53)***
Reciprocity	2.62 (0.34)***	2.50 (0.70)***	2.47 (0.67)***
Simple 2-path	-	-0.20 (0.05)***	-0.20 (0.05)***
Alternating k-out star	-	0.32 (0.25	0.26 (0.26)
Alternating k-in star	-	-0.02 (0.23)	-0.01 (0.24)
Transitive Closure	-	1.76 (0.19)***	1.70 (0.20)***
Cyclic Closure	-	-0.53 (0.22)**	-0.53 (0.21)**
Homophily (Occupation)	-	-	0.66 (0.14)***
Homophily (Gender)	-	-	-0.58 (0.22)***
Homophily (Age)	-	-	0.37 (0.14)***
Homophily (Duration of Employment)	-	-	-0.07 (0.21)

Case 2 – Trust

Variables	Model 1 *Parameter (S.E)*	Model 2 *Parameter (S.E)*	Model 3 *Parameter (S.E)*
Edge	**-2.33 (0.11)***	**-2.83 (0.60)***	**-2.81 (0.65)***
Reciprocity	**1.49 (0.33)***	**2.17 (0.55)***	**1.99 (0.56)***
Simple 2-path	-	**-0.21 (0.04)***	**-0.19 (0.04)***
Alternating k-out star	-	0.05 (0.27)	0.05 (0.27)
Alternating k-in star	-	-0.03 (0.23)	0.00 (0.23)
Transitive Closure	-	**1.48 (0.16)***	**1.41 (0.16)***
Cyclic Closure	-	**-0.61 (0.20)***	**-0.64 (0.19)***
Homophily (Occupation)	-	-	**0.80 (0.14)***
Homophily (Gender)	-	-	-0.33 (0.21)
Homophily (Age)	-	-	**0.47 (0.14)***
Homophily (Duration of Employment)	-	-	**-0.38 (0.23)***

Case 3 – Socialising

Variables	Model 1 *Parameter (S.E)*	Model 2 *Parameter (S.E)*	Model 3 *Parameter (S.E)*
Edge	**-2.44 (0.15)***	**-2.97 (0.63)***	**-3.21 (0.63)***
Reciprocity	**2.08 (0.38)***	**1.90 (0.70)***	**1.84 (0.67)***
Simple 2-path	-	**-0.28 (0.07)***	**-0.28 (0.07)***
Alternating k-out star	-	**0.51(0.30)***	0.47 (0.31)
Alternating k-in star	-	-0.21 (0.31)	-0.23 (0.31)
Transitive Closure	-	**1.33 (0.21)***	**1.32 (0.21)***
Cyclic Closure	-	-0.17 (0.23)	-0.18 (0.23)
Homophily (Occupation)	-	-	**0.52 (0.17)***
Homophily (Gender)	-	-	0.28 (0.24)
Homophily (Age)	-	-	-0.13 0.29)
Homophily (Duration of Employment)	-	-	0.30 (0.19)

Case 1 – Trust
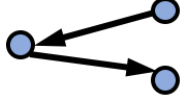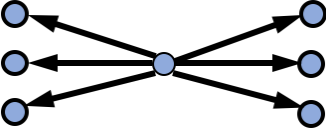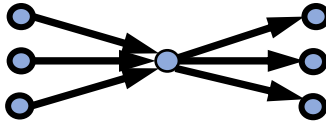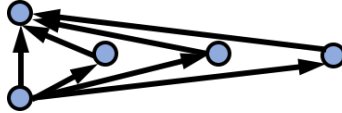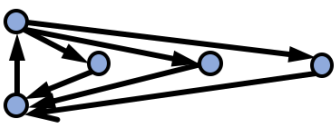
Variables	Model 1 *Parameter (S.E)*	Model 2 *Parameter (S.E)*	Model 3 *Parameter (S.E)*
Edge	**-2.26 (0.14)***	**-3.32 (0.78)***	**-3.56 (0.80)***
Reciprocity	**2.08 (0.34)***	**2.79 (0.48)***	**2.68 (0.50)***
Simple 2-path	-	**-0.19 (0.06)***	**-0.20 (0.06)***
Alternating k-out star	-	**0.85 (0.33)***	**0.81 (0.31)***
Alternating k-in star	-	-0.01 (0.36)	-0.01 (0.36)
Transitive Closure	-	**0.66 (0.19)***	**0.66 (0.19)***
Cyclic Closure	-	-0.23 (0.19)	-0.25 (0.19)
Homophily (Occupation)	-	-	**0.66 (0.20)***
Homophily (Gender)	-	-	0.18 (0.22)
Homophily (Age)	-	-	0.24 (0.22)
Homophily (Duration of Employment)	-	-	0.29 (0.20)

5.3.3 Nomination Models

The network of nominations for Case 1 and 2 was modelled in order to explore the patterns of tie formation when doctors nominate their colleagues for MSF. The nominations of Case 3 was not modelled due to only one doctor sending ties, thus causing significant challenges in reliably modelling the data due to limited ties available for exchange within the model and a very high multiplication factor needed to converge any model. The nominations network is directed, with six doctors sending ties in Case 1 and five doctors sending ties in Case 2. Ties could not be reciprocated, except between the five doctors who were making nominations.

Unlike the socialising and trust networks, the nomination networks are not expected to behave as 'usual' self-organising social networks due to requirements of the nomination process (i.e. doctors must to choose colleagues from various occupational roles and there is no opportunity to reciprocate ties other than between nominating doctors). As the inclusion of attribute parameters in ERGM models should be theoretically driven, and no homophily was observed in the descriptive analysis, no attribute parameters were included in the final nomination models. Actor attributes previously observed by authors to impact on the scores received by a doctor (including age, gender, occupation and ethnicity) were trialled in the development of the nomination models, yet as expected from the descriptive analysis none of these parameters had a significant effect on nomination choices.

Figure 14. Overview of the patterns included in the one-mode nominations ERGM (p* Model)

Parameter	Pattern	Interpretation
Structural effects		
Edge		*Baseline tendency for actors to build ties with colleagues*
Reciprocity		*Tendency for actors to build ties with reciprocating colleagues*
Simple 2-path		*Basic tendency for actors to both send and receive ties*
Alternating k-out-star		*Tendency for actors to be active i.e. send ties to many colleagues*
Alternating k-in-out star		*Tendency for actors to send ties to different actors than whom they received ties*
Transitive Closure		*Tendency for actors to build ties with colleagues of colleagues*
Cyclic Closure		*Tendency of managers to build ties with colleagues in small groups without any expectation of being reciprocated*

An overview of the parameters included in the final models can be seen in Figure 14 with the parameter estimates and associated significance detailed in Table 22. As results demonstrate, small differences existed in the network structures of nominations between the two cases. Although it may not be unusual to observe differences in network structure, it is likely that some of these differences may be attributable to the time delay in nomination vs. social relationships data collection at Case 1. As a result, the validity of the Case 1 model should be considered weaker than that of Case 2, however it is still informative in understanding the interplay between social relationships and nominations.

145

Summary

In line with descriptive findings of page 107, the ERGM results demonstrate the potential of collusory nomination behaviours in both of the cases. A significant positive tendency exists towards transitive closure occurring with both cases, with doctors at Case 2 demonstrating a tendency (although not significant) towards reciprocating a nomination tie if received, and a negative tendency towards nominating colleagues whom hadn't also nominated them. Case 1 demonstrated a negative tendency towards reciprocity and a positive tendency towards nominating different colleagues than those whom nominated them, however this result is less reliable than that of Case 2 due to the completeness of the data.

Table 22. Maximum likelihood estimates of one-mode nomination ERGM (p* Models)

Case 1 – Nominations

Variable	Model 1	Model 2
	Parameter (S.E)	*Parameter (S.E)*
Edge	**-1.11 (0.16)*****	21.02 (30.47)
Reciprocity	**1.73 (0.61)*****	**-2.27 (1.06)****
Simple 2-path	-	**-0.26 (0.15)***
Alternating k-out star	-	-11.75 (15.29)
Alternating k-in-out star	-	0.95 (1.11)
Transitive Closure	-	**1.50 (0.24)*****
Cyclic Closure	-	0.15 (0.43)

Case 2 – Nominations

Variable	Model 1	Model 2
	Parameter (S.E)	*Parameter (S.E)*
Edge	**-2.33 (0.25)*****	-7.36 (6.06)
Reciprocity	**2.34 (0.60)*****	2.49 (6.30)
Simple 2-path	-	-0.31 (0.30)
Alternating k-out star	-	3.07 (3.12)
Alternating k-in-out star	-	-3.94 (4.95)
Transitive Closure	-	**0.87 (0.34)*****
Cyclic Closure	-	0.55 (1.84)

Finally, in order to finally answer the research question of *'to what extent do social relationships within healthcare teams impact the rater nomination choices made by UK GP's?',* multiplex ERGM's were performed to explore both the structure of tie formation in social networks (Networks A) and the nominations networks (Networks B), but also to explore the tendencies for doctors to send ties and receive ties to the same colleagues in both networks. Within the multiplex model, parameters previously adopted for the one mode models were again trialled and included as they previously demonstrated a good model fit. Multiplex parameters were subsequently included to explore associations between the two networks. These included the parameters: Edge AB, Reciprocity AB, Mixed 2-path AB and Mixed 2-path BA (Figure 15).

In terms of statistically exploring the relationship between socialising, trust and nominations, only Case 1 and 2 networks are analysed. Case 3 is again not modelled due to the reasons of network size and lack of completeness stated above. Also, as with the nomination model for Case 1 above (Table 22), confidence in the interpretability of structural effects is also is lower in the multiplex model. However, although social relationships may have formed or dissolved in the time between nominations and mapping the social networks, the multiplex parameters provide an indication of the potential impact of social relationships on nominations at the practice.

5.3.4 Socialising vs. Nomination Models

An overview of the parameters included in the final multiplex models can be seen in Figure 15. As expected, the structural effects significant in the one-mode

models are also significant within the multiplex models (i.e. Reciprocity A, Transitive Closure B etc.) (Table 23). Of the one-mode attribute patterns, although not included in the nomination models, in line with convention reflecting the often strong effect of gender homophily on tie formation, gender is controlled for within the nomination network of the final multiplex model but has a negative tendency which is largely not significant. Occupational homophily is included in the socialising network due to its significant demonstrable impact in the one-mode models of socialising and trust.

Importantly, the results of the multiplex parameters demonstrate that in both cases, a positive tendency exists towards doctors sending a nomination to those whom they also socialise with (although this parameter is not statistically significant). Interestingly, a positive tendency also exists (and is highly significant at Case 2) for doctors whom receive a socialising tie from a colleague, to send these colleagues a nomination tie.

5.3.5 Trust vs. Nomination Models
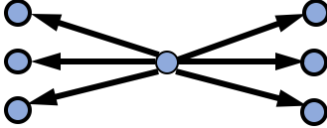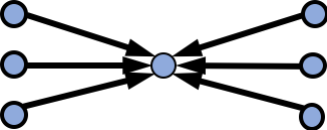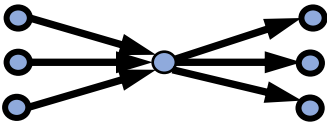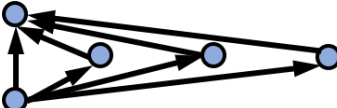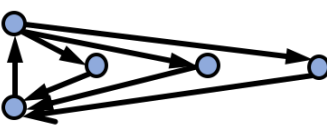
Much like the socialising vs. nomination model, the structural effects significant in the one mode trust and nomination models are also largely significant within the multiplex trust vs. nomination models (Table 24). Highly significant patterns of occupational homophily exist within the trust network of the multiplex models, however there is also a marginally positive tendency towards gender homophily in the nomination network of Case 2. This result can likely be explained by the majority of doctors sending ties in the nomination network being male who, as well as nominating mainly female colleagues, did also largely nominate each other.

148

In terms of the multiplex parameters, much like the socialising vs. nominations model a positive tendency is observed towards raters nominating those whom they trust (which is highly significant at Case 2). Interestingly, a positive tendency also exists, again highly significant at Case 2, for ratees whom receive a trust tie from a colleague to nominate these colleagues.

Summary

What these multiplex models demonstrate is that there are clear and observable cross network patterns of tie formation between the socialising/trust and nomination networks indicating social relationships to be a factor in nomination choices. This finding fits the narrative from the interview data that social relationships do impact rater selection choices, and that subsequently doctors may select those raters whom they believe will provide positive feedback. However, i) the significance of some of multiplex parameters, ii) the differences between the Case 1 and 2 model results and iii) the varying factors ratees describe at interview as impacting nomination choices all point towards a need to adopt a more nuanced and considered evaluation of nomination bias in respect to social relationships.

Figure 15. Overview of the patterns included in the multiplex ERGM (p* Model)

Parameter	Pattern	Interpretation
Structural effects		
Edge		Baseline tendency for actors to build ties with colleagues
Reciprocity		Tendency for actors to build ties with reciprocating colleagues
Simple 2-path		Basic tendency for actors to both send and receive ties
Alternating k-out star		Tendency for actors to be active i.e. send ties to many colleagues
Alternating k-in star (Network A Only)		Tendency for actors to be popular i.e. receive ties to many colleagues
Alternating k-in-out star (Network B Only)		Tendency for actors to send ties to different colleagues in which they received ties
Transitive Closure		Tendency for actors to build ties with colleagues of colleagues
Cyclic Closure		Tendency of managers to build ties with colleagues in small groups without any expectation of being reciprocated
Attribute related patterns (black nodes indicate actor with attribute)		
Homophily (Occupation) (Network A Only)		Tendency for ties to occur between actors of the same occupation
Homophily (Gender) (Network A Only)		Tendency for ties to occur between actors of the same gender
Multiplex network patterns		
Network A ⟶		Network B ⟶
Edge AB		Tendency for a tie occurring in Network A, to also occur in Network B
Reciprocity AB		Tendency for a tie to occur in Network A, to be reciprocated with a tie in Network B
Mixed 2-path AB		Basic tendency for actors to send ties in Network B and receive ties in Network A
Mixed 2-path BA		Basic tendency for actors to send ties in Network A and receive ties in Network B

*Network A = Socialising or Trust, Network B = Nominations

150

Table 23. Maximum likelihood estimates of multiplex ERGM (p* Models) – socialising vs. nominations

Variable	Case1		Case 2	
	Model 1	Model 2	Model 1	Model 2
	Parameter (S.E)	Parameter (S.E)	Parameter (S.E)	Parameter (S.E)
Unimodal Patterns				
Edge A	-2.74 (0.74)***	-2.71 (0.76)***	-3.42 (0.52)***	-3.47 (0.63)***
Edge B	22.48 (0.87)***	26.66 (0.66)***	-8.38 (4.21)**	-7.94 (4.84)*
Reciprocity A	1.84 (0.55)***	1.86 (0.52)***	2.51 (0.69)***	2.62 (0.74)***
Reciprocity B	-2.29 (1.06)**	-2.31 (1.05)**	3.04 (3.12)	1.60 (4.04)
Simple 2-path A	-0.11 (0.03)***	-0.11 (0.03)***	-0.21 (0.05)***	-0.21 (0.06)***
Simple 2-path B	-0.26 (0.15)*	-0.26 (0.15)*	-0.35 (0.29)	-0.32 (0.31)
Alternating k-in star A	-0.62 (0.33)*	-0.62 (0.33)*	-0.01 (0.23)	-0.03 (0.25)
Alternating k-out star A	0.30 (0.31)	0.27 (0.32)	0.25 (0.25)	0.38 (0.26)
Alternating k-out star B	-12.48 (0.47)***	-14.56 (0.38)***	3.70 (2.21)*	3.52 (2.58)
Alternating k-in-out star B	1.05 (1.04)	0.85 (1.06)	-0.70 (2.28)	-0.32 (2.42)
Transitive Closure A	1.45 (0.16)***	1.45 (0.17)***	1.71 (0.18)***	1.62 (0.19)***
Transitive Closure B	1.51 (0.25)***	1.49 (0.24)***	0.88 (0.30)***	0.85 (0.32)***
Cyclic Closure A	-0.31 (0.15)**	-0.32 (0.15)**	-0.53 (0.22)**	-0.57 (0.23)**
Cyclic Closure B	0.13 (0.44)	0.16 (0.44)	0.19 (1.20)	0.32 (1.41)
Homophily A (Role)	0.80 (0.14)***	0.78 (0.14)***	0.62 (0.15)***	0.56 (0.16)***
Homophily B (Gender)	-0.12 (0.14)	-0.12 (0.14)	-0.58 (0.23)**	-0.48 (0.36)
Multiplex Patterns				
Edge AB	-	0.41 (0.34)	-	0.36 (0.38)
Reciprocity AB	-	0.14 (0.46)	-	1.54 (0.54)***
Mixed 2-path AB	-	0.00 (0.02)	-	-0.03 (0.03)
Mixed 2-Path BA	-	-0.02 (0.02)	-	-0.08 (0.06)

*Network A = Socialising, Network B= Nominations

Table 24. Maximum likelihood estimates of multiplex ERGM (p* Models) – trust vs. nominations

Variable	Case1		Case 2	
	Model 1	Model 2	Model 1	Model 2
	Parameter (S.E)	*Parameter (S.E)*	*Parameter (S.E)*	*Parameter (S.E)*
Unimodal Patterns				
Edge A	**-3.25 (0.75)***	**-3.21 (0.76)***	**-2.67 (0.62)***	**-3.62 (0.68)***
Edge B	**14.56 (1.35)***	**27.97 (0.63)***	**-14.51 (2.83)***	**-12.69 (3.30)***
Reciprocity A	**1.60 (0.47)***	**1.58 (0.48)***	**2.12 (0.56)***	**2.03 (0.56)***
Reciprocity B	**-2.32 (1.07)**	**-2.28 (1.07)**	2.34 (3.43)	1.39 (4.00)
Simple 2-path A	**-0.14 (0.03)***	**-0.14 (0.03)***	**-0.20 (0.04)***	**-0.18 (0.04)***
Simple 2-path B	-0.25 (0.16)	**-0.26 (0.15)***	-0.35 (0.31)	-0.38 (0.32)
Alternating k-in star A	-0.22 (0.32)	-0.26 (0.33)	-0.02 (0.22)	-0.13 (0.25)
Alternating k-out star A	**0.65 0.32)**	**0.64 (0.32)**	-0.01 (0.29)	0.12 (0.27)
Alternating k-out star B	**-8.52 (0.70)***	**-15.28 (0.37)***	**6.76 (1.50)***	**5.77 (1.75)***
Alternating k-in-out star B	0.92 (1.05)	0.84 (1.09)	-1.23 (2.54)	-0.24 (2.77)
Transitive Closure A	**0.97 (0.17)***	**0.95 (0.16)***	**1.43 (0.17)***	**1.32 (0.16)***
Transitive Closure B	**1.50 (0.25)***	**1.48 (0.25)***	**0.87 (0.33)***	**0.82 (0.31)***
Cyclic Closure A	-0.11 (0.15)	-.010 (0.15)	**-0.64 (0.19)***	**-0.74 (0.20) ***
Cyclic Closure B	0.16 (0.46)	0.16 (0.44)	0.47 (1.37)	0.42 (1.48)
Homophily A (Role)	**0.93 (0.16)***	**0.95 (0.16)***	**0.77 (0.14)***	**0.86 (0.17)***
Homophily B (Gender)	-0.09 (0.16)	-0.08 (0.15)	-0.27 (0.20)	**0.56 (0.32)***
Multiplex Patterns				
Edge AB	-	0.42 (0.38)	-	**1.23 (0.42)***
Reciprocity AB	-	0.08 (0.46)	-	**1.26 (0.46)***
Mixed 2-path AB	-	0.04 (0.02)	-	0.02
Mixed 2-Path BA	-	-0.03 (0.03)	-	0.03

*Network A = Socialising, Network B= Nominations

152

CHAPTER 6. DISCUSSION

6.1 Socialising and Trust between Colleagues within General Practice

Staff teams within healthcare organisations can be understood as a set of social actors and the social rules which govern the relations between them (Quinlan & Robertson, 2010). This research has contributed new knowledge to the structures and patterns of social relations between staff within healthcare teams by exploring socialising and trust within the general practice setting in the UK.

In terms of network structure, variation was observed between the socialising and trust networks of all three cases. Case 1 staff socialised and trusted more colleagues on average compared to those within Cases 2 and 3. Staff in Cases 2 and 3 had more colleagues who they trusted compared with the number of colleagues they socialised with. However, the reverse was true in Case 1. Overall, individual staff frequently socialised with and trusted the same colleague(s). Differences between the trust and socialising networks highlighted that these two functional indicators of social relationships should be treated separately.

Although no previous study has explored both the socialising and trust networks of staff in a healthcare setting highlighting the unique contribution of this study, a number of studies have explored the social or personal relationships between healthcare staff using a network approach (Creswick, Westbrook & Braithwaite, 2009; Yousefi-Nooraie *et al.*, 2012; Zheng, Padman & Johnson, 2007; Zheng *et al.*, 2010). In terms of the social connectivity between healthcare staff, this study

observed network densities within the socialising and trust networks of between 12-26%. Creswick, Westbrook and Braithwaite (2009) observed a similar level of connectivity when exploring the socialising network of an interdisciplinary staff team within an emergency department (network density =18%).

Rates of reciprocation identified in this study were also similar to other network studies exploring social relationships within healthcare. Social science research has generally demonstrated that reciprocal social relationships are more close (Almaatouq et al., 2016; Buhrmester, 1990; Gershman & Hayes, 1983; Vaquera & Kao, 2008), provide greater emotional support (Stanton-Salazar & Spina, 2005), and form a superior resource of social capital (Lazega & Pattison, 2001; Vaquera & Kao, 2008) when compared to those that are not reciprocated. Each socialising and trust network in this study averaged close to 30% of reciprocated ties (with the lowest rates of reciprocation observed in Case 2), compared with 24% of reciprocated ties in the socialising network of Creswick, Westbrook and Braithwaite (2009) and 32% reciprocated ties in the friendship network of healthcare staff in Yousefi-Nooraie et al. (2012).

Many factors influence why actors may or may not reciprocate social ties in a healthcare setting, including individuals' interpretation of the network questions (De Vaus, 2013), the expectation of receiving a tie from an alter (Shulman, 1993), power dynamics and issues of seniority (Adloff & Mau, 2006). Although the networks of social relationships within healthcare teams may not be as close nor as reciprocal as has been observed in other networks of social relationships (e.g. school children, non-work based friendship networks etc.), the social capital

resources available to popular doctors and those in brokerage positions within the network may be of benefit when making rater selection choices.

This study observed the presence of social ties forming around occupational roles in what Mascia *et al.* (2015) term 'professional homophily'. This finding was reinforced by the community detection analysis clearly demonstrating, particularly within the socialising networks (Figure 7.), clustering by occupational roles. Observing the formation of homphilous social ties around occupational roles is consistent with wider healthcare network research within both primary and secondary care settings as highlighted by Creswick, Westbrook and Braithwaite (2009), *"staff largely socialise tribally, i.e. with colleagues from within their own profession"*. As well as staff within occupational roles potentially working more frequently together and being located within close proximity throughout the working day, Mascia *et al.* (2015) demonstrates that in a professional setting, actors professional backgrounds may influence connections to one another as they are more likely to share similar perspectives and levels of social capital.

Alongside professional homophily, it is also common when exploring networks of social relationships to observe the formation of homphilous ties around other demographic characteristics such as gender, age, ethnicity etc. (McPherson, Smith-Lovin & Cook, 2001). There was however no visible sign of homophilous patterns of tie formation in the socialising or trust networks based around any of the personal characteristics collected within this study (gender, age, ethnicity, occupation, full/part time working and duration of employment). One explanation may have been the limited variation in the personal characteristics of staff within this study, with a large majority of all three cases consisting of white, female staff,
155

between the ages of 45-54. Future research should look to explore how social relationships form in more diverse healthcare teams.

6.2 Selecting Raters in MSF Assessments for Revalidation

In order to understand the potential impact of social relationships on rater nominations for MSF assessments with Revalidation, it was important to firstly understand participating doctor's attitudes towards the purpose, value and significance of Revalidation. Within this study, doctors discussed that the formal process of Revalidation has bureaucratised annual appraisal, where doctors are jumping through hoops to complete a 'tick-box' administrative exercise, mirroring the findings of wider research (Curnock *et al.*, 2012; Dale *et al.*, 2016; Hill *et al.*, 2012). Doctors also demonstrated views that, contrary to the professionalism discourse purported by many stakeholders surrounding the purpose of Revalidation (Archer *et al.*, 2015b), Revalidation for many is viewed as a summative assessment, due largely to the point that there is an element of 'passing' Revalidation where *'doctors who do not engage with Revalidation can, ultimately, lose their license to practice'* (Tazzyman *et al.*, 2018, p.642). For these doctors, MSF forms a component part of this high-stakes exercise where the focus is to 'pass the test' (Ingram, Anderson & Pugsley, 2013). Although participating doctors in this study generally valued the formative potential of receiving feedback through MSF assessments, doctors who view Revalidation as a summative assessment may be more inclined to 'game' the selection of their raters (Ingram, Anderson & Pugsley, 2013) and be *'creative in the way they collect and present data for appraisal'* (Archer, Nunn & Regan de Bere, 2017, p.998).

156

For doctors within the study who discussed the process that they adopted to select raters, all participating doctors unanimously nominated raters themselves. Through informal discussions with these doctors and staff at the MSF administrative supporting service partnering this study (CFEP UK Surveys), self-selection was understood to be the dominant method of nominating colleagues for GP's nationally. This however may not be the case for all GP's and it is unknown whether many other clinical settings adopt self-selection policies. Self-selection of raters has been the most common method of selecting raters for peer feedback assessments since the early 1990's when the work of Ramsey *et al.* (1993) and subsequently Lurie *et al.* (2006) concluded that within medicine, ratees selecting their own raters does not substantially bias MSF results. However, this study adds new evidence to the literature supporting the notion that self-selection may not be the most valid method of rater selection within a regularity setting due to the potential for bias.

Doctors within this study highlighted a number of key factors impacting which colleagues they nominated for their MSF assessment. Understanding qualitatively the factors doctors themselves perceived to have influenced the colleagues they nominate was important for a number of reasons. Firstly, it was interesting to explore the extent to which, in line with previous studies (Brown *et al.*, 2014; Burford *et al.*, 2010; Hill *et al.*, 2012), doctor's themselves perceived their nomination choices were influenced by social relationships. Subsequently, if doctors discussed any tendencies towards nominating those with whom they have a social relationship, then the reasons underpinning why social relationships impact their choices could be explored. Finally, these qualitative findings were used to aid the interpretation of the quantitative findings in order to support any

157

inferences made about the potential impact of social relationships on nomination choices.

Echoing the findings of Burford *et al.* (2010), a number of doctors highlighted a desire to nominate colleagues whom they have had frequent professional contact and communication, and who have observed the doctors performance enough to be able to comment. Existing evidence suggests ratees are less likely to accept feedback and make positive changes to their practice from colleagues who they have had in sufficient work based interactions with (Bracken, Timmreck & Church, 2001; Church *et al.*, 2019). The second factor identified as influential in nomination selection, although less commonly discussed, was a desire to receive objective and honest feedback, aligning with the developmental underpinnings and traditional purpose of MSF. Importantly however, in line with the wider literature (Brown *et al.*, 2014; Burford *et al.*, 2010; Hill *et al.*, 2012) the most commonly discussed factor impacting nominations for the perspective of doctors was social relationships.

In terms of exploring bias in relation to the colleagues doctors nominate when completing MSF assessments, particularly for Revalidation, limited previous research exists. A number of studies have explored differences in feedback scores based on rater characteristics, often demonstrating differences based on factors such as length of working relationship, occupation, seniority and ethnicity (Archer J, McGraw M & Davies H, 2010; Archer & McAvoy, 2011; Ford JK, Kraiger K & Schechtman SL, 1986; Kraiger K & Ford J, 1985; Williams, Klamen & McGaghie, 2003). Although these studies highlight differences in how raters may score ratees depending on characteristics of the rater, this study demonstrated

158

no observable bias towards ratees nominating colleagues based on these characteristics, highlighting a further contribution of this study.

Doctors overwhelming nominated colleagues within their own practice (98% of nominations within the practice. These colleagues were highly likely to respond, with an average response rate of 90%, similar to response rates for doctors undertaking MSF within secondary care (Davies *et al.*, 2008; Violato, Lockyer & Fidler, 2003). The extent to which this is usual practice for MSF assessments within general practice is unknown and requires further research. In terms of doctors nominating their doctor colleagues, this study demonstrates a tendency towards nominations between doctors to be reciprocal at the triplet level. This tendency towards reciprocation could be an indication of what Bullock *et al.* (2009) hypothesise as collusory behaviours, with many doctors interviewed for the purposes of this study describing a desire for positive feedback in order to Revalidate successfully with minimal critique. There is however no direct evidence of collusion in the nominations made by participating doctors. It must also be recognised that within general practice, there is only a finite number of doctors employed in which a ratee could nominate. The extent to which reciprocation in nomination occurs in larger multisite GP practices, or within secondary care settings, is an interesting further area for future research.

6.3 The Impact of Social Relationships on Rater Selection Choices

This study confirms that, particularly within general practice, there is evidence to suggest that social relationships impact the nomination choices made by doctors. The quantitative results demonstrate a clear positive tendency towards

159

nominating those with whom a ratee socialises and/or trusts to discuss personal matters. At interview, ten of the eleven doctors interviewed discussed that social relationships did have, or had the potential to, impact the nominations for a number of reasons. Firstly, nearly half of the doctors interviewed discussed a desire to complete their MSF in a timely manner and therefore would nominate those they were socially closer to as they were more comfortable asking them and believed they would be more likely to respond. With ever increasing workloads (Roland & Everington, 2016), and the need to complete an MSF assessments satisfactorily in order to revalidate and maintain a license to practice, relying on those who are socially close to a doctor provides for doctors what could be considered a 'path of least resistance'.

What is perhaps most important to understand however is that a number of doctors interviewed for the purpose of this study directly discussed relying on social relationships when nominating raters in order to receive positive (or avoid negative) feedback. Similar to studies exploring the use of MSF in postgraduate speciality training (Brown *et al.*, 2014) and with GP's for Revalidation (Hill *et al.*, 2012), this study demonstrates that when used for what doctors perceive as a high stakes assessment, many doctors will rely on social relationships in order to secure sufficiently positive feedback in order to 'pass the test'.

In terms of the two key theoretical strands that provide differing explanations for the mechanisms underlying the consequences of networking, the findings of this study provides evidence that the social capital framework impacts the nomination choices for doctor. However, there is less evidence of social influence. Building on Putnam (2000) and Coleman (1988) theories of social capital it can be argued

160

that for ratees participating in MSF assessments for Revalidation purposes, '*social networks have value'* (Putnam, 2000, p.18). Using the resources inherent in a doctor's network of social relationships may put them at an advantage when it comes to receiving timely and positive feedback. Those who establish strong social networks may provide themselves with an increasing advantage over those with fewer social ties, a potential issue for ratees who are new to a workplace or who naturally maintain a smaller social network.

Although not every doctor interviewed discussed the same factors and reasoning behind their nomination choices, and not all ratees in the statistical analysis demonstrated a significant tendency towards nominating colleagues who they shared a social connection with, overall, the study data consistently demonstrated that social relationships are often associated with nomination choices.

The study explored the impact of homophily at the ego level by exploring which colleagues establish social relationships and who ratees nominate. However, homophily is also important at the structural level as the social environment can induce similarity of behaviours (Ferlie *et al.*, 2005). Future studies should therefore look to explore the extent to which a 'nomination homophily' exists where doctors who are socially or professionally well connected nominate in a similar way.

Finally, it is also important to highlight that there was no evidence that the rurality of the practice, the size of the workforce, nor the demographic characteristics of

the doctors had any observable impact on the factors influencing how ratees nominated their raters nor their attitudes towards MSF and Revalidation.

6.4 Limitations of the study

Firstly, exploring a network of social relationships through self-reported measures will always have its limitations. Two name generators exploring socialising and trust were chosen as measures of a social connection between colleagues due to 1) their success in previous studies and 2) the specificity in the wording (Bailey & Marsden, 1999; Burt, 1984; Burt *et al.*, 2012). Although the questions were worded in such a way as to minimise differences in interpretability, it is likely that the due to the subjective nature of social relationships there may have been some variation in how respondents interpreted the network questions. It is important to consider this variation in interpretation when exploring network measures such as reciprocity and transitivity, where the existence, or non-existence of a reciprocal tie may be affected by the respondent's interpretation of the question.

As with most social network studies collecting self-reported data through survey methods, there was an element of missing data. Missing data in quantitative network research is often more of a threat to research validity than more traditional quantitative methods of social enquiry, as unlike traditional methods, network measures often rely on data completion for accuracy. Network scientists cannot use statistical methods as easily to make inferences from wider populations based on samples, as the ties between actors within a network are interdependent. Each of the networks were close to or achieved threshold of 75% typically required for SNA data to be considered reliable (Borgatti, Carley &

162

Krackhardt, 2006). It should however be recognised that achieving response rates of 75% and above, especially when using survey methods, is particularly challenging (De Brún & McAuliffe, 2018).

Furthermore, this study collected data from three GP practices in the South West of England. In order to establish whether the findings of this study are consistent with other GP practices within the region and throughout the UK more widely, and the extent to which similar findings may be observed within secondary care settings, a larger scale study in the future is require. Furthermore, organisational structures continue to change within UK General Practice, including the formation of multisite practices and creation of Primary Care Networks. These continuing changes may impact the pool of colleagues from which a focal doctor may select raters from and may therefore impact the transferability of the study findings.

Critics may argue that the self-reported nature of data in this study to be a limitation, as individuals may not be honest or may interpret questions not as intended (Althubaiti, 2016). Alternative methods of data collection, such as ethnographic observations for example, could potentially be argued to offer an alternative 'measure' of friendship between staff members, however, the analysis would then be influenced by the researcher's own interpretation of what constitutes a social relationship.

It is also important to discuss the implications of adopting qualitative methods of data collection within this study. Qualitative research is often aligned with a social constructionist viewpoint of knowledge creation, due largely to a shared respect for the complexities of the human experience and an appreciation that any aspect

163

of someone's reality (and a researcher's participation in exploring this reality) is intertwined with other unobserved facets. Constructionists view knowledge as *"created not discovered"*, supporting the view that being a realist is not inconsistent with being a constructionist (Andrews, 2012:40). From this perspective, individuals can believe that concepts are constructed rather than discovered yet maintain that they do correspond to something within the real world (Schwandt, 2003).

Considering the social construction of information collected through qualitative methods is important to recognise as it has impacts on 1) the collection and 2) the analysis and interpretations of the data (Andrews, 2012). Firstly, it is important to recognise that the emphasis of qualitative enquiry is not a business of gathering 'truth', but is instead to collect information in which a level of knowledge can be gained. To this end, it must be recognised that the findings of this study are reminiscent of information that has been collected and interpreted by a researcher and should be considered as an informed interpretation of the observed reality.

Within this pursuit of new knowledge, the importance of context must also be considered. The context of this research was to explore social relationships and the potential association towards rater nomination choices for doctors as part of multisource feedback assessments of UK GP's. Undertaking this research within the workplace of the participants may have positively impacted the quality of information gathered due to the familiarity of participating in the MSF assessment process from the same location as the interviews took place. However, the local context of the interviews may also have impacted responses where some staff

164

may have felt less willing to speak openly due to their role in the organisational hierarchy, type of occupation, or concerns surrounding a reliance on some of the other participants in the study for their employment. Finally, the context of focussing on multisource feedback assessments for revalidation, where the (arguably summative) outcome of the process may impact a doctor's license to practice, is also important to consider. For example, both the focal doctors participating in MSF assessments, as well as the staff providing feedback, may have reported different attitudes and behaviours if this study had been focussed on MSF assessments in low stakes settings or where the potential impact on the doctor's career was less.

Along with the emphasis on context, qualitative research is distinguished by the fact that 1) it places the researcher at the centre of the data-gathering phase and 2) the researcher is the instrument by which information is collected. The researcher was not close to any of the participants in terms of prior educational or occupational similarities, nor had they any prior relationship or interactions before the study took place. The potential for researcher and participant bias in this respect was reduced, however a rapport was built up over time with many of the staff due the researcher occupying a lot of time at the study sites conducting the research. The establishment of rapport with many of the participants on daily basis may have enabled them to feel that they could speak more openly with the researcher however this affinity could heighten any concerns that the researcher is able to collect (and interpret) data in an objective, unbiased manner. The researcher as the data collection instrument for the qualitative methods also may have impacted the information collected in the study where the personal demographic and personality characteristics of the researcher may have elicited

different responses from the participants than a researcher with different characteristics.

When conducting qualitive research, quality is heavily dependent on the individual skills of the researcher (Anderson, 2010). The researcher was previously trained in conducting qualitative research in both and undergraduate and postgraduate social sciences degree programmes. Building rapport and having sufficient active listening skills had been previously practiced in multiple research projects prior to this doctoral study, however the skills of the researcher both in the collection, analysis and subsequent interpterion of the data must be considered as a potential limitation of the study.

Overall, the knowledge generated from this study should be considered socially constructed through dialogues and interactions between the researcher and the participants. This process enabled the researcher to interpret the experiences and opinions of the participants. However, the researcher's interpretation of participants experiences and beliefs must be recognised to have, potentially, been influenced by their own beliefs, values and biases.

CHAPTER 7. CONCLUSION

7.1 Summary of Key Findings

This study sought to explore the extent to which social relationships within general practice teams impact the rater nomination choices made by UK GP's in MSF assessments for Revalidation. The study responds to calls for more high quality network research in healthcare (Cunningham *et al.*, 2012), which adopts inferential analytical techniques to better understand the impact of network structures on the quality, safety and effectiveness of healthcare (Bae *et al.*, 2015). The study contributes new knowledge to the existing literature exploring the use of social network analysis to understand connectivity in order to improve the quality and delivery of healthcare within general practice (Fattore *et al.*, 2009), and provides an empirical exploration of the potential role social relationships and rater familiarity play in rater nomination choices for MSF assessments (Archer & McAvoy, 2011; Sargeant, Mann & Ferrier, 2005). Overall, colleagues within all three cases largely formed tribal patterns of social relationships around job roles. There was no observable evidence of homophily within the social networks by any other demographic characteristic. Social relationships were shown to play a significant role in the nomination choices of doctors, due partly to ratees feeling more comfortable in asking those they were socially close to, alongside a perception that these colleagues would be more likely to respond and provide more positive feedback. However, social relationships were not the only factor that impacted nomination decisions, and not all ratees are likely to rely on social relationships to the same extent when nominating.

167

7.2 Implications for Practice

Within a small sample of GP practices in the SW UK, this study has demonstrated that overall, social relationships do appear to impact the rater nomination choices made by doctors. For confirmability, the findings of this study should be validated in a wider sample of healthcare teams nationally both within, and outside, of general practice. In spite of this, the potential impact of a friendship bias to the validity of MSF results should not be underestimated.

As Ingram, Anderson and Pugsley (2013) demonstrate, when evaluating the educational impact of MSF assessments for the appraisal of medical trainees (a high stakes assessment similar to that of Revalidation), the self-selection of raters undermines the education value of MSF. In the national evaluation of Revalidation led by Sir Keith Pearson in 2017 (Pearson, 2017, p.45), Pearson concluded how the selection of raters may undermine the validity of MSF as currently used within Revalidation as *"colleagues sometimes lack the necessary objectivity, honesty and candour when providing feedback",* which may *"translate into the quality and safety of care provided to patients".* Pearson goes on to suggest that *"colleague feedback works better when the appraiser approves or recommends which colleagues are sampled, rather than the doctor selecting their 'friends'".* This recommendation is also echoed by Brown *et al.* (2014) and Ingram, Anderson and Pugsley (2013, p.842) who state that educational supervisors selecting raters rather than the subjects themselves *"would improve rater anonymity and eliminate the possibility of selection bias in choice of raters".* Finally, recent advances in the guidance to designing MSF assessments across a multitude of industries and disciplines highlights that *"raters should be selected based on some work-related interaction; there should be strong guidance against*

168

selecting them just because they know that person well (i.e. are simply friends with no work-related interaction)" (Church *et al.*, 2019, p.287).

However, despite the evidence from strategists, academics and national evaluators, at present, the GMC make recommendations on the 'types' of colleagues a doctor should nominate including:

1. Nominating colleagues from a variety of occupation roles

2. Nominating those who will give honest and constructive feedback

3. Considering colleagues after working together in difficult or challenging circumstances

Approval of nominations from the appraiser, nor any form of randomisation in the nomination process is stated as a GMC requirement of Revalidation (General Medical Council, 2018). The results of this study add further credence to arguments that the UK medical regulator should consider, despite the stated benefits to the acceptability of feedback results and feasibility of self-selecting raters (General Medical Council, 2018), consider advising or mandating against the use of unmonitored self-selection of raters in MSF assessments for Revalidation. It is recognised that changes to professional regulation are emotive since they impact on the core identities of individuals as well as the profession as a whole (Whitehead & Dent, 2001). However, if the process of Revalidation is to reassure employers, the profession, and the general public that licensed doctors are both *"up to date and fit to practice"*, then the validity and reliability of supporting evidence provided by doctors when revalidating should be of high importance.

169

7.3 Implications for Research

As far as the researcher is aware, this is the first study to apply a relational approach using social network analysis techniques to explore bias in the selection of raters for MSF assessments of doctors. This relational approach is a particular strength of the research and further studies should build similar relational approaches in order to explore the validity, efficacy and acceptability of peer assessment (Hafferty *et al.*, 2013; Michalec *et al.*, 2016).

First and foremost, research replicating this study in a larger sample of GP practices would be beneficial to demonstrate consistency (or otherwise) of the study findings in different practice sizes and organisational structures (i.e. primary care networks, federated practices etc.). The rurality of practice locations did not impact the study findings within this project, however this study did not include GP practices in densely population urban areas. Undertaking the study in more diverse healthcare teams (by gender, age, ethnicity etc.) should also be considered in order to explore any differences in 1) how social relationships form and 2) the extent to which ratees nominate those similar to them if at all. Exploring the extent to which social relationships may impact nominations in secondary care settings should be also considered due to the differing number of colleagues from a wider range of occupational roles present within these settings. As discussed above, one limitation of the social network data for the study was participant's interpretation of the name generator questions. Future research should consider the use of more objective measures of determining social relationships between colleagues through social media connections (Facebook friends, Twitter followers etc.), or ethnographic observations of informal colleague communication in the workplace.

170

Furthermore, from a patient and public involvement perspective, research exploring patients attitudes towards the rater selection process for MSF assessments of doctors is needed. As stated above, Pearson (2017, p.45) already highlights that the current model of colleague feedback within Revalidation may have negative impacts on *"the quality and safety of care provided to patients".* Therefore, as receivers of care, patients should be consulted on their attitude towards the rater selection process.

One alternative method of qualitative analysis was trialled for this study through a socio-semantic approach. Semantic analysis of qualitative data using automated processes has risen in popularity in recent decades, with automated co-occurrence and machine learning approaches overcoming many of the reliability and validity concerns of traditional qualitative scholars (Young & Munksgaard, 2018). Socio-semantic analysis adopts a networks perspective to integrating the co-occurrence of concepts discussed within the interview data, with the socialising and trust ties between the interview participants. This approach therefore looks to explore the extent to which socially connected actors share meaning structure's when discussing particular concepts, a phenomena known as cultural homophily (Basov, 2019). Building on advances in multilevel exponential random graph models (MERGM'S) (Wang *et al.*, 2013), a socio-semantic analysis was conducted on the interview and social tie data from this study under the guidance of Dr Nikita Basov at the St Petersburg State University (Russia). This analysis provided valuable insights into the shared meaning structures of socially connected actors, especially in relation to shared meanings for doctors surrounding the value of Revalidation and attitudes towards how the

171

rater selection process. However, the interviews discussed a variety of different topics and the semi-structured nature of the interview schedule reduced the depth of narrative best suited to co-occurrence concept analyses. This socio-semantic analysis, although not included as part of the thesis, may be explored in the future using more broad thematic concepts, as opposed to co-occurrence, in order to explore cultural homophily.

Finally, due to sensitivity of the data and a clear barrier to participation when discussing the project with local doctors prior to recruitment, the performance data associated to the nominations made by participating GP's was not collected. Future studies should consider combining the experimental approach of Archer and McAvoy (2011) to explore differences in MSF feedback for self vs. third party nominated/approved rater's, with the social network approach of this study to explore empirically the impact of social relationships on rater selection choices and subsequently assessment feedback. Similarly to the design of Archer and McAvoy's (2011) study, doctors whom are both performing well and those whom are experiencing difficulties should participate in order to explore if social relationships impact nomination choices similarly between these two groups. Building on advances in inferential social network analysis techniques, future studies should consider combining the analysis of rater nomination choices, social relationships and MSF scores using an Auto-logistic Actor Attribute Models (ALAAM) (Lusher et al: 2013). This modelling technique would identify significant differences in performance scores between doctors whilst controlling for the impact of their rater nomination choices to those whom they are socially close to.

172

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177

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189

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APPENDICES

Appendix 1: Validity of Multisource Feedback – Systematic Review of Reviews

Validation of Multisource Feedback in Assessing Medical Performance: A Systematic Review

Abstract

Introduction

Over the past ten years, a number of systematic reviews have evaluated the validity of multisource feedback (MSF) to assess and quality assure medical practice. The purpose of this study is to synthesise the results from existing reviews to provide a holistic overview of the validity evidence.

Methods

This review identified eight systematic reviews evaluating the validity of MSF published between January 2006 and October 2016. Using a standardised data extraction form, two independent reviewers extracted study characteristics. A framework of validation developed by the American Psychological Association (APA) was used to appraise the validity evidence within each systematic review.

Results

In terms of validity evidence, each of the eight reviews demonstrated evidence across at least one domain of the APA validity framework. Evidence of assessment validity within the domains of 'internal structure' and 'relationship to other variables' has been well established. However, the domains of content validity (i.e. ensuring MSF tools measure what they are intended to measure); consequential validity (i.e. evidence of the intended or unintended consequences MSF assessments may have on participants or wider society) and response process validity (i.e. the process of standardisation and quality control in the delivery and completion of assessments) remain limited.

Discussion

Evidence for the validity of MSF has, across a number of domains, been well-established. However, the size and quality of the existing evidence remains variable. In order to determine the extent to which MSF is considered a valid instrument to assess medical performance, future research is required to determine: 1) how best to design and deliver MSF assessments that address the identified limitations of existing tools, and 2) how to ensure involvement within MSF supports positive changes in practice. Such research is integral if MSF is to continue to inform medical performance and subsequent improvements in the quality and safety of patient care.

Key words: multisource feedback, MSF, systematic review, medical education, validity, physician

Introduction

Multisource feedback (MSF) is a method of workplace based assessment (WBA) used to facilitate the collection of feedback from colleagues, and at times patients, in order to inform on-going performance. This method of assessment has a long history of use outside of healthcare [1], however more recently it has been adopted internationally within healthcare environments, particularly within medicine, as an instrument to assess and quality-assure clinical practice [2,3].

Within medicine, MSF increasingly forms a key component of regulatory processes worldwide [4-7]. The use of MSF in regulatory settings requires an assurance for stakeholders (including patients, physicians and the regulators), that instruments have substantial validity evidence. This issue is particularly pertinent when the outcome of such assessments could have career affecting consequences for physicians (e.g. remediation or license withdrawal), and potential implications for care quality and patient safety.

The wide adoption of MSF across a multitude of medical disciplines internationally predicates an inherent need to critically evaluate evidence to support or refute its validity. Whilst a number of systematic reviews demonstrate MSF to be a valid, reliable and feasible method of performance assessment [8-11], critics regularly cite concerns around important issues that may undermine assessment validity [12-14]. Past reviews have largely focussed on specific areas of assessment validity (e.g. statistical and psychometric properties) or have explored the validity of feedback instruments in regards to particular medical specialities [8-10,15-19]. This review critically evaluated existing reviews on the validity evidence of MSF in assessing medical performance among qualified physicians in the healthcare settings, through answering the following question:

- To what extent is MSF a valid instrument to assess medical performance?

For the purpose of this review, MSF was inclusive of all colleague feedback instruments that include ratings from peers, colleagues and co-workers [20]. While patient feedback can be encapsulated within MSF assessments[21], it was not the focus of this review. In order to maintain research integrity, data included in studies that discuss patient feedback are not extracted, synthesised or reported.

Methods

We conducted a systematic review of reviews and narrative synthesis, adopting a configurative approach to the review design[22]. One author carried out a systematic search of MEDLINE, PubMed, PsycINFO, CINAHL and Cochrane Library for systematic reviews published in the English Language,

between January 2006 and October 2016. Search terms listed in Table 1. were reviewed using the Peer Review of Electronic Search Strategies (PRESS) initiative [23]. Electronic searches were supplemented with reference list searches to ensure sufficient coverage.

Two reviewers independently examined titles and abstracts (facilitated through the online systematic review application, Rayyan[24]). Inter-reviewer agreement was sought through consensus, with any disagreements resolved by a third reviewer. The criteria for inclusion were systematic reviews exploring the use of MSF for qualified physicians in any healthcare setting. Previous systematic reviews focussed on medical students were excluded due to the differing nature of performance assessment in undergraduate medical education. Due to the nature of the review of reviews methodology, non-systematic literature reviews were excluded and the grey literature was not searched. In order to standardise the inclusion process, an inclusion criteria form was developed and piloted (Table 2).

Quality assessment was conducted using a modified version of the AMSTAR checklist as adapted by SIGN [25-27]. One author conducted a full quality appraisal of all the potentially relevant reviews , after a high level of interrater reliability was reached on appraisal of a sub sample of the reviews by two authors (100%). Methodological quality of the included studies was not the main focus of this systematic review, therefore content relevance took precedence over methodological rigour [28]. However, sensitivity analyses were conducted to assess the impact of study quality on review findings (29). Sensitivity analyses test the effect of including (or excluding) review findings of differing quality on the review synthesis. In this instance, any low-quality studies that contributed no new themes to the findings were removed from the analysis.

Using a standardised data extraction form, two reviewers extracted the study characteristics from the included articles. The findings and author conclusions of articles reviewed were extracted, themed and reported in a systematic format (full study characteristics available in Supplementary Data 1). Previous studies and reviews, exploring the validity of MSF assessments within medical education, have often categorised evidence in terms of construct, criterion and/or content validity. For this review however, the themed findings were mapped against a validity framework developed by the American Psychological Association (APA), the American Educational Research Association (AERA), the and the National Council on Measurement in Education (NCME), as described by Downing [29]. The "APA framework", with its five domains of validity evidence, has been described as the '*the current standard of assessment validation*' [30]. Table 3 provides a summary of the framework adapted from Downing [29].

The analysis was synthesised using a modified narrative synthesis technique grounded in Popay et al's guidance [31]. A modified narrative synthesis relies on three non-sequential framework elements: i) developing a preliminary synthesis of findings of included studies; ii) exploring relationships within and between studies; and iii) assessing the robustness of the synthesis by "relying primarily on the use of words and text to summarise and explain findings from a synthesis" [31].

Table 1. Search terms

Setting: "health" OR "healthcare" OR "medic*" OR "care" AND **Perspective**: "doctor*" OR "physician*" OR "surgeon*" AND **Intervention**: "multisource feedback" OR "multi-source feedback" OR "peer feedback" OR "colleague feedback" OR "360-degree feedback" OR "360-degree evaluation" OR "MSF" OR "performance feedback" AND **Evaluation:** "reliability" OR "feasibility" OR "accuracy" OR "validity" OR "effectiveness" OR "strength*" OR "weakness*" OR "limitation*" AND "systematic review" OR "review"

Table 2. Inclusion criteria form

1. Is the study published post 2006?
   a. Yes (proceed) b. No (reject)
2. Is the study available in English?
   a. Yes (proceed) b. No (reject)
3. Is the study type a systematic review?
   a. Yes (proceed) b. No (reject)
4. Is the context of the study healthcare?
   a. Yes (proceed) b. No (reject)
5. Does the study discuss MSF in healthcare?
   a. Yes (proceed) b. No (reject)
6. Are qualified medical doctors the target population?
   a. Yes (include) b. No (exclude)

Table 3 Summary of the APA validity framework, adapted from Downing[29]

Domains of Validity Evidence	Description
Content	Content validity is concerned with ensuring that the content of the test is sufficiently similar to, and representative of, the task that it is intending to measure.
Response Process	Response process validity is concerned with ensuring that all sources of error associated with the administration of the test are recognised and limited to the full extent possible
Internal Structure	Internal structure validity is concerned with the statistical and psychometrics characteristics of the questions or prompts, and the psychometric properties of the model used to score/scale the assessment. This aspect of validity is involved in determining the generalisability and reproducibility of the assessment.
Relationship to other variables	This type of validity evidence is concerned with the correlational or relationship of assessment results with other previous or existing measures of performance
Consequences	Consequential validity is concerned with the impact that the assessment has on both the examinees, as well as on the health service, patients and wider society.

Results

Review characteristics and Study Quality

Eight studies were ultimately included in our qualitative synthesis (see PRISMA flow diagram; Figure 1). Key characteristics of the included reviews are summarised in Table 4. Of the reviews included in

the final analysis, the majority of studies were observational in design with no control group. With the validity evidence for MSF based largely on observational studies, the risk of bias associated with the findings may be viewed as high. However, descriptive and observational studies can still provide useful information of validity evidence, particularly in relation to consequential validity [17].Of the eight reviews included, five included articles exploring only MSF to assess medical performance [8-10,15,16]. The remaining three included studies exploring MSF alongside other WBA methods[17-19]. All reviews included qualified physicians as the target population, with six including studies from multiple specialities [10,15-19], one including paediatric physicians only [8], and one including surgical specialities only [9]. In terms of validity evidence, each of the eight reviews included demonstrated evidence across at least one domain of the APA validity framework: content validity (n=5); response process (n=5); internal structure (n=5) [8-10,15,18]; relationship to other variables (n=3)[9,10,18]; and consequential validity (n=6) [10,15-19], of which three provided evidence of this domain only [16,17,19].

The methodological quality of included reviews was mixed (Supplementary Data 2). Three studies were considered high in quality [16-18], five were considered acceptable [8-11,19] and one study was considered low [32]. The most common methodological weaknesses were reviews excluding studies based on their status (e.g. excluding grey literature/non-peer reviewed articles) and not listing the studies excluded at full text.

Content

Of the literature included in the analysis, content validity evidence for MSF instruments can be categorised into two themes. Firstly, validity is discussed in terms of the technical and non-technical competencies that can effectively and feasibly be assessed through MSF assessments [8-10,15]. Donnon et al (2014) [15] identify five key domains of; professionalism, clinical competence, communication, management, and interpersonal relationships across which MSF can be a valid means of assessing medical performance. However, other reviews highlighted further competencies that can be successfully assessed including treatment skills, patient relationships, collegiality, leadership, decision making, system based practice, probity, and knowledge and judgment [8-10]. One study did however demonstrate that in terms of surgical specialties, MSF appears to adequately assess non-technical skills but fails to adequately assess areas of clinical procedural competence[9]. Secondly, reviews discuss evidence of how the content validity for MSF instruments can be maximised [8,10,18]. A number of reviews conclude that in order to enhance content validity, experts should review MSF question items, as part of the development stage, to ensure desired competencies are adequately assessed by the instrument. It is proposed that this can best be carried out systematically using a modified Delphi to ensure consensus across a number of experts [8,10]. Further validity evidence is required within the

6

content validity domain in order to provide a consistent understanding of the areas of clinical practice that can be suitably assessed using MSF, as well demonstrating how to best to design MSF questionnaires used within specific medical specialities or for differing purposes of assessment (e.g. regulatory vs. professional development).

Response Process

In the context of MSF, response process validity is concerned with the process of standardisation and quality control in the delivery and completion of assessments. A number of reviews presented validity evidence within this domain[8-10,15,18], however this evidence focussed solely on the feasibility of assessment implementation. Overall, the feasibility of MSF was considered to be high as; 1) assessments often take a short period of time to complete[8,9,18]; 2) assessments are cost effective[10,18] and 3) physicians often receive high rates of response to requests for feedback[8-10]. One review did demonstrate however that physicians of certain medical specialties have issues in finding adequate numbers of suitable assesors[10]. Although the feasibility of MSF is well established within the reviews, no alternative factors that may impact the standardisation and quality control in assessment delivery were reported.

Internal Structure

Evidence exploring the reliability, replicability and generalisability of MSF assessments falls within the domain of structural validity. Five reviews reported evidence supporting the internal structure of MSF assessments [8-10,15,18], using statistical analyses to explore the psychometric properties of assessments. Firstly, overall reliability of MSF was high. Cronbach's Alpha (a) scores for MSF instruments generally were reported to be >=.90 [8,10,15], or standard error measurements (SEM) <=.40 for a number of studies that evaluated the SPRAT tool [8,15]. Secondly, generalisability of test scores was widely evidenced with high generalisability coefficients (>=.80) for instruments involving six to eight (or more) assessors [8-10,15,18]. Thirdly, the expectation of progression was observed through increased feedback scores over time with consistently higher ratings given to advanced trainees by year of programme [8,9,15]. Finally, the consistency of feedback scores between different assessor groups was generally moderate to high with interclass correlations (ICC) ranging between .45 to .90. These scores were often >.70 [8,10,15], demonstrating a good level of consistency between different assessor groups [15]. Despite the high ICC results, a number of reviews did report that clear differences were present in the mean feedback scores between different assessor groups (e.g. senior physicians rated more stringently than junior

physicians) potentially affecting the validity of the instrument [8,15]. Overall, the size and quality of the evidence underpinning the structural validity of MSF within the reviews was high.

Relationship to other variables

To verify if results of MSF assessments are providing a valid representation of physicians' performance, feedback scores can be correlated against scores of other WBA methods to explore consistency of findings. This provides validity evidence, as one might postulate that those who do well in other WBA assessments should also do well in MSF. Three reviews demonstrate validity evidence within this domain[9,10,18], with each reporting significant correlations between feedback scores for MSF assessments with other WBA methods. Significant correlations were observed across a number of medical specialties between MSF assessment results and the results of other examinations including: 1) Procedures Based Assessments (PBA), 2) Objective Structured Assessment of Technical Skills (OSATS), 3) American Board of Surgery in Training Examinations (ABSITE), 4) Patient Satisfaction Questionaires (PSQ), 5) Significant Event Analysis (SEA), plus many others[9,10,18]. Although the evidence base underpinning this domain of assessment validity is small compared with others, findings are consistent and demonstrate that in comparison with other methods of workplace based assessment, MSF can provide a valid representation of physician performance.

Consequences

Consequential validity is concerned with evidence of the intended or unintended consequences MSF assessments may have on participants or wider society. Six reviews demonstrate validity evidence within this domain with much of the evidence focussed around the likelihood of positive change in physicians' attitudes or behaviours as a result of receiving feedback.[10,15-19] In order to stimulate modifications to behaviours and attitudes, reviews identified a number of factors influencing the likelihood of change. In terms of the source of feedback, participants must perceive assessors as credible and familiar with their work.[10,16] In terms of assessment delivery, feedback should be facilitated[16,17] and narrative comments should be employed alongside quantitative questionnaire results.[16,19] As for the content of the feedback, mixed conclusions are drawn about the likelihood of change as a result of negative comments. Two reviews concluding negative feedback reduces the likelihood of change,[10,17] however a further review concluded that negative comments may not stimulate changes in performance where feedback is inconsistent with a physicians' own perceptions of their performance.[16] Repetitive comments about the same behaviour is understood to increase likelihood of change,[16] as does providing the participant time to reflect on the feedback[16] and ensuring that the feedback is specific and action based, avoiding global judgements of performance.[10,19] One review noted variability in the likelihood of change as a result of MSF assessments by seniority and

8

medical speciality, with some junior physicians and most surgeons displaying little willingness to change. This variability may however be due to individual differences.[17] A general consensus within reviews suggests that well designed, delivered and evaluated colleague feedback (MSF) instruments can lead to modifications in attitudes and changes in behaviour. However, inconsistencies in the findings predicate the need for further research to ensure that MSF can reliably support positive changes in physician performance.

Figure 1. Flow diagram of study selection

Identification

Records identified through database
(n= 82)
Medline = 15
PubMed = 9
PsychINFO = 11
CINAHL = 9
Cochrane Library = 7
EMBASE = 31

Additional records identified through other sources
(n = 2)

Screening

Potentially relevant items
(n = 84)

Duplicates removed
(n = 30)

Titles and abstracts screened
(n = 54)

Records excluded
(n= 44)

Eligibility

Full text articles assessed for eligibility
(n = 10)

Full-text articles excluded, with reasons
(n = 1)

Not Multi-Source Feedback = 1

Studies considered for qualitative synthesis
(n = 9)

Studies excluded after sensitivity analysis
(n = 1)

Eligibility

Studies included in qualitative synthesis
(n = 8)

9

Table 4. Characteristics of included reviews

Authors	Date	Title	Aim	Perspective	Studies	WBA Methods
Al Alawi, S. Al Ansari, A. Raees, A. & Al Khalifa, S.	2013	Multisource feedback to assess paediatric practice: a systematic review	Describe the use of MSF in pediatric settings and to determine its psychometric characteristics and evidence of its validity based on the published literature.	Doctors (paediatrics only)	6	Multi-source feedback (MSF) = 100%
Al Khalifa, K. Al Ansari, A. Violato, C. & Donnon, T	2013	Multisource feedback to assess surgical practice: a systematic review	Describe the use of MSF in surgical settings and to determine the psychometric characteristics and the evidence of its validity based on the published literature.	Doctors (surgical specialties only)	8	Multi-source feedback (MSF) = 100%
Andrews, J. Violato, C. Al Ansari, A. Donnon, T & Pugliese, G.	2013	Assessing psychologists in practice: Lessons from the health professions using multisource feedback.	Review of the use of MSF in healthcare and to summarize the evidence of its feasibility, reliability, generalizability, validity, and other psychometric characteristics.	Doctors (multiple specialties) (n=46), Occupation Therapy (n=1), Medical Radiation Technology (n=1)	48	Multi-source feedback (MSF) = 100%
Donnon, T. Al Ansari, A. Al Alawi, S. & Violato, C.	2014	The reliability, validity, and feasibility of multisource feedback physician assessment: A systematic review	Review research on the different types of MSF instruments used to assess physicians' performance on clinical and nonclinical skills and to investigate the evidence for reliability, generalizability, validity, and feasibility of this assessment approach.	Doctors (multiple specialties)	43	Multi-source feedback (MSF) = 100%
Ferguson, J. Wakeling, J. & Bowie, P	2014	Factors influencing the effectiveness of multisource feedback in improving the professional practice of medical doctors: a systematic review	Identify the key factors that influence the effectiveness of multisource feed- back in improving the professional practice of medical doctors	Doctors (multiple specialties)	16	Multi-source feedback (MSF) = 100%
Miller, A & Archer, J	2010	Impact of workplace based assessment on doctors' education and performance: a systematic review	Investigate whether workplace based assessment affects doctors' education and performance.	Doctors (multiple specialties)	16	Multi-source feedback (MSF) = 50.0% Mini-clinical examination exercise (mini-CEX) = 25.0% Direct observation of procedural skills (DOPS) = 6.25% Multiple assessment methods = 18.75%
Saedon, H. Salleh, S. Balakrishnan, A. Imray, C. & Saedon, M	2012	The role of feedback in improving the effectiveness of workplace based assessments: a systematic review	Elucidate the impact of feedback on the effectiveness of WBAs in postgraduate medical training.	Doctors (multiple specialties)	15	Multi-source feedback (MSF) = 46% Mini-clinical examination exercise (mini-CEX) = 20% Procedure based assessment (PBA) = 14% General workplace based assessments = 7% Multiple assessment methods = 13%

200

Discussion

This review has systematically collected, synthesised and categorised the evidence underpinning the validity of MSF as an assessment tool to assess the ongoing performance of qualified physicians. No review to date has drawn together all of the evidence supporting or refuting the validity of MSF, to provide an up-to-date and holistic analysis of MSF validity. Using the APA framework to map the current validity evidence for the use of MSF in medicine,[29] it is clear that the size and strength of evidence across the different domains of validity is variable.

This review has demonstrated that the evidence base supporting the statistical and psychometric properties of MSF is sufficient. The internal structural validity of MSF has been repeatdely tested, with feedback instruments often demonstrated to be statistically reliable methods of performance assessment. What is also apparent, although the size of the evidence base is smaller, is that results of MSF assessments often correlate highly with other WBA methods., sufficient evidence exists to demonstrate that MSF is a feasible method of assessing medical performance in terms of cost, time and response rates.[8-10,18] We have also shown however that validity evidence is currently lacking in to order to determine 1) how best to ensure MSF tools measure what they intend to measure (content validity); 2) how best to maximise positive impact on practice (consequential validity); and 3) how to ensure the process of assessment delivery is rigorous, robust, and free from bias (response process validity).

Ensuring the MSF can provide a valid assessment of physician performance is a central component of current debate within the UK. Adopted within a recent process of medical relicensure for physicians,[6] MSF has recently been criticised by Sir Keith Pearson for not being able to "consistently identify physicians...whose behaviours are 'disruptive'", which may impact on "the quality and safety of care provided to patients".[33] Physicians choosing their own assessors and the potential for this to undermine the validity of feedback where "colleagues sometimes lacks the necessary objectivity, honesty and candour" has also been raised as a continuing concern for the validity of MSF.[33] Early work by Ramsey et al suggested that the self-selection of assessors had no significant impact on MSF results.[34] However, the issue of bias within the selection of assessors has previously been brought into question, with one study demonstrating that the 'practice of choosing one's own raters is likely to lead to more favourable results'.[14] A number of studies have suggested that interpersonal relationships may play a part in a physician's selection of assessors,[12-14,35] however more research is required to understand this threat to assessment validity.

11

Finally, central to the validity debate for MSF is that the priority for different aspects of validity varies depending on its proposed purpose. Reliability and other components of internal structure are paramount if the purpose is to identify poor practice as part of a patient safety agenda. Whereas content, response process and consequences validity come to the fore if the focus is more formative; with the hypothesis that feedback will drive up standards, thereby supporting better patient care. In order to "review different approaches and determine which works best, drawing upon learning from other sectors",[33] the purpose of which MSF is being used must be clearly articulated. As van der Vleuten concludes in his seminal paper there is always a "trade off"; when decisions need to be made about prioritising different aspects of validity.[36] When used within high stakes/regulatory processes, MSF instruments require validity with more evidence in the tool's statistical and psychometric properties (internal structure validity). However, utilising MSF within low stakes/formative processes focusses on the personal development of physicians and requires more evidence in how to facilitate positive changes to practice (consequence validity). While not mutually exclusive, the use of MSF within both high stakes or formative processes has a direct impact on resource allocation and requires a focus on different implementation approaches in how data is collected and analysed. This factors subsequently shapes the validity evaluation for MSF tools in order to understand "which works best".[33]

Limitations

The present review has some limitations. Although comprehensive, the review is based on a relatively modest number of prior reviews that were published in peer reviewed English language journals only. The grey literature was not searched and experts in the area were not contacted. Publication bias therefore cannot be ruled out. The methodological quality of the included reviews varied and the results should therefore be treated with some caution. Variability in the reporting of reliability (i.e., generalisability, intraclass correlation) and validity (i.e., construct and criterion related) measures, while supportive of the MSF process, were difficult to combine consistently between studies. There is also a potential for over reporting of results with four of the reviews using similar search terms and data sources as well as overlap of included studies.[8-10,15] Finally, the absence of evidence synthesis relating to patient feedback, an aspect of performance feedback which many view as part of MSF, is a recognised limitation of this review.

Conclusion

MSF is increasingly adopted within continuing professional development and regulatory frameworks worldwide as a method to assess medical performance and quality assure clinical practice. The validity

evidence for MSF used within medicine has, in many domains, been well-established; however, the size and quality of the evidence base is variable. To ensure that MSF can support improvements in medical performance and subsequently the quality and safety of patient care, further validity evidence is required to determine: 1) how best to design and deliver MSF assessments that address the identified limitations of existing tools, and 2) how to ensure participation in MSF supports positive changes in practice. Further validity evidence will be particularly important if the purpose of using MSF is to support improvements in medical performance and therefore the quality and safety of patient care.

Lessons for Practice

MSF is increasingly adopted within continuing professional development and regulatory frameworks worldwide as a method to assess medical performance and quality assure clinical practice.

The use of MSF within such settings requires assurances for physicians, patients and regulators that instruments contain substantial validity evidence.

More validity evidence is required to determine how best to design and deliver MSF assessments that address the identified limitations of existing tools, and how to ensure participation in MSF supports positive changes in practice.

13

203

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Appendix 2: Rater Nomination Guidance Document – CFEP Surveys

cfep UK Surveys

Helping People Make a Difference

Guidelines for Clinicians

CFEP360 - Patient and Colleague Multi-source Feedback (MSF)

The following guidelines will help you understand the process in order to quickly and simply obtain your MSF feedback. (NB: If you are just completing colleague feedback please ignore references to the patient feedback element) .

CFEP360 has been developed for use within the context of appraisal and revalidation. It incorporates the Interpersonal Skills Questionnaire (ISQ) and the Colleague Feedback Evaluation Tool (CFET), which capture patient and colleague feedback respectively. Both questionnaires are validated, widely used instruments designed to provide practitioners with an insight into many aspects of their practice. Also incorporated is a self assessment questionnaire which allows you to personally assess the questionnaire items prior to receipt of your report.

Requirement

• Undertake a patient exit survey (ISQ)
• Nominate 15 colleagues (CFET)
• Nominate a Supporting Medical Colleague (SMC) with whom you can discuss the report
• Complete a self-assessment questionnaire

Patient Survey: Interpersonal Skills Questionnaire (ISQ)

The ISQ is a paper-based post-consultation exit survey. The questionnaire asks for patients' views of the consultation and the quality of care they have received. It takes only a short time to complete and is designed to be run by administrative staff, who have reported that it is "minimally disruptive" in clinics.

CFEP provides all necessary materials as well as full guidelines for successful distribution in clinics. Once all questionnaires have been completed, they can be returned in the envelope provided for analysis.

To produce a report which is statistically robust and reliable, feedback from at least 28 patients is necessary.

Colleague Survey: Colleague Feedback Evaluation Tool (CFET)

The CFET questionnaire is an electronic survey designed to provide clinicians with feedback from a range of colleagues. It should be completed by 15 colleagues with whom you have regular contact. Choose colleagues who might be prepared to provide feedback and confirm that they would be happy to do so. Reassurance should be given that their individual ratings will remain anonymous.

Colleague nomination is completed online. We provide you with login details to access our website to be able to do this. Ideally colleague nomination should include a mixture of medical peers, healthcare professionals and managerial/administration staff from within your organisation and some from outside your organisation. Most importantly, these individuals should be people who know you well and with whom you work regularly. Try to include people who work for you, with you and who you report to in the course of your usual practice. Once you have provided us the email addresses of your 15 nominated colleagues we will contact them with login details to access our website and complete the questionnaire online.

To produce a report which is statistically robust and reliable, feedback from at least 12 colleagues is necessary.

Self-assessment

To complete the MSF process, clinicians are required to complete a self-assessment questionnaire which contains the ISQ and CFET questions. We will provide comparison tables within the report, displaying self-assessed ratings and scores against those of patients and peers for each question.

• We will provide you with login details (as above for CFET) which you can use to access our website and complete the self assessment online.

Supporting Medical Colleague (SMC)

We ask you to nominate a supporting medical colleague (SMC), someone preferably who is on the medical register, who could support and discuss the report with you. This may help you to more fully reflect on the feedback and compare with self-assessment ratings. Reflection can be helpful in the preparation for your appraisal meeting where you can discuss your areas of strength and areas where improvement may be required, in order to build a personal development plan.

In most cases feedback is very positive and encouraging but occasionally clinicians can feel unhappy or hurt by the feedback they receive and this is why the nomination of a SMC is essential. This person need not necessarily be your appraiser (although this will depend on your own organisation's requirements) but can be a trusted colleague who you feel will be honest with you and supportive. CFEP will send your identified SMC some guidance notes on how to undertake the discussion, and if you request, CFEP will send them copy of your report at the same time as you receive yours (you can indicate this when nominating your SMC).

Report

The information collected is analysed and fed back in a constructive and sensitive manner within a clear, comprehensive report. All evaluation scores are benchmarked against other participating clinicians. We will provide all colleague comments in their entirety and all patient comments with the removal of personal identifiers.

We will provide supporting material to help you reflect on your results, and to pinpoint areas of strengths and areas where personal and professional development might be desirable.

Every report is checked before being sent by a member of our experienced Reports Team. During that check, if they see anything which may be a cause for concern, they would pass it to senior management for review, which could result in the SMC being contacted, consultation with our Clinical Associate or could set in motion any procedures set up within the participants' organisation to deal with such eventualities.

Important Notes

In the unlikely event where instances of potential professional misconduct have been identified or where patient safety may be affected, the feedback will be referred to our senior staff and the professional's overarching employer/contracting organisation may be contacted and results disclosed as appropriate.

Need help or guidance with your survey?
Call us on **0845 519 7493** or e-mail us at **enquiries@cfepsurveys.co.uk**

Appendix 3: Online Network Survey

Section A: Impact of Social Relationships on MSF Assessments for UK GP's

Welcome!

This online survey looks to explore social relationships within primary healthcare teams. The survey should take no more than 10 minutes to complete and contains two short sections:

Section 1 asks questions about your background characteristics Section 2 asks questions about your social relationships with colleagues within your workplace

As an incentive to take part in the study, you have the opportunity to be entered into a prize draw! Two study participants will be randomly selected to win one of two prizes (winners to be announced via email):

1st Prize - £ 100 Amazon Voucher 2nd Prize - £ 50 Amazon Voucher

If you are willing to participate in this survey, please read the following statements and select 'Yes' in the box below:

I understand that my participation is voluntary and that I am free to withdraw my data without giving any reason up until 31st May 2018 I understand that my answers to this survey are confidential I understand that neither myself nor my practice will be identified in any output from the study.

If you have any questions or concerns about the research, please contact: sebastian.stevens@plymouth.ac.uk or julian.archer@plymouth.ac.uk

A1. **I agree to take part in this survey**

Yes ☐

No ☐

Section B: Section 1 - Personal Characteristics

B1. **What is your title?**

Dr ☐

Mrs ☐

Ms ☐

Miss ☐

Mr ☐

B2.	What is your full name?

B3. **What is your age?**

Under 18 ☐

18-24 ☐

25-34 ☐

35-44 ☐

45-54 ☐

55-64 ☐

65-74 ☐

75+ ☐

Prefer not to say ☐

B4. **What is your gender?**

Male ☐

Female ☐

Prefer not to say ☐

Other ▼

Other

B5. **What is your ethnicity?**

White ☐

Mixed/Multiple Ethnic Groups ☐

Asian/Asian British ☐

Black/African/Caribbean/Black British ☐

Prefer not to say ☐

Other ▼

Other

Section C: Section 1 - Occupational Characteristics

C1. **At which GP practice do you currently work?**

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

C2. **What is your occupation?**

GP Senior Partner	☐
GP Partner	☐
GP Salaried	☐
GP Locum	☐
GP Registrar/Trainee	☐
Physicians Associate	☐
Nurse/Practice Nurse/Nurse Practitioner/Advanced Nurse Practitioner	☐
Allied Health Professional (e.g. pharmacist, physiotherapist etc.)	☐
Practice Manager	☐
Medical Secretary	☐
Dispensary Staff	☐
Receptionist, Administrative or other Support Staff	☐

C3. **Do you work full-time or less than full-time at this practice?**

Full time	☐
Less than full time	☐

C4. **How many hours do you work per week on average?**

Less than 10 hours	☐
11-20 hours	☐
21-30 hours	☐
More than 31 hours	☐

C5. **How long have you worked at this practice?**

Less than 6 months	☐
6 months – 1 year	☐
1 year – 3 years	☐
3 years – 5 years	☐
More than 5 years	☐

C6. **Please list any other GP practices in the South West where you have worked within the past five years?**

Section D: Section 2 - Introduction
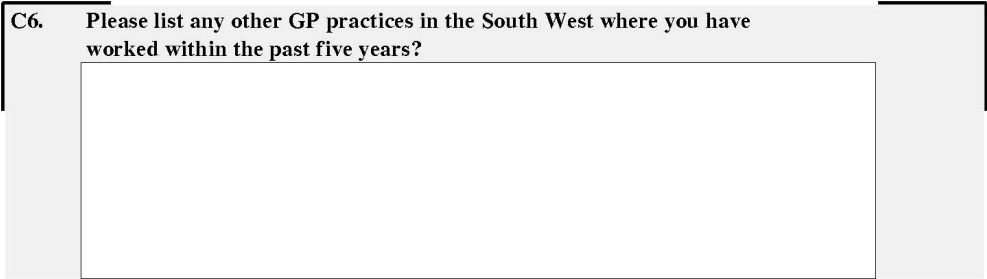
The final three questions look to explore your social relationships within the workplace environment.

In terms of this survey, your workplace should be considered as the practice (business) in which you work.

If your practice operates across multiple sites/localities, please include in your answers those colleagues whom you have a social relationship with from any of these sites.

Section E: Section 2: Social relationships - Activities

E1. **Please list the full names of up to 12 colleagues whom you have attended informal social activities (e.g. lunch, coffee, dinner, drinks etc.) with in the past 6 months.**

After entering these full names, please provide the gender and ethnicity of each individual in the drop-down menus below.

Colleague 1

Colleague 2

Colleague 3

Colleague 4

Colleague 5

Colleague 6

Colleague 7

Colleague 8

Colleague 9

Colleague 10
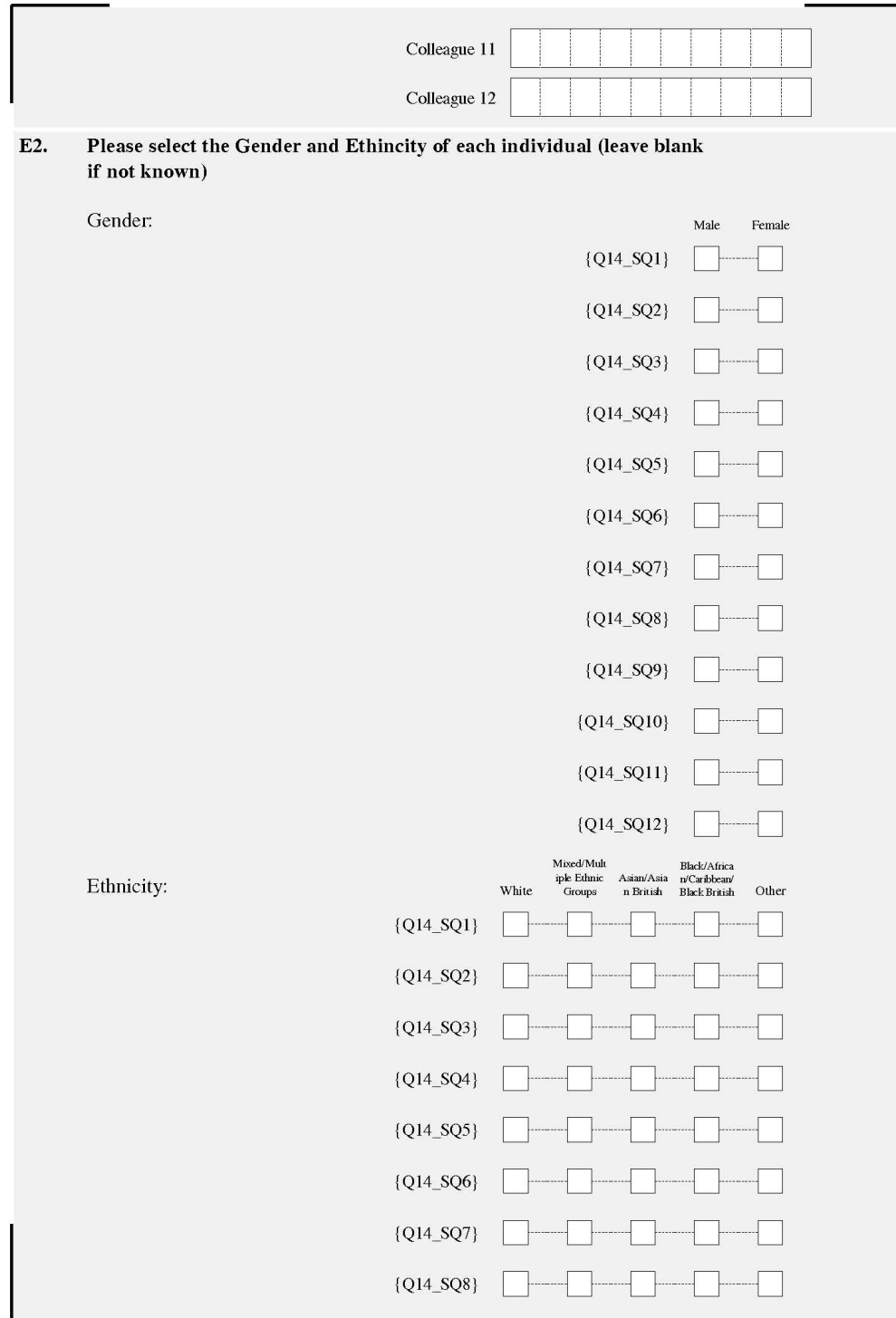
| Colleague 11 | | | | | | | | | | |
| Colleague 12 | | | | | | | | | | |

E2. **Please select the Gender and Ethincity of each individual (leave blank if not known)**

Gender:

		Male	Female
{Q14_SQ1}		☐	☐
{Q14_SQ2}		☐	☐
{Q14_SQ3}		☐	☐
{Q14_SQ4}		☐	☐
{Q14_SQ5}		☐	☐
{Q14_SQ6}		☐	☐
{Q14_SQ7}		☐	☐
{Q14_SQ8}		☐	☐
{Q14_SQ9}		☐	☐
{Q14_SQ10}		☐	☐
{Q14_SQ11}		☐	☐
{Q14_SQ12}		☐	☐

Ethnicity:

	White	Mixed/Multiple Ethnic Groups	Asian/Asian British	Black/African/Caribbean/Black British	Other
{Q14_SQ1}	☐	☐	☐	☐	☐
{Q14_SQ2}	☐	☐	☐	☐	☐
{Q14_SQ3}	☐	☐	☐	☐	☐
{Q14_SQ4}	☐	☐	☐	☐	☐
{Q14_SQ5}	☐	☐	☐	☐	☐
{Q14_SQ6}	☐	☐	☐	☐	☐
{Q14_SQ7}	☐	☐	☐	☐	☐
{Q14_SQ8}	☐	☐	☐	☐	☐

213

Ethnicity:		White	Mixed/Mult iple Ethnic Groups	Asian/Asia n British	Black/Africa n/Caribbean/ Black British	Other
{Q14_SQ9}		☐	☐	☐	☐	☐
{Q14_SQ10}		☐	☐	☐	☐	☐
{Q14_SQ11}		☐	☐	☐	☐	☐
{Q14_SQ12}		☐	☐	☐	☐	☐

Section F: Section 2: Social relationships - Trust

F1. From time-to-time we discuss important matters about our personal lives with people that we trust.

From the list of colleagues below, please select those colleagues whom you trust to discuss matters related to your personal life.

	Yes	No
{Q14_SQ1}	☐	☐
{Q14_SQ2}	☐	☐
{Q14_SQ3}	☐	☐
{Q14_SQ4}	☐	☐
{Q14_SQ5}	☐	☐
{Q14_SQ6}	☐	☐
{Q14_SQ7}	☐	☐
{Q14_SQ8}	☐	☐
{Q14_SQ9}	☐	☐
{Q14_SQ10}	☐	☐
{Q14_SQ11}	☐	☐
{Q14_SQ12}	☐	☐

F2. Furthermore, please list the full names of any other colleagues from the practice whom you trust to discuss personal matters, but you do not regularly socialise with outside of the workplace.

Colleague 1 ☐☐☐☐☐☐☐☐☐☐☐☐

Colleague 2	
Colleague 3	
Colleague 4	
Colleague 5	
Colleague 6	

F3. **Please select the Gender and Ethnicity of these individuals (leave blank if not known)**

Gender:

	Male	Female
{Q15a_SQ1}	☐	☐
{Q15a_SQ2}	☐	☐
{Q15a_SQ3}	☐	☐
{Q15a_SQ4}	☐	☐
{Q15a_SQ5}	☐	☐
{Q15a_SQ6}	☐	☐

Ethnicity:

	White	Mixed/Multiple Ethnic Groups	Asian/Asian British	Black/African/Caribbean/Black British	Other
{Q15a_SQ1}	☐	☐	☐	☐	☐
{Q15a_SQ2}	☐	☐	☐	☐	☐
{Q15a_SQ3}	☐	☐	☐	☐	☐
{Q15a_SQ4}	☐	☐	☐	☐	☐
{Q15a_SQ5}	☐	☐	☐	☐	☐
{Q15a_SQ6}	☐	☐	☐	☐	☐

Section G: Section 2: Social relationships - Closeness

G1. Finally, please think about each of the colleagues you have nominated in the previous three questions and consider how socially close you feel to them based on the following categories:

1 - Colleagues whom you feel socially closest to

2 - Colleagues whom you feel less socially close to

3 - Colleagues whom you feel least socially close to

4 - Colleagues whom you do not feel socially close to

	1- Closest	2- Less close	3- Least close	4- Not close
{Q14_SQ1}	☐	☐	☐	☐
{Q14_SQ2}	☐	☐	☐	☐
{Q14_SQ3}	☐	☐	☐	☐
{Q14_SQ4}	☐	☐	☐	☐
{Q14_SQ5}	☐	☐	☐	☐
{Q14_SQ6}	☐	☐	☐	☐
{Q14_SQ7}	☐	☐	☐	☐
{Q14_SQ8}	☐	☐	☐	☐
{Q14_SQ9}	☐	☐	☐	☐
{Q14_SQ10}	☐	☐	☐	☐
{Q14_SQ11}	☐	☐	☐	☐
{Q14_SQ12}	☐	☐	☐	☐
{Q15a_SQ1}	☐	☐	☐	☐
{Q15a_SQ2}	☐	☐	☐	☐
{Q15a_SQ3}	☐	☐	☐	☐
{Q15a_SQ4}	☐	☐	☐	☐

	1- Closest	2- Less close	3- Least close	4- Not close
{Q15a_SQ5}	☐	☐	☐	☐
{Q15a_SQ6}	☐	☐	☐	☐

Section H: Prize Draw

H1. If you would like to be entered into the prize draw for participating in the study, please provide an email address below:

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Thank you for completing this survey!

Your participation in the study may help to increase the understanding of organisational cultures and social relations within healthcare teams at UK GP practices.

If you would like to receive a copy of the final report or would like to provide feedback, comments or concerns about the study, please contact sebastian.stevens@plymouth.ac.uk

Thanks to Jamie Carmichael at TelMED, Plymouth University for his technical support in designing this survey.

217

Appendix 4: Study Participants by Case

Case 1 Participation

Pseudonym	Role	Survey Complete	RN Data Received	Interview Completed
Doctor 1	GP Senior Partner	No	Yes	Yes
Doctor 2	GP Partner	Yes	Yes	No
Doctor 3	GP Partner	Yes	Yes	No
Doctor 4	GP Partner	No	Yes	No
Doctor 5	GP Partner	No	Yes	No
Doctor 6	GP Partner	Yes	Yes	Yes
Doctor 7	GP Partner	Yes	Not Available	Yes
Doctor 8	Salaried GP	Yes	Not Available	Yes
Doctor 9	GP Registrar	Yes	Not Available	Yes
Doctor 10	GP Registrar	Yes	Not Available	Yes
Doctor 11	GP Registrar	Yes	Not Available	Yes
Nurse 1	Practice Nurse	No	N/A	No
Nurse 2	Practice Nurse	Yes	N/A	No
Nurse 3	Practice Nurse	Yes	N/A	No
Health Care Assistant 1	HCA	Yes	N/A	No
Health Care Assistant 2	HCA	Yes	N/A	No
Phlebotomist	Phlebotomist	No	N/A	No
Pharmacist	Pharmacist	No	N/A	No
Practice Manager	Practice Manager	Yes	N/A	No
Admin 1	Admin Team Leader	No	N/A	No
Admin 2	Admin	Yes	N/A	Yes
Admin 3	Admin	Yes	N/A	Yes
Admin 4	Summariser	No	N/A	No
Admin 5	Finance Officer	Yes	N/A	Yes
Secretary 1	Secretary Team Leader	Yes	N/A	Yes
Secretary 2	Secretary	Yes	N/A	No
Secretary 3	Secretary	No	N/A	No
Secretary 4	Secretary	Yes	N/A	No
Receptionist 1	Reception Team Manager	Yes	N/A	No
Receptionist 2	Receptionist	No	N/A	No
Receptionist 3	Receptionist	Yes	N/A	No
Receptionist 4	Receptionist	Yes	N/A	No
Receptionist 5	Receptionist	Yes	N/A	No
Receptionist 6	Receptionist	No	N/A	No
Receptionist 7	Receptionist	No	N/A	No
Receptionist 8	Receptionist	Yes	N/A	No
Receptionist 9	Receptionist	No	N/A	No

		Survey Complete	RN Data Received	Interview Completed
Receptionist 10	Receptionist	Yes	N/A	No

Case 2 Participation

Pseudonym	Role	Survey Complete	RN Data Received	Interview Completed
Doctor 1	GP Partner	Yes	Yes	Yes
Doctor 2	GP Partner	Yes	Yes	No
Doctor 3	GP Partner	Yes	Yes	No
Doctor 4	GP Partner	No	Yes	Yes
Doctor 5	GP Partner	Yes	No	No
Doctor 6	GP Salaried	Yes	No	Yes
Doctor 7	GP Salaried	Yes	Yes	No
Doctor 8	GP Salaried	Yes	No	No
Doctor 9	GP Registrar	Yes	Not Available	Yes
Business Manager	Business Manager/Partner	Yes	N/A	Yes
Nurse 1	Lead Research Nurse	Yes	N/A	Yes
Nurse 2	Nurse Practitioner	No	N/A	No
Nurse 3	Lead Practice Nurse	Yes	N/A	No
Nurse 4	Practice Nurse	Yes	N/A	No
Nurse 5	Practice Nurse	No	N/A	No
Nurse 6	Practice Nurse	No	N/A	No
Nurse 7	Research Nurse	No	N/A	No
Health Care Assistant 1	Healthcare Assistant	Yes	N/A	No
Health Care Assistant 2	Healthcare Assistant	Yes	N/A	Yes
Health Care Assistant 3	Healthcare Assistant	No	N/A	No
Health Care Assistant 4	Health Care Assistant	Yes	N/A	No
Practice Manager	Practice Manager	Yes	N/A	No
Secretary 1	Secretary	Yes	N/A	No
Secretary 2	Secretary	Yes	N/A	No
Secretary 3	Secretary	Yes	N/A	No
Research Staff 1	Research Assistant	Yes	N/A	Yes
Research Staff 2	Research Assistant	Yes	N/A	Yes
Reception/Admin 1	Office/Reception Manager	No	N/A	No
Reception/Admin 2	Administration Manager	Yes	N/A	No
Reception/Admin 3	Senior Receptionist	No	N/A	No
Reception/Admin 4	Receptionist/Administrator	Yes	N/A	No
Reception/Admin 5	Receptionist/Administrator	No	N/A	No
Reception/Admin 6	Receptionist/Administrator	Yes	N/A	No
Reception/Admin 7	Receptionist/Administrator	Yes	N/A	No
Reception/Admin 8	Receptionist/Administrator	Yes	N/A	No
Reception/Admin 9	Receptionist/Administrator	Yes	N/A	No
Reception/Admin 10	Receptionist/Administrator	Yes	N/A	No
Reception/Admin 11	Receptionist/Administrator	No	N/A	No
Reception/Admin 12	Receptionist/Administrator	Yes	N/A	No

219

Pseudonym	Role	Survey Complete	RN Data Received	Interview Completed
Reception/Admin 13	Receptionist/Administrator	No	N/A	No
Reception/Admin 14	Receptionist/Administrator	Yes	N/A	No
Reception/Admin 15	Receptionist/Administrator	Yes	N/A	No

Case 3 Participation

Pseudonym	Role	Survey Complete	RN Data Received	Interview Completed
Doctor 1	GP Senior Partner	Yes	Yes	No
Doctor 2	GP Partner	Yes	No	No
Doctor 3	GP Partner	Yes	Not Available	No
Doctor 4	GP Partner	Yes	Not Available	No
Doctor 5	GP Partner	Yes	Not Available	No
Doctor 6	GP Salaried	Yes	Not Available	No
Practice Manager	Practice Manager	Yes	N/A	No
Pharmacist	Pharmacist	No	N/A	No
Nurse 1	Nurse Practitioner	Yes	N/A	No
Nurse 2	Practice Nurse	Yes	N/A	No
Nurse 3	Practice Nurse	Yes	N/A	No
Nurse 4	Practice Nurse	Yes	N/A	No
Health Care Assistant 1	Healthcare Assistant	Yes	N/A	No
Health Care Assistant 2	Healthcare Assistant	Yes	N/A	No
Dispensary Staff 1	Dispensary Staff	Yes	N/A	No
Dispensary Staff 2	Dispensary Staff	Yes	N/A	No
Dispensary Staff 3	Dispensary Staff	Yes	N/A	No
Dispensary Staff 4	Dispensary Staff	Yes	N/A	No
Secretary 1	Secretary	Yes	N/A	No
Secretary 2	Secretary	Yes	N/A	No
Reception/Admin 1	Reception Manager	Yes	N/A	No
Reception/Admin 2	Receptionist/Administrator	Yes	N/A	No
Reception/Admin 3	Receptionist/Administrator	Yes	N/A	No
Reception/Admin 4	Receptionist/Administrator	Yes	N/A	No
Reception/Admin 5	Receptionist/Administrator	Yes	N/A	No
Reception/Admin 6	Receptionist/Administrator	No	N/A	No
Reception/Admin 7	Receptionist/Administrator	No	N/A	No
Reception/Admin 8	Receptionist/Administrator	No	N/A	No
Reception/Admin 9	Receptionist/Administrator	No	N/A	No
Reception/Admin 10	Receptionist/Administrator	No	N/A	No
Reception/Admin 11	Receptionist/Administrator	No	N/A	No

Social Relations

1. The survey that you completed looked to explore social relationships within the workplace. What do you view as a social relationship with someone that you work with?
   a. Meet outside of work?
   b. Trust?
   c. Friend? Same as non-work friends?

2. How important, if it all, is it to have social relationships with the people that you work with?
   a. Does this change depending on how close you are to someone?
   b. Are there any negatives?
      i. Cliques?

3. Thinking about the colleagues that you nominated in the survey, would you consider any of the colleagues to be your 'friends'?
   a. Are 'work' friends different to friends from outside of work for you?
      i. Why?
   b. Why would you want/not want to have 'friends' from your workplace?

MSF

4. Thinking about your most recent MSF assessment, how many raters did you nominate personally and how many were nominated on your behalf (by a 3rd party)?
   a. For those that you nominated yourself, how did you go about deciding who to nominate?
      i. Were there any particular factors that affected who you nominated or didn't nominate?
      ii. What qualities do you look for when selecting suitable raters?
         1. Does this, or would this change if the purpose of the MSF was not for regulatory purposes? (Formative)
         2.
5. How much time do you spend deciding which colleagues to nominate for your MSF?
   a. Do you select all your raters at once or keep coming back to the list?

b. Do you discuss with your colleagues who you intend to nominate or just select them yourself?
6. Have you ever discussed with your colleagues how they go about selecting their raters?
   a. Has this affected how you select yours?

Rater Nomination Data

7. Thinking about the list of names you nominated at your most recent MSF, did you nominate all of your GP colleagues that you worked with at the time?
   a. Why didn't you nominate a/these doctors?

8. How did you decide on which non-clinical staff to nominate?

9. Hawks or Doves?

Summary

10. To what extent, if at all, do you believe your personal/social relationships play could play in shaping your rater nomination decisions?

11. Do you believe you would actively **nominate** or **not-nominate** colleagues with whom you have a social relationship?

12. Do you think that GP's should be able to self-select any/all of the colleagues who provide them with feedback?
    a. Why should they/shouldn't they?
    b. How do you think it should be done differently?

Appendix 6: Sample Interview Schedule – Non-GP Staff

Social relations

1. The survey that you completed looked to explore social relationships within the workplace. What do you view as a social relationship with someone that you work with?
    a. Meet outside of work?
    b. Trust?
    c. Friend? Same as non-work friends?

2. How important, if it all, is it to have social relationships with the people that you work with?
    a. Does this change depending on how close you are to someone?
    b. Morale

3. Looking at this list of colleagues that you nominated in the survey, would you consider any of the colleagues to be your 'friends'?
    a. Are 'work' friends different to friends from outside of work for you?
        i. Why?
    b. Why would you want/not want to have 'friends' from your workplace?

Feedback

4. How many of the doctors here have you been asked to provide them with CFEP?
    a. Do you feel that you get nominated more or less often than other colleagues that you work with?

5. When you receive a request to provide feedback, how often do you reply to the request?
    a. Are you encouraged or required by your line manager to provide feedback to a GP if you are nominated?

6. Have you ever provided feedback for a GP working outside of the practice that you currently work?
    a. How did you know them?

223

7. What do you believe are the main factors that affect whether you reply to a feedback request?
    a. Whether you have time?
    b. Whether you have concerns about the doctor?
    c. How long they have been working at the practice long?
    d. Whether you get on with them well on a personal level?

8. To what extent do you believe social relationships play a part in your decision to provide feedback to a doctor?

9. To what extent do you believe social relationships play in part in the feedback that is provided to the GP?

10. In terms of assessing doctor performance, would you consider yourself to be more of a hawk (stringent) or dove (lenient)?

11. Do you think that GP's should be able to self-selected the colleagues who provide the feedback?
    a. Why should they/shouldn't they?
    b. How do you think it should be done differently?

Appendix 7: Health Research Authority Ethical Approval

NHS
Health Research Authority

Mr Sebastian Stevens
PhD Candidate
Plymouth University
C507 Portland Square
Plymouth University
Drakes Circus
PL48AA

Email: hra.approval@nhs.net

02 February 2017

Dear Mr Stevens

Letter of HRA Approval

Study title: The Impact of Clinical Team Networks on Multi-Source Feedback Assessments for UK General Practitioners: A Social Network Analysis

IRAS project ID: 212805

Sponsor University of Plymouth

I am pleased to confirm that **HRA Approval** has been given for the above referenced study, on the basis described in the application form, protocol, supporting documentation and any clarifications noted in this letter.

Participation of NHS Organisations in England

The sponsor should now provide a copy of this letter to all participating NHS organisations in England.

Appendix B provides important information for sponsors and participating NHS organisations in England for arranging and confirming capacity and capability. **Please read *Appendix B* carefully**, in particular the following sections:

- *Participating NHS organisations in England* – this clarifies the types of participating organisations in the study and whether or not all organisations will be undertaking the same activities
- *Confirmation of capacity and capability* - this confirms whether or not each type of participating NHS organisation in England is expected to give formal confirmation of capacity and capability. Where formal confirmation is not expected, the section also provides details on the time limit given to participating organisations to opt out of the study, or request additional time, before their participation is assumed.
- *Allocation of responsibilities and rights are agreed and documented (4.1 of HRA assessment criteria)* - this provides detail on the form of agreement to be used in the study to confirm capacity and capability, where applicable.

Further information on funding, HR processes, and compliance with HRA criteria and standards is also provided.

225

Appendix 8: Faculty Research Ethical Approval

RESEARCH WITH PLYMOUTH UNIVERSITY

2nd February 2017

CONFIDENTIAL

Sebastian Stevens
Room C507
Portland Square Building
Plymouth University
Plymouth
PL4 8AA

Dear Sebastian

Application for Approval by Faculty Research Ethics Committee

Reference Number: 16/17-632
Application Title: **The Impact of Clinical Team Networks on Multi-Source Feedback Assessments for UK General Practitioners: A Social Network Analysis**

I am pleased to inform you that the Committee has granted approval to you to conduct this research.

Please note that this approval is for three years, after which you will be required to seek extension of existing approval.

Please note that should any MAJOR changes to your research design occur which effect the ethics of procedures involved you must inform the Committee. Please contact Sarah Jones (email sarah.c.jones@plymouth.ac.uk).

Yours sincerely

Professor Michael Sheppard, PhD, FAcSS
Chair, Research Ethics Committee -
Faculty of Health & Human Sciences and
Peninsula Schools of Medicine & Dentistry

Appendix 9: Information Sheet – GP's Only

WITH PLYMOUTH UNIVERSITY PENINSULA
SCHOOLS OF MEDICINE & DENTISTRY

CAMERA
Collaboration for the Advancement of Medical Education Research & Assessment

Information Sheet: General Practitioners

Project Title: The Impact of Social Relationships on Multi-Source Feedback Assessments for UK General Practitioners: A Social Network Analysis

Invitation and Brief Summary

This study is part of a PhD Degree to explore the network of social relationships between staff working at GP practices within the South West, and how these networks may relate to the MSF component of revalidation for GP's. Study participation is voluntary and you are free to discuss participation with others before deciding. If you agree to take part, you will be asked to complete the following research activities at a time suitable to yourself. **You may agree to take part in some or all of the elements of the project as stated above**:

1. Complete an online social network survey (**Time to complete: 10mins**). This survey looks to explore social closeness within workplace teams in primary care. You may answer as many or as few of the questions as you like. You may complete the survey at a time that is convenient to you before (1st November). The survey will collect non-intrusive data relating to social relationships which will be confidential and fully anonymised in any outputs. This data will not be made available to anyone within or outside of your place of work and is accessible only by the research team and regulators of the research.

2. Provide access to your archival colleague feedback data for your last multisource feedback assessment (**Time to complete: 2mins**). This data will be released by C-FEP UK Surveys to the researcher on your behalf and will contain **ONLY** the details of the nominated raters that you selected, as well as the details of those that provided you with feedback. The data **WILL NOT** contain the feedback scores or feedback comments that your colleagues provided to you.

3. Take part in a one-to-one interview (**Time to complete: 20mins**). The interview will further explore the results of the network survey that you have completed previously in more detail and discuss how this relates to the multisource feedback assessment that you most recently completed. The interview may discuss your nominations for your previous multisource feedback assessment, but will not discuss details of those that provided feedback to you. The interview will be audio recorded and stored securely by the research team. Audio files will be transcribed and all data stored for a minimum of ten years in line with the University of Plymouth Ethics Policy.

You may agree to take part in some or all of the elements of the project as stated above. You will be asked to sign a consent form to confirm that you are happy to be involved in the study. Your involvement in the research will have no direct impact on any past, current or future MSF assessments that you are involved in.

Why have I been invited to take part?

You have been invited to take part in the research as a GP at a practice in the South West Region of the UK.

Do I have to take part?

No. It is entirely up to you whether or not you choose to be involved in the study. If you do decide to take part, you will be asked to sign a consent form to confirm that you are happy to be involved. You may withdraw any data you provide without penalty up until the 1st December 2017, by which time all data will be analysed and fully anonymised. To withdraw your data, please email: sebastian.stevens@plymouth.ac.uk.

IRAS ID 212805, Amendment No. N-SA-212805-SS-01 Version 1.2 16/5/17

1

227

What are the possible benefits of taking part?
By agreeing to take part in the study, your participant number will be entered into a prize draw to win vouchers to spend at Amazon.co.uk. Two prizes are available (1st Prize £100 in vouchers, 2nd Prize £50 in vouchers) and winners will be randomly selected used a random number generator. Your participation in the study may also help to increase the understanding of team functioning, organisational cultures and social relations with clinical teams at UK GP practices. It may also support understanding in how the social relationships within clinical team's impact on performance assessment processes for UK GP's.

What are the possible disadvantages of taking part?
Reflecting on your personal social network or discussing your most recent appraisal may make you feel uncomfortable. If you have found this process affected you negatively, please inform the research team who can guide you to support through your relevant line manager/mentor, or the standard GP services available to you.

Will taking part in the study be kept confidential?
Any information collected will be kept strictly confidential and will not be disclosed outside the research team. Any personal information that we collect, in order to arrange interviews and any consent forms that you complete, will be stored securely at the University of Plymouth and will only be used for the purposes of the research. You have the right to check the accuracy of the data collected and to correct any errors. Procedures for the handling, processing, storage and destruction of your data will be compliant with the Data Protection Act 1998 and the University of Plymouth's Policy on Data Protection. If required, some of the data collected for the study, may be checked by authorised representatives of regulatory authorities, to check that the study is being correctly carried out and we will seek your consent to do this. Should this occur, all such individuals will have a duty to you as a research participant to protect your confidentiality. You will not be able to be identified in any report or publication about the project.

What will happen to the results of the research?
The results of this study will be published in a PhD thesis by Sebastian Stevens. Publications in academic journals and conferences may result, but individuals and GP practice names will not be identified in any publications. A summary of the results will be made available to your GP Practice at the end of the study.

Who has reviewed the study?
This study has been reviewed and the protocol has been approved by the University of Plymouth's Faculty Research Ethics Committee for Health and Human Sciences (Ref: 16/17- 632). The Health Research Authority Approval Programme has assessed and approved the project, granting HRA Approval (IRAS No. 212805).

If you have any questions, concerns or cause for complaint:
For questions please contact Sebastian Stevens (sebastian.stevens@plymouth.ac.uk) PhD researcher – or Dr Arunangsu Chatterjee (arunangsu.chatterjee@plymouth.ac.uk) Academic Supervisor

If you have any concerns or complaints about the conduct of this study, please contact the Chair of Faculty Research Ethics Committee for Health and Human Sciences (Email:hhsethics@plymouth.ac.uk)
Telephone: 01752 585339) quoting reference 16/17-632.

Appendix 10: Information Sheet – Non-GP Staff

WITH PLYMOUTH UNIVERSITY PENINSULA
SCHOOLS OF MEDICINE & DENTISTRY

CAMERA
Collaboration for the Advancement of Medical Education Research & Assessment

Information Sheet:
General Practice Staff (Excluding GP's)

Project Title: The Impact of Social Relationships on Multi-Source Feedback (MSF) Assessments for UK General Practitioners: A Social Network Analysis

Invitation and Brief Summary
This study is part of a PhD Degree to explore the network of social relationships between staff working at GP practices within the South West, and how these networks may relate to the MSF component of revalidation for GP's. Study participation is voluntary and you are free to discuss participation with others before deciding.

If you agree to take part, you will be asked to complete the following research activities at a time suitable to yourself.

1. Complete an online social network survey (**Time to complete: 10mins**). This survey looks to explore social closeness within workplace teams in primary care. You may answer as many or as few of the questions as you like. You may complete the survey at a time that is convenient to you before (1st November). The survey will collect non-intrusive data relating to social relationships which will be confidential and fully anonymised in any outputs. This data will not be made available to anyone within or outside of your place of work and is accessible only by the research team and regulators of the research.

2. Take part in a short one-to-one interview (**Time to complete: 20mins**) to further explore the results of the network survey that you have completed previously and discuss your attitudes towards providing performance feedback to GP's when requested. You can choose not to answer any question asked by the researcher and are free to leave the interview at any time. The interview will be audio recorded and stored securely by the research team. Audio files will be transcribed and all data stored for a minimum of ten years in line with the University of Plymouth Ethics Policy.

You may agree to take part in some or all of the elements of the project as stated above. You will be asked to sign a consent form to confirm that you are happy to be involved in the study.

Why have I been invited to take part?
You have been invited to take part in the research because you are a member of staff in one of the following positions:

- GP Partner/Principle
- GP Salaried
- GP Locum
- GP Trainee
- Physicians Associate
- Nurse/Practice Nurses/Nurse Practitioner/Advanced Nurse Practitioner

- Allied Health Professionals (e.g. pharmacists, physiotherapists etc.)
- Dispensary staff
- Practice Managers
- Secretaries
- Receptionist, Administrative and Support Staff

Do I have to take part?

1

No. It is entirely up to you whether or not you choose to be involved in the study. If you do decide to take part, you will be asked to sign a consent form to confirm that you are happy to be involved. You may withdraw any data you provide without penalty up until the 1st December 2017, by which time all data will be analysed and fully anonymised. To withdraw your data, please email: sebastian.stevens@plymouth.ac.uk.

What are the possible benefits of taking part?
By agreeing to take part in the study, your participant number will be entered into a prize draw to win vouchers to spend at Amazon.co.uk. Two prizes are available (1st Prize £100 in vouchers, 2nd Prize £50 in vouchers) and winners will be randomly selected used a random number generator. Your participation in the study may also help to increase the understanding of team functioning, organisational cultures and social relations with clinical teams at UK GP practices. It may also support understanding in how the social relationships within clinical team's impact on performance assessment processes for UK GP's.

What are the possible disadvantages of taking part?
Reflecting on your personal social network may make you feel uncomfortable. If you have found this process affected you negatively, please inform the research team who can guide you to support through your relevant line manager/mentor, or the standard GP services available to you.

Will my taking part in the study be kept confidential?
Any information collected will be kept strictly confidential and will not be disclosed outside the research team. Any personal information that we collect, in order to arrange interviews and any consent forms that you complete, will be stored securely at the University of Plymouth and will only be used for the purposes of the research. You have the right to check the accuracy of the data collected and to correct any errors. Procedures for the handling, processing, storage and destruction of your data will be compliant with the Data Protection Act 1998 and the University of Plymouth's Policy on Data Protection. If required, some of the data collected for the study, may be checked by authorised representatives of regulatory authorities, to check that the study is being correctly carried out and we will seek your consent to do this. Should this occur, all such individuals will have a duty to you as a research participant to protect your confidentiality. You will not be able to be identified in any report or publication about the project.

What will happen to the results of the research?
The results of this study will be published in a PhD thesis by Sebastian Stevens. Publications in academic journals and conferences may result, but individuals and GP practice names will not be identified in any publications. A summary of the results will be made available to your GP Practice at the end of the study.

Who has reviewed the study?
This study has been reviewed and the protocol has been approved by the University of Plymouth's Faculty Research Ethics Committee for Health and Human Sciences (Ref: 16/17- 632). The Health Research Authority Approval Programme has assessed and approved the project, granting HRA Approval (IRAS No. 212805).

If you have any questions, concerns or cause for complaint:
Sebastian Stevens (sebastian.stevens@plymouth.ac.uk) PhD researcher – Chief Investigator, or
Dr Arunangsu Chatterjee (arunangsu.chatterjee@plymouth.ac.uk) Academic Supervisor

If you have any concerns or complaints about the conduct of this study, please contact the Chair of Faculty Research Ethics Committee for Health and Human Sciences (Email:hhsethics@plymouth.ac.uk)
Telephone: 01752 585339) quoting reference 16/17-632.

Thank you for taking the time to read about the study.

Appendix 11: Consent Form – GP's Only

WITH PLYMOUTH UNIVERSITY PENINSULA
SCHOOLS OF MEDICINE & DENTISTRY

CAMERA
Collaboration for the Advancement of Medical Education Research & Assessment

IRAS Project ID: 212805

Participant Identification Number for this study:

CONSENT FORM: General Practitioners Only

Title of Project: **The Impact of Social Relationships on Multi-Source Feedback Assessments for UK General Practitioners: A Social Network Analysis**

Please Initial box

1. I confirm that I have read the information sheet dated 16/5/17 (Version 1.2) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐

2. I understand that my participation is voluntary and that I am free to withdraw any of my data up until 1st July 2018 without giving a reason. ☐

3. I understand that relevant sections of the data I provide may be looked at by individuals from Plymouth University, from regulatory authorities or from the NHS Trust, where it is relevant to my taking part in this research. I give permission for these individuals to have access to my records. ☐

4. I understand that the information collected about me will be used to support other research in the future, and may be shared anonymously with other researchers. ☐

5. I understand that any data I provide is confidential and I that myself, nor my workplace, will be named or identifiable in outputs from the study. ☐

6. I understand that direct anonymised quotes may be used in outputs from this study ☐

7. I agree to take part in the above study. ☐

_____   _____   _____

Name of Participant   Date   Signature

_____   _____   _____

Name of Researcher   Date   Signature

'1 copy for participant, 1 copy for researcher'

IRAS ID 212805 Version 1.2 16/5/17

231

Appendix 12: Consent Form – Non-GP Staff

WITH
**PLYMOUTH
UNIVERSITY
PENINSULA**
SCHOOLS OF MEDICINE & DENTISTRY

CAMERA
Collaboration for the Advancement of Medical Education Research & Assessment

IRAS Project ID: 212805

Participant Identification Number for this study:

CONSENT FORM: General Practice Staff (Excluding GP's)

Title of Project: **The Impact of Social Relationships on Multi-Source Feedback Assessments for UK General Practitioners: A Social Network Analysis**

Please Inital box

1. I confirm that I have read the information sheet dated 16/5/17 (Version 1.2) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

2. I understand that my participation is voluntary and that I am free to withdraw any of my data up until 1st July 2018 without giving a reason.

3. I understand that relevant sections of the data I provide may be looked at by individuals from Plymouth University, from regulatory authorities or from the NHS Trust, where it is relevant to my taking part in this research. I give permission for these individuals to have access to my records.

4. I understand that the information collected about me will be used to support other research in the future and may be shared anonymously with other researchers.

5. I understand that any data I provide is confidential and I that myself, nor my workplace, will be named or identifiable in outputs from the study.

6. I understand that direct anonymised quotes may be used in outputs from this study

7. I agree to take part in the above study.

_____   _____   _____
Name of Participant   Date   Signature

_____   _____   _____
Name of Researcher   Date   Signature

'1 copy for participant, 1 copy for researcher'

IRAS ID 212805 Version 1.2 16/5/17

Appendix 13: Goodness of Fit (GOF) Tests for ERGM's

Case 1 Socialising

Statistics	Observed	Mean	StdDev	t-ratio
ArcA	184	182.7	14.459	0.09
ReciprocityA	37	36.605	5.062	0.078
In2StarA	492	455.373	71.958	0.509
Out2StarA	820	855.508	125.168	-0.284
In3StarA	932	750.016	199.199	0.914
Out3StarA	2384	2813.917	695.918	-0.618
TwoPathA	975	962.105	133.262	0.097
Transitive-TriadA	480	431.582	62.207	0.778
Cyclic-TriadA	76	77.839	15.88	-0.116
T1A	23	21.297	6.13	0.278
T2A	160	155.864	38.382	0.108
T3A	190	190.451	41.503	-0.011
T4A	113	102.969	21.106	0.475
T5A	175	165.817	27.556	0.333
T6A	120	129.339	29.59	-0.316
T7A	407	376.808	73.488	0.411
T8A	611	673.493	103.065	-0.606
SinkA	16	14.81	1.526	0.78
SourceA	0	0.373	0.607	-0.615
IsolateA	0	0.778	0.872	-0.892
AinSA	232.8652	230.6961	25.749	0.084
AoutSA	283.9814	281.4014	26.792	0.096
AinSA2	232.8652	230.6961	25.749	0.084
AoutSA2	283.9814	281.4014	26.792	0.096
AinAoutSA	77.5361	77.175	6.357	0.057
ATA-T	264.1875	261.1819	28.763	0.104
ATA-C	141.7188	140.0562	22.36	0.074
ATA-D	256.6094	254.5297	27.928	0.074
ATA-U	195.4453	181.2683	22.72	0.624
ATA-TD	520.7969	515.7115	56.33	0.09
ATA-TU	459.6328	442.4501	49.49	0.347
ATA-DU	452.0547	435.7979	48.257	0.337
ATA-TDU	716.2422	696.9798	76.339	0.252
A2PA-T	631.3125	643.1492	79.715	-0.148
A2PA-D	515.7656	573.9553	72.096	-0.807
A2PA-U	244.2148	238.9415	37.159	0.142
A2PA-TD	1147.078	1217.105	140.936	-0.497
A2PA-TU	875.5273	882.0907	112.505	-0.058
A2PA-DU	759.9805	812.8968	93.781	-0.564

233

A2PA-TDU	1391.293	1456.046	168.469	-0.384
Completed_MatchA	135	124.774	10.733	0.953
Completed_MismatchA	49	57.926	8.402	-1.062
Completed_MatchReciprocityA	37	36.605	5.062	0.078
Completed_MismatchReciprocityA	0	0	0	NaN
Dr/Non-Doctor_MatchA	147	128.054	11.645	1.627
Dr/Non-Doctor_MismatchA	37	54.646	10.564	-1.67
Dr/Non-Doctor_MatchReciprocityA	33	28.048	4.322	1.146
Dr/Non-Doctor_MismatchReciprocityA	4	8.557	3.283	-1.388
Role_MatchA	89	87.153	9.377	0.197
Role_MismatchA	95	95.547	14.745	-0.037
Role_MatchReciprocityA	25	22.975	4.073	0.497
Role_MismatchReciprocityA	12	13.63	4.157	-0.392
Gender_MatchA	129	127.394	12.07	0.133
Gender_MismatchA	55	55.306	8.748	-0.035
Gender_MatchReciprocityA	27	24.386	4.182	0.625
Gender_MismatchReciprocityA	10	12.219	3.24	-0.685
Ethnicity_MatchA	169	171.887	13.462	-0.214
Ethnicity_MismatchA	15	10.813	5.267	0.795
Ethnicity_MatchReciprocityA	36	34.244	4.708	0.373
Ethnicity_MismatchReciprocityA	1	2.361	1.915	-0.711
Full time/Part Time_MatchA	112	112.424	11.478	-0.037
Full time/Part Time_MismatchA	72	70.276	10.774	0.16
Full time/Part Time_MatchReciprocityA	22	21.251	3.973	0.189
Full time/Part Time_MismatchReciprocityA	15	15.354	3.92	-0.09
Duration at Practice_MatchA	93	93.051	11.535	-0.004
Duration at Practice_MismatchA	91	89.649	11.84	0.114
Duration at Practice_MatchReciprocityA	17	16.415	3.685	0.159
Duration at Practice_MismatchReciprocityA	20	20.19	4.379	-0.043
Age_MatchA	59	58.969	8.985	0.003
Age_MismatchA	125	123.731	12.065	0.105
Age_MatchReciprocityA	10	9.581	2.831	0.148
Age_MismatchReciprocityA	27	27.024	4.323	-0.006
stddev_indegreeA	5.6185	5.4223	0.389	0.504
skew_indegreeA	-1.2113	-1.2125	0.038	0.03
stddev_outdegreeA	7.0212	7.1371	0.494	-0.235
skew_outdegreeA	-1.2749	-1.152	0.121	-1.013
clusteringA_tm	0.4923	0.4493	0.033	1.317
clusteringA_cm	0.2338	0.2427	0.037	-0.241
clusteringA_ti	0.4878	0.4769	0.045	0.24
clusteringA_to	0.2927	0.2536	0.026	1.533

234

Case 1 Trust

Statistics	Observed	Mean	StdDev	t-ratio
ArcA	169	168.84	15.25	0.01
ReciprocityA	30	30.015	4.768	-0.003
In2StarA	417	394.867	69.208	0.32
Out2StarA	750	706.93	107.017	0.402
In3StarA	736	617.353	178.827	0.663
Out3StarA	2386	2078.205	508.574	0.605
TwoPathA	777	777.266	117.644	-0.002
Transitive-TriadA	362	309.492	53.084	0.989
Cyclic-TriadA	58	54.947	12.993	0.235
T1A	19	11.969	4.416	1.592
T2A	124	93.911	28.59	1.052
T3A	144	123.759	32.105	0.63
T4A	76	66.438	16.478	0.58
T5A	131	109.326	22.513	0.963
T6A	94	86.24	22.866	0.339
T7A	289	275.594	59.858	0.224
T8A	497	497.009	88.284	0
SinkA	15	14.465	1.409	0.38
SourceA	0	0.577	0.743	-0.777
IsolateA	0	0.766	0.836	-0.916
AinSA	206.6387	206.2536	26.471	0.015
AoutSA	252.2845	252.4166	27.354	-0.005
AinSA2	206.6387	206.2536	26.471	0.015
AoutSA2	252.2845	252.4166	27.354	-0.005
AinAoutSA	76.4303	75.7632	6.507	0.103
ATA-T	205.0625	205.0969	28.396	-0.001
ATA-C	109.2188	109.3067	20.65	-0.004
ATA-D	207.6719	201.2039	27.887	0.232
ATA-U	148.793	149.7854	21.402	-0.046
ATA-TD	412.7344	406.3008	56.034	0.115
ATA-TU	353.8555	354.8823	48.778	-0.021
ATA-DU	356.4648	350.9893	47.977	0.114
ATA-TDU	561.5273	556.0862	76.019	0.072
A2PA-T	532.625	565.382	77.218	-0.424
A2PA-D	505.1328	509.806	66.751	-0.07
A2PA-U	226.6992	234.5726	39.009	-0.202
A2PA-TD	1037.758	1075.188	136.687	-0.274
A2PA-TU	759.3242	799.9546	111.546	-0.364
A2PA-DU	731.832	744.3786	95.244	-0.132
A2PA-TDU	1264.457	1309.761	168.099	-0.27
Completed_MatchA	117	111.203	10.928	0.53

235

Completed_MismatchA	52	57.641	8.965	-0.629
Completed_MatchReciprocityA	30	30.015	4.768	-0.003
Completed_MismatchReciprocityA	0	0	0	NaN
Dr/Non-Doctor_MatchA	135	120.832	11.95	1.186
Dr/Non-Doctor_MismatchA	34	48.012	10.102	-1.387
Dr/Non-Doctor_MatchReciprocityA	29	24.267	4.361	1.085
Dr/Non-Doctor_MismatchReciprocityA	1	5.748	2.835	-1.675
Role_MatchA	83	83.094	9.018	-0.01
Role_MismatchA	86	85.75	14.008	0.018
Role_MatchReciprocityA	19	20.509	3.836	-0.393
Role_MismatchReciprocityA	11	9.506	3.589	0.416
Gender_MatchA	121	120.441	12.607	0.044
Gender_MismatchA	48	48.403	8.481	-0.048
Gender_MatchReciprocityA	21	20.731	4.023	0.067
Gender_MismatchReciprocityA	9	9.284	2.97	-0.096
Ethnicity_MatchA	159	160.354	14.662	-0.092
Ethnicity_MismatchA	10	8.49	4.367	0.346
Ethnicity_MatchReciprocityA	29	28.512	4.521	0.108
Ethnicity_MismatchReciprocityA	1	1.503	1.511	-0.333
Full time/Part Time_MatchA	108	103.995	11.02	0.363
Full time/Part Time_MismatchA	61	64.849	9.567	-0.402
Full time/Part Time_MatchReciprocityA	17	17.528	3.604	-0.146
Full time/Part Time_MismatchReciprocityA	13	12.487	3.48	0.147
Duration at Practice_MatchA	85	84.791	10.573	0.02
Duration at Practice_MismatchA	84	84.053	10.485	-0.005
Duration at Practice_MatchReciprocityA	12	12.994	3.223	-0.308
Duration at Practice_MismatchReciprocityA	18	17.021	3.752	0.261
Age_MatchA	56	56.67	8.726	-0.077
Age_MismatchA	113	112.174	11.013	0.075
Age_MatchReciprocityA	7	7.996	2.674	-0.373
Age_MismatchReciprocityA	23	22.019	3.9	0.252
stddev_indegreeA	5.2065	5.0738	0.404	0.328
skew_indegreeA	-1.2077	-1.2211	0.04	0.335
stddev_outdegreeA	6.7163	6.5235	0.469	0.411
skew_outdegreeA	-1.0866	-1.1595	0.119	0.611
clusteringA_tm	0.4659	0.3984	0.035	1.928
clusteringA_cm	0.2239	0.2116	0.036	0.341
clusteringA_ti	0.4341	0.3945	0.044	0.893
clusteringA_to	0.2413	0.2194	0.024	0.922

Case 2 Socialising

Statistics	Observed	Mean	StdDev	t-ratio
ArcA	104	103.333	15.247	0.044
ReciprocityA	19	19.082	4.32	-0.019
In2StarA	174	175.779	49.534	-0.036
Out2StarA	266	272.351	79.763	-0.08
In3StarA	187	213.283	104.014	-0.253
Out3StarA	493	543.073	261.786	-0.191
TwoPathA	319	311.289	79.622	0.097
Transitive-TriadA	158	142.444	41.459	0.375
Cyclic-TriadA	22	21.254	8.102	0.092
T1A	6	7.262	3.32	-0.38
T2A	45	49.605	20.751	-0.222
T3A	55	56.29	22.158	-0.058
T4A	33	35.549	12.227	-0.208
T5A	59	52.257	17.861	0.378
T6A	33	37.452	14.991	-0.297
T7A	117	125.506	40.55	-0.21
T8A	201	196.585	62.078	0.071
SinkA	12	12.117	2.29	-0.051
SourceA	3	4.247	1.855	-0.672
IsolateA	8	6.11	2.415	0.783
AinSA	106.5313	104.7814	22.81	0.077
AoutSA	129.7354	127.0084	26.359	0.103
AinSA2	106.5313	104.7814	22.81	0.077
AoutSA2	129.7354	127.0084	26.359	0.103
AinAoutSA	56.4521	55.6134	8.336	0.101
ATA-T	110.8125	106.5053	26.017	0.166
ATA-C	50.625	49.1521	15.825	0.093
ATA-D	100.9063	99.9881	24.805	0.037
ATA-U	84.75	81.8279	18.73	0.156
ATA-TD	211.7188	206.4934	50.577	0.103
ATA-TU	195.5625	188.3332	43.9	0.165
ATA-DU	185.6563	181.8159	42.359	0.091
ATA-TDU	296.4688	288.3212	68.092	0.12
A2PA-T	256.9375	249.6323	57.678	0.127
A2PA-D	197.0938	211.9777	56.541	-0.263
A2PA-U	110.7813	123.9289	32.226	-0.408
A2PA-TD	454.0313	461.61	108.866	-0.07
A2PA-TU	367.7188	373.5611	86.218	-0.068
A2PA-DU	307.875	335.9066	80.254	-0.349
A2PA-TDU	564.8125	585.5389	134.774	-0.154
Completed_MatchA	75	79.702	12.557	-0.374

237

Completed_MismatchA	29	23.631	7.491	0.717
Completed_MatchReciprocityA	19	19.082	4.32	-0.019
Completed_MismatchReciprocityA	0	0	0	NaN
Dr/Non Doctor_MatchA	80	67.385	12.583	1.003
Dr/Non Doctor_MismatchA	24	35.948	7.618	-1.568
Dr/Non Doctor_MatchReciprocityA	16	12.413	3.851	0.932
Dr/Non Doctor_MismatchReciprocityA	3	6.669	2.353	-1.559
Role_MatchA	38	37.417	10.416	0.056
Role_MismatchA	66	65.916	13.349	0.006
Role_MatchReciprocityA	7	8.433	3.318	-0.432
Role_MismatchReciprocityA	12	10.649	3.644	0.371
Gender_MatchA	75	74.907	12.912	0.007
Gender_MismatchA	29	28.426	6.39	0.09
Gender_MatchReciprocityA	12	12.706	3.723	-0.19
Gender_MismatchReciprocityA	7	6.376	2.194	0.284
Ethnicity_MatchA	93	99.842	14.845	-0.461
Ethnicity_MismatchA	11	3.491	2.897	2.592
Ethnicity_MatchReciprocityA	16	18.546	4.18	-0.609
Ethnicity_MismatchReciprocityA	3	0.536	0.972	2.535
Full time/Part Time_MatchA	73	67.035	11.344	0.526
Full time/Part Time_MismatchA	31	36.298	9.389	-0.564
Full time/Part Time_MatchReciprocityA	12	11.506	3.417	0.145
Full time/Part Time_MismatchReciprocityA	7	7.576	2.992	-0.193
Duration at Practice_MatchA	26	26.765	6.292	-0.122
Duration at Practice_MismatchA	78	76.568	12.649	0.113
Duration at Practice_MatchReciprocityA	4	4.477	1.989	-0.24
Duration at Practice_MismatchReciprocityA	15	14.605	3.874	0.102
Age_MatchA	37	38.702	9.329	-0.182
Age_MismatchA	67	64.631	11.253	0.211
Age_MatchReciprocityA	9	8.347	3.112	0.21
Age_MismatchReciprocityA	10	10.735	3.234	-0.227
stddev_indegreeA	3.3203	3.3049	0.416	0.037
skew_indegreeA	-1.2625	-1.1828	0.126	-0.635
stddev_outdegreeA	3.9386	3.9396	0.534	-0.002
skew_outdegreeA	-0.8944	-0.8468	0.24	-0.199
clusteringA_tm	0.4953	0.4564	0.057	0.683
clusteringA_cm	0.2069	0.203	0.054	0.072
clusteringA_ti	0.454	0.409	0.065	0.696
clusteringA_to	0.297	0.2653	0.044	0.716

Case 2 Trust

Statistics	Observed	Mean	StdDev	t-ratio
ArcA	135	132.90	15.90	0.132
ReciprocityA	16	15.44	3.251	0.172
In2StarA	283	264.519	68.218	0.271
Out2StarA	339	360.893	92.779	-0.236
In3StarA	466	398.923	181.588	0.369
Out3StarA	595	747.576	334.687	-0.456
TwoPathA	374	364.182	80.178	0.122
Transitive-TriadA	148	133.609	37.071	0.388
Cyclic-TriadA	9	8.771	4.426	0.052
T1A	0	2.111	1.592	-1.326
T2A	8	16.373	10.193	-0.821
T3A	17	20.829	11.388	-0.336
T4A	18	20.205	7.852	-0.281
T5A	37	33.767	12.072	0.268
T6A	15	16.514	7.974	-0.19
T7A	90	94.688	29.592	-0.158
T8A	152	151.298	45.511	0.015
SinkA	12	11.668	1.591	0.209
SourceA	2	3.418	1.648	-0.861
IsolateA	2	1.655	1.199	0.288
AinSA	147.4297	144.292	26.535	0.118
AoutSA	169.7588	166.3019	28.779	0.12
AinSA2	147.4297	144.292	26.535	0.118
AoutSA2	169.7588	166.3019	28.779	0.12
AinAoutSA	74.2646	70.6501	7.298	0.495
ATA-T	110.1875	106.8704	25.333	0.131
ATA-C	24.75	23.5508	10.548	0.114
ATA-D	108.625	99.6477	23.218	0.387
ATA-U	99.8125	85.8713	18.427	0.757
ATA-TD	218.8125	206.5181	48.259	0.255
ATA-TU	210	192.7417	43.267	0.399
ATA-DU	208.4375	185.519	40.839	0.561
ATA-TDU	318.625	292.3894	65.943	0.398
A2PA-T	306.75	310.2403	60.63	-0.058
A2PA-D	276.5938	292.149	65.406	-0.238
A2PA-U	212.3125	201.1392	44.163	0.253
A2PA-TD	583.3438	602.3893	120.277	-0.158
A2PA-TU	519.0625	511.3796	100.35	0.077
A2PA-DU	488.9063	493.2882	101.834	-0.043
A2PA-TDU	795.6563	803.5285	158.121	-0.05
Completed_MatchA	94	90.716	10.967	0.299

239

Completed_MismatchA	41	42.186	9.498	-0.125
Completed_MatchReciprocityA	16	15.44	3.251	0.172
Completed_MismatchReciprocityA	0	0	0	NaN
Dr/Non Doctor_MatchA	112	97.133	13.551	1.097
Dr/Non Doctor_MismatchA	23	35.769	8.013	-1.593
Dr/Non Doctor_MatchReciprocityA	13	11.826	3.168	0.371
Dr/Non Doctor_MismatchReciprocityA	3	3.614	1.927	-0.319
Role_MatchA	54	52.09	11.071	0.173
Role_MismatchA	81	80.812	13.558	0.014
Role_MatchReciprocityA	6	8.173	3.069	-0.708
Role_MismatchReciprocityA	10	7.267	2.684	1.018
Gender_MatchA	113	111.512	14.461	0.103
Gender_MismatchA	22	21.39	5.638	0.108
Gender_MatchReciprocityA	14	12.535	3.126	0.469
Gender_MismatchReciprocityA	2	2.905	1.661	-0.545
Ethnicity_MatchA	124	128.16	15.784	-0.264
Ethnicity_MismatchA	11	4.742	2.785	2.247
Ethnicity_MatchReciprocityA	13	14.835	3.205	-0.573
Ethnicity_MismatchReciprocityA	3	0.605	0.829	2.89
Full time/Part Time_MatchA	94	89.355	12.498	0.372
Full time/Part Time_MismatchA	41	43.547	7.676	-0.332
Full time/Part Time_MatchReciprocityA	10	9.378	2.78	0.224
Full time/Part Time_MismatchReciprocityA	6	6.062	2.167	-0.029
Duration at Practice_MatchA	26	25.746	5.63	0.045
Duration at Practice_MismatchA	109	107.156	12.875	0.143
Duration at Practice_MatchReciprocityA	3	1.927	1.313	0.817
Duration at Practice_MismatchReciprocityA	13	13.513	3.043	-0.169
Age_MatchA	50	48.888	9.579	0.116
Age_MismatchA	85	84.014	11.872	0.083
Age_MatchReciprocityA	8	6.61	2.52	0.552
Age_MismatchReciprocityA	8	8.83	2.708	-0.307
stddev_indegreeA	4.1349	3.9918	0.458	0.312
skew_indegreeA	-1.1424	-1.1939	0.083	0.623
stddev_outdegreeA	4.453	4.5342	0.536	-0.152
skew_outdegreeA	-1.2047	-1.0899	0.151	-0.758
clusteringA_tm	0.3957	0.3641	0.045	0.709
clusteringA_cm	0.0722	0.0714	0.032	0.024
clusteringA_ti	0.2615	0.2535	0.036	0.219
clusteringA_to	0.2183	0.1856	0.025	1.312

Case 3 Socialising

Statistics	Observed	Mean	StdDev	t-ratio
ArcA	81	82.079	11.069	-0.097
ReciprocityA	14	13.78	3.675	0.06
In2StarA	110	118.263	34.141	-0.242
Out2StarA	184	201.213	55.005	-0.313
In3StarA	89	116.581	63.061	-0.437
Out3StarA	287	361.476	168.262	-0.443
TwoPathA	201	207.017	52.983	-0.114
Transitive-TriadA	94	88.339	27.139	0.209
Cyclic-TriadA	15	13.298	6.134	0.277
T1A	4	3.699	2.305	0.131
T2A	28	26.943	14.715	0.072
T3A	35	32.715	16.177	0.141
T4A	22	19.385	8.612	0.304
T5A	26	31.211	11.761	-0.443
T6A	19	21.282	10.325	-0.221
T7A	76	72.189	28.356	0.134
T8A	103	127.298	41.418	-0.587
SinkA	10	9.92	1.724	0.046
SourceA	2	1.891	1.216	0.09
IsolateA	2	1.762	1.292	0.184
AinSA	75	76.6722	16.77	-0.1
AoutSA	96.5664	98.9069	19.057	-0.123
AinSA2	75	76.6722	16.77	-0.1
AoutSA2	96.5664	98.9069	19.057	-0.123
AinAoutSA	48.0273	47.3956	6.764	0.093
ATA-T	70.25	70.9469	18.704	-0.037
ATA-C	33.375	32.8131	13.047	0.043
ATA-D	64.4375	68.9411	18.072	-0.249
ATA-U	60.875	56.1544	14.209	0.332
ATA-TD	134.6875	139.888	36.656	-0.142
ATA-TU	131.125	127.1013	32.465	0.124
ATA-DU	125.3125	125.0955	31.662	0.007
ATA-TDU	195.5625	196.0424	50.218	-0.01
A2PA-T	170.25	175.5129	40.59	-0.13
A2PA-D	149.4375	167.277	40.925	-0.436
A2PA-U	76.375	88.681	22.985	-0.535
A2PA-TD	319.6875	342.7899	76.734	-0.301
A2PA-TU	246.625	264.1939	60.735	-0.289
A2PA-DU	225.8125	255.958	58.593	-0.514
A2PA-TDU	396.0625	431.4709	95.704	-0.37
Completed_MatchA	61	63.997	8.691	-0.345

241

Completed_MismatchA	20	18.082	5.571	0.344
Completed_MatchReciprocityA	14	13.766	3.664	0.064
Completed_MismatchReciprocityA	0	0.014	0.117	-0.119
Dr or Non Doctor_MatchA	78	61.724	9.937	1.638
Dr or Non Doctor_MismatchA	3	20.355	6.181	-2.808
Dr or Non Doctor_MatchReciprocityA	14	10.785	3.494	0.92
Dr or Non Doctor_MismatchReciprocityA	0	2.995	2.042	-1.467
Role_MatchA	24	22.833	6.643	0.176
Role_MismatchA	57	59.246	9.451	-0.238
Role_MatchReciprocityA	5	4.829	2.612	0.065
Role_MismatchReciprocityA	9	8.951	2.984	0.016
Gender_MatchA	69	69.303	10.494	-0.029
Gender_MismatchA	12	12.776	5.041	-0.154
Gender_MatchReciprocityA	10	12.021	3.458	-0.585
Gender_MismatchReciprocityA	4	1.759	1.651	1.358
Ethnicity_MatchA	81	82.079	11.069	-0.097
Ethnicity_MismatchA	0	0	0	NaN
Ethnicity_MatchReciprocityA	14	13.78	3.675	0.06
Ethnicity_MismatchReciprocityA	0	0	0	NaN
Full time/Part Time_MatchA	32	30.477	6.234	0.244
Full time/Part Time_MismatchA	49	51.602	8.66	-0.3
Full time/Part Time_MatchReciprocityA	7	6.583	2.668	0.156
Full time/Part Time_MismatchReciprocityA	7	7.197	2.555	-0.077
Duration at Practice_MatchA	27	28.252	6.227	-0.201
Duration at Practice_MismatchA	54	53.827	9.793	0.018
Duration at Practice_MatchReciprocityA	5	6.909	2.712	-0.704
Duration at Practice_MismatchReciprocityA	9	6.871	2.863	0.744
Age_MatchA	14	14.534	3.826	-0.14
Age_MismatchA	67	67.545	9.669	-0.056
Age_MatchReciprocityA	5	2.892	1.593	1.324
Age_MismatchReciprocityA	9	10.888	3.128	-0.604
stddev_indegreeA	3.1675	3.2342	0.4	-0.166
skew_indegreeA	-1.292	-1.2292	0.073	-0.865
stddev_outdegreeA	3.8687	3.9876	0.499	-0.238
skew_outdegreeA	-1.1054	-1.0265	0.185	-0.426
clusteringA_tm	0.4677	0.4241	0.06	0.725
clusteringA_cm	0.2239	0.1889	0.065	0.542
clusteringA_ti	0.4273	0.3768	0.071	0.709
clusteringA_to	0.2554	0.2211	0.044	0.782

Case 3 Trust

Statistics	Observed	Mean	StdDev	t-ratio
ArcA	99	98.93	10.13	0.007
ReciprocityA	19	19.03	3.83	-0.007
In2StarA	163	160.22	34.37	0.081
Out2StarA	262	241.79	50.50	0.4
In3StarA	179	172.123	66.632	0.103
Out3StarA	509	409.205	147.019	0.679
TwoPathA	287	288.161	58.536	-0.02
Transitive-TriadA	84	78.044	22.272	0.267
Cyclic-TriadA	14	12.362	5.336	0.307
T1A	2	2.366	1.726	-0.212
T2A	19	19.871	11.398	-0.076
T3A	29	27.32	13.176	0.128
T4A	20	16.935	7.058	0.434
T5A	22	24.41	8.9	-0.271
T6A	27	30.989	13.146	-0.303
T7A	124	113.237	34.931	0.308
T8A	154	169.345	45.603	-0.336
SinkA	9	8.604	1.44	0.275
SourceA	1	0.813	0.908	0.206
IsolateA	0	0.813	0.882	-0.922
AinSA	99.875	99.9272	16.211	-0.003
AoutSA	122.0938	121.7795	17.759	0.018
AinSA2	99.875	99.9272	16.211	-0.003
AoutSA2	122.0938	121.7795	17.759	0.018
AinAoutSA	58.6563	60.8076	5.935	-0.362
ATA-T	66.625	66.4548	16.778	0.01
ATA-C	32.875	32.7962	12.83	0.006
ATA-D	61	65.6345	16.535	-0.28
ATA-U	63.25	58.9619	13.967	0.307
ATA-TD	127.625	132.0893	33.227	-0.134
ATA-TU	129.875	125.4168	30.533	0.146
ATA-DU	124.25	124.5964	30.203	-0.011
ATA-TDU	190.875	191.0513	46.889	-0.004
A2PA-T	249	254.4625	46.471	-0.118
A2PA-D	223.0625	209.5935	38.599	0.349
A2PA-U	125.1875	129.9631	24.025	-0.199
A2PA-TD	472.0625	464.056	80.532	0.099
A2PA-TU	374.1875	384.4256	67.619	-0.151
A2PA-DU	348.25	339.5566	58.05	0.15
A2PA-TDU	597.25	594.0191	101	0.032
Completed_MatchA	82	78.068	8.267	0.476
Completed_MismatchA	17	20.863	5.329	-0.725

243

Completed_MatchReciprocityA	17	18.988	3.826	-0.52
Completed_MismatchReciprocityA	2	0.038	0.191	10.262
Dr or Non Doctor_MatchA	82	72.239	8.912	1.095
Dr or Non Doctor_MismatchA	17	26.692	5.927	-1.635
Dr or Non Doctor_MatchReciprocityA	18	14.22	3.433	1.101
Dr or Non Doctor_MismatchReciprocityA	1	4.806	2.139	-1.78
Role_MatchA	28	27.913	5.953	0.015
Role_MismatchA	71	71.018	9.305	-0.002
Role_MatchReciprocityA	7	6.786	2.484	0.086
Role_MismatchReciprocityA	12	12.24	3.209	-0.075
Gender_MatchA	80	80.533	9.17	-0.058
Gender_MismatchA	19	18.398	5.085	0.118
Gender_MatchReciprocityA	14	15.711	3.644	-0.469
Gender_MismatchReciprocityA	5	3.315	1.912	0.881
Ethnicity_MatchA	99	98.931	10.134	0.007
Ethnicity_MismatchA	0	0	0	NaN
Ethnicity_MatchReciprocityA	19	19.026	3.826	-0.007
Ethnicity_MismatchReciprocityA	0	0	0	NaN
Full time/Part Time_MatchA	42	38.283	6.312	0.589
Full time/Part Time_MismatchA	57	60.648	8.519	-0.428
Full time/Part Time_MatchReciprocityA	11	9.59	2.816	0.501
Full time/Part Time_MismatchReciprocityA	8	9.436	2.795	-0.514
Duration at Practice_MatchA	32	32.118	5.937	-0.02
Duration at Practice_MismatchA	67	66.813	8.88	0.021
Duration at Practice_MatchReciprocityA	7	8.438	2.671	-0.538
Duration at Practice_MismatchReciprocityA	12	10.588	3.107	0.454
Age_MatchA	24	24.213	5.347	-0.04
Age_MismatchA	75	74.718	9.2	0.031
Age_MatchReciprocityA	7	6.229	2.37	0.325
Age_MismatchReciprocityA	12	12.797	3.305	-0.241
stddev_indegreeA	3.7639	3.7228	0.347	0.118
skew_indegreeA	-1.2214	-1.2141	0.047	-0.158
stddev_outdegreeA	4.557	4.3869	0.415	0.41
skew_outdegreeA	-1.1179	-1.2262	0.099	1.097
clusteringA_tm	0.2927	0.2684	0.04	0.609
clusteringA_cm	0.1463	0.1257	0.041	0.505
clusteringA_ti	0.2577	0.2423	0.039	0.389
clusteringA_to	0.1603	0.1605	0.027	-0.008

Case 1 Nominations

Statistics	Observed	Mean	StdDev	t-ratio
ArcA	60	59.918	8.337	0.01
ReciprocityA	4	4.053	1.439	-0.037
In2StarA	82	70.996	16.541	0.665
Out2StarA	290	291.918	85.775	-0.022
In3StarA	67	48.518	17.387	1.063
Out3StarA	897	928.478	437.095	-0.072
TwoPathA	164	163.63	37.199	0.01
Transitive-TriadA	89	88.827	25.697	0.007
Cyclic-TriadA	8	8.111	3.113	-0.036
T1A	0	0.637	0.758	-0.84
T2A	3	6.387	5.302	-0.639
T3A	10	11.77	6.742	-0.263
T4A	7	6.264	3.527	0.209
T5A	16	24.286	11.261	-0.736
T6A	4	4.705	3.457	-0.204
T7A	23	19.601	9.021	0.377
T8A	73	80.987	34.976	-0.228
SinkA	15	16.224	2.479	-0.494
SourceA	0	0.183	0.409	-0.447
IsolateA	17	15.776	2.479	0.494
AinSA	55.125	51.025	10.394	0.394
AoutSA	96.0889	95.9314	16.619	0.009
AinSA2	55.125	51.025	10.394	0.394
AoutSA2	96.0889	95.9314	16.619	0.009
AinAoutSA	19.1616	19.2108	1.606	-0.031
ATA-T	67	66.8478	16.222	0.009
ATA-C	19	18.9401	5.999	0.01
ATA-D	61.5	65.5008	16.179	-0.247
ATA-U	32.7969	31.7651	4.886	0.211
ATA-TD	128.5	132.3486	32.307	-0.119
ATA-TU	99.7969	98.6129	20.382	0.058
ATA-DU	94.2969	97.2658	20.347	-0.146
ATA-TDU	161.2969	164.1136	36.393	-0.077
A2PA-T	131	126.634	23.973	0.182
A2PA-D	206.6875	221.2589	58.185	-0.25
A2PA-U	28.1211	27.1349	2.027	0.487
A2PA-TD	337.6875	347.8929	79.899	-0.128
A2PA-TU	159.1211	153.7689	25.276	0.212
A2PA-DU	234.8086	248.3938	59.184	-0.23
A2PA-TDU	365.8086	375.0278	81.001	-0.114
Completed_MatchA	43	42.027	6.794	0.143

245

Completed_MismatchA	17	17.891	4.448	-0.2
Completed_MatchReciprocityA	4	2.845	1.322	0.873
Completed_MismatchReciprocityA	0	1.208	1.037	-1.165
Dr/Non Doctor_MatchA	27	24.554	4.278	0.572
Dr/Non Doctor_MismatchA	33	35.364	5.526	-0.428
Dr/Non Doctor_MatchReciprocityA	3	1.937	1.095	0.971
Dr/Non Doctor_MismatchReciprocityA	1	2.116	1.166	-0.957
Role_MatchA	8	6.751	2.032	0.615
Role_MismatchA	52	53.167	7.716	-0.151
Role_MatchReciprocityA	1	0.266	0.442	1.661
Role_MismatchReciprocityA	3	3.787	1.406	-0.56
Gender_MatchA	39	45.458	7.343	-0.879
Gender_MismatchA	21	14.46	3.567	1.834
Gender_MatchReciprocityA	1	2.722	1.324	-1.301
Gender_MismatchReciprocityA	3	1.331	1.038	1.608
Ethnicity_MatchA	56	58.499	8.349	-0.299
Ethnicity_MismatchA	4	1.419	1.747	1.477
Ethnicity_MatchReciprocityA	4	4.053	1.439	-0.037
Ethnicity_MismatchReciprocityA	0	0	0	NaN
Full time/Part Time_MatchA	32	34.236	5.713	-0.391
Full time/Part Time_MismatchA	28	25.682	4.565	0.508
Full time/Part Time_MatchReciprocityA	1	1.898	1.093	-0.822
Full time/Part Time_MismatchReciprocityA	3	2.155	1.163	0.726
Duration at Practice_MatchA	18	18.149	4.235	-0.035
Duration at Practice_MismatchA	42	41.769	7.048	0.033
Duration at Practice_MatchReciprocityA	1	1.57	1.126	-0.506
Duration at Practice_MismatchReciprocityA	3	2.483	1.25	0.414
Age_MatchA	16	14.731	3.359	0.378
Age_MismatchA	44	45.187	6.845	-0.173
Age_MatchReciprocityA	2	1.09	0.891	1.021
Age_MismatchReciprocityA	2	2.963	1.291	-0.746
stddev_indegreeA	2.4605	2.3242	0.235	0.58
skew_indegreeA	-1.0338	-1.1304	0.144	0.669
stddev_outdegreeA	4.159	4.131	0.577	0.048
skew_outdegreeA	0.6451	0.6072	0.128	0.297
clusteringA_tm	0.5427	0.5372	0.061	0.09
clusteringA_cm	0.1463	0.1462	0.041	0.003
clusteringA_ti	0.5427	0.6198	0.072	-1.072
clusteringA_to	0.1534	0.1542	0.026	-0.029

Case 2 Nominations

Statistics	Observed	Mean	StdDev	t-ratio
ArcA	69	68.727	4.409	0.062
ReciprocityA	8	8.122	1.175	-0.104
In2StarA	78	74.553	7.556	0.456
Out2StarA	443	455.902	57.68	-0.224
In3StarA	49	43.198	6.416	0.904
Out3StarA	1755	1942.646	375.696	-0.499
TwoPathA	230	230.555	24.923	-0.022
Transitive-TriadA	140	135.776	18.519	0.228
Cyclic-TriadA	14	14.666	3.222	-0.207
T1A	5	5.512	2.337	-0.219
T2A	34	36.498	12.647	-0.198
T3A	38	40.14	11.168	-0.192
T4A	20	20.543	5.191	-0.105
T5A	62	61.231	12.405	0.062
T6A	19	19.962	5.67	-0.17
T7A	44	44.728	8.875	-0.082
T8A	203	207.959	35.68	-0.139
SinkA	21	21.243	1.647	-0.148
SourceA	0	0.004	0.063	-0.063
IsolateA	16	15.753	1.646	0.15
AinSA	57.25	55.8968	5.137	0.263
AoutSA	118.0016	117.4547	8.814	0.062
AinSA2	57.25	55.8968	5.137	0.263
AoutSA2	118.0016	117.4547	8.814	0.062
AinAoutSA	17.9984	18.0687	0.592	-0.119
ATA-T	91.25	91.2773	9.626	-0.003
ATA-C	28	28.5138	4.338	-0.118
ATA-D	90.5	90.7599	10.041	-0.026
ATA-U	35.6699	35.671	2.522	0
ATA-TD	181.75	182.0371	19.623	-0.015
ATA-TU	126.9199	126.9482	11.47	-0.002
ATA-DU	126.1699	126.4308	11.92	-0.022
ATA-TDU	217.4199	217.7081	21.421	-0.013
A2PA-T	162.5	163.3585	13.114	-0.065
A2PA-D	325.6875	343.3228	40.316	-0.437
A2PA-U	19.8252	19.6834	0.327	0.434
A2PA-TD	488.1875	506.6813	51.654	-0.358
A2PA-TU	182.3252	183.0419	13.26	-0.054
A2PA-DU	345.5127	363.0061	40.401	-0.433
A2PA-TDU	508.0127	526.3646	51.756	-0.355
Completed_MatchA	42	43.039	2.353	-0.442

247

Completed_MismatchA	27	25.688	3.475	0.378
Completed_MatchReciprocityA	4	5.071	0.949	-1.129
Completed_MismatchReciprocityA	4	3.051	1.045	0.908
Dr/Non Doctor_MatchA	30	28.275	1.748	0.987
Dr/Non Doctor_MismatchA	39	40.452	4.105	-0.354
Dr/Non Doctor_MatchReciprocityA	8	8.122	1.175	-0.104
Dr/Non Doctor_MismatchReciprocityA	0	0	0	NaN
Role_MatchA	11	9.397	0.863	1.857
Role_MismatchA	58	59.33	4.246	-0.313
Role_MatchReciprocityA	3	2.66	0.482	0.705
Role_MismatchReciprocityA	5	5.462	0.983	-0.47
Gender_MatchA	27	27.66	2.559	-0.258
Gender_MismatchA	42	41.067	3.005	0.31
Gender_MatchReciprocityA	3	3.413	0.647	-0.638
Gender_MismatchReciprocityA	5	4.709	0.89	0.327
Ethnicity_MatchA	52	53.235	3.434	-0.36
Ethnicity_MismatchA	17	15.492	2.324	0.649
Ethnicity_MatchReciprocityA	5	5.034	0.838	-0.041
Ethnicity_MismatchReciprocityA	3	3.088	0.717	-0.123
Full time/Part Time_MatchA	48	45.872	3.733	0.57
Full time/Part Time_MismatchA	21	22.855	1.94	-0.956
Full time/Part Time_MatchReciprocityA	5	4.809	0.912	0.209
Full time/Part Time_MismatchReciprocityA	3	3.313	0.701	-0.447
Duration at Practice_MatchA	27	28.876	2.709	-0.693
Duration at Practice_MismatchA	42	39.851	2.961	0.726
Duration at Practice_MatchReciprocityA	3	3.049	0.82	-0.06
Duration at Practice_MismatchReciprocityA	5	5.073	0.787	-0.093
Age_MatchA	24	22.299	2.27	0.749
Age_MismatchA	45	46.428	3.22	-0.443
Age_MatchReciprocityA	2	1.434	0.531	1.067
Age_MismatchReciprocityA	6	6.688	0.939	-0.732
stddev_indegreeA	2.3426	2.3028	0.101	0.396
skew_indegreeA	-1.2179	-1.245	0.052	0.525
stddev_outdegreeA	4.8262	4.8812	0.298	-0.185
skew_outdegreeA	0.9955	1.145	0.095	-1.57
clusteringA_tm	0.6087	0.5877	0.031	0.678
clusteringA_cm	0.1826	0.1896	0.03	-0.228
clusteringA_ti	0.8974	0.9088	0.061	-0.185
clusteringA_to	0.158	0.1495	0.016	0.534

248

Case 1 Socialising vs. Nominations

Statistics	Observed	Mean	StdDev	t-ratio
ArcA	184	183.788	15.787	0.013
ReciprocityA	37	36.885	4.937	0.023
2-In-StarA	492	458.02	76.845	0.442
2-Out-StarA	820	867.169	131.85	-0.358
3-In-StarA	932	751.54	205.665	0.877
3-Out-StarA	2384	2867.493	706.378	-0.684
Mixed-2-StarA	975	969.697	141.863	0.037
030TA	480	435.283	65.799	0.68
030CA	76	78.627	15.497	-0.17
SinkA	16	14.877	1.501	0.748
SourceA	0	0.407	0.643	-0.633
IsolatesA	0	0.719	0.858	-0.838
AinS-A(2.00)	232.865	232.406	28.058	0.016
AoutS-A(2.00)	283.981	283.704	29.107	0.01
AinAoutS-A(2.00)	77.536	77.197	6.104	0.056
Ain1outS-A(2.00)	336.433	341.871	33.714	-0.161
1inAoutS-A(2.00)	230.624	219.265	25.504	0.445
AKT-TA(2.00)	264.188	263.903	31.08	0.009
AKT-CA(2.00)	141.719	141.104	21.981	0.028
AKT-DA(2.00)	256.609	257.795	30.467	-0.039
AKT-UA(2.00)	195.445	182.053	22.81	0.587
A2P-TA(2.00)	631.313	647.449	84.775	-0.19
A2P-DA(2.00)	515.766	582.604	76.449	-0.874
A2P-UA(2.00)	244.215	240.235	38.714	0.103
Matching A Arc-Role	89	88.757	9.121	0.027
Matching A Arc-Gender	129	129.076	12.876	-0.006
Mismatching A Arc-Role	95	95.031	15.068	-0.002
Mismatching A Arc-Gender	55	54.712	8.785	0.033
Matching A Reciprocity-Role	25	23.878	3.77	0.298
Matching A Reciprocity-Gender	27	24.772	4.139	0.538
Mismatching A Reciprocity-Role	12	13.007	4.343	-0.232
Mismatching A Reciprocity-Gender	10	12.113	3.059	-0.691
ArcB	60	60.13	8.099	-0.016
ReciprocityB	4	3.909	1.512	0.06
2-In-StarB	82	72.303	16.52	0.587
2-Out-StarB	290	293.114	84.718	-0.037
3-In-StarB	67	50.276	17.798	0.94
3-Out-StarB	897	930.609	440.593	-0.076
Mixed-2-StarB	164	163.478	37.059	0.014
030TB	89	89.446	26.098	-0.017
030CB	8	7.967	3.25	0.01

SinkB	15	16.127	2.441	-0.462
SourceB	0	0.201	0.423	-0.475
IsolatesB	17	15.873	2.441	0.462
K-In-StarB(2.00)	55.125	51.677	10.263	0.336
AoutS-B(2.00)	96.089	96.349	16.151	-0.016
AinAoutS-B(2.00)	19.162	19.103	1.647	0.036
Ain1outS-B(2.00)	91.75	94.595	17.53	-0.162
1inAoutS-B(2.00)	35.734	33.867	4.54	0.411
AKT-TB(2.00)	67	67.125	16.236	-0.008
AKT-CB(2.00)	19	18.607	6.301	0.062
AKT-DB(2.00)	61.5	65.494	16.243	-0.246
AKT-UB(2.00)	32.797	31.861	4.906	0.191
A2P-TB(2.00)	131	126.235	23.515	0.203
A2P-DB(2.00)	206.688	220.955	57.134	-0.25
A2P-UB(2.00)	28.121	27.376	1.869	0.398
Matching B Arc-Role	11	13.176	2.578	-0.844
Matching B Arc-Gender	50	43.233	6.821	0.992
Mismatching B Arc-Role	49	46.954	7.606	0.269
Mismatching B Arc-Gender	10	16.897	3.971	-1.737
Matching B Reciprocity-Role	2	2.844	1.396	-0.604
Matching B Reciprocity-Gender	2	2.844	1.396	-0.604
Mismatching B Reciprocity-Role	2	1.065	1.03	0.907
Mismatching B Reciprocity-Gender	2	1.065	1.03	0.907
ArcAB	11	11.161	3.976	-0.04
ReciprocityAB	10	9.937	3.399	0.019
ReciprocityAAB	3	4.978	2.377	-0.832
ReciprocityABB	4	2.801	1.935	0.62
ReciprocityAABB	1	0.823	0.851	0.208
In2StarAB	306	277.506	50.027	0.57
Out2StarAB	262	268.438	90.637	-0.071
Mix2StarAB	285	281.664	68.456	0.049
Mix2StarBA	243	241.672	61.956	0.021
TABA	45	43.205	17.667	0.102
TABB	52	43.934	18.469	0.437
TBBA	82	70.278	26.721	0.439
TBAB	29	26.99	11.259	0.179
TAAB	99	77.936	25.73	0.819
TBAA	28	37.427	16.924	-0.557
CAAB	32	40.269	15.254	-0.542
CBBA	27	24.546	9.817	0.25
IsolatesAB	0	0.289	0.562	-0.514
AT-T-ABA(2.00)	24.938	29.32	10.155	-0.432
AT-C-ABA(2.00)	22.25	27.53	9.088	-0.581
AT-D-ABA(2.00)	63.063	53.214	14.421	0.683

250

AT-U-ABA(2.00)	14.406	19.123	6.836	-0.69
AT-T-BAB(2.00)	20	20.404	7.544	-0.054
AT-C-BAB(2.00)	22	19.101	6.775	0.428
AT-D-BAB(2.00)	56.25	53.737	18.475	0.136
AT-U-BAB(2.00)	16.676	15.549	5.039	0.224
Matching ArcAB-Role	4	5.783	2.301	-0.775
Matching ArcAB-Gender	9	9.117	3.407	-0.034
Mismatching ArcAB-Role	7	5.378	2.9	0.559
Mismatching ArcAB-Gender	2	2.044	1.606	-0.027
Matching ReciprocityAB-Role	5	5.564	2.419	-0.233
Matching ReciprocityAB-Gender	9	7.393	2.728	0.589
Mismatching ReciprocityAB-Role	5	4.373	2.426	0.258
Mismatching ReciprocityAB-Gender	1	2.544	1.845	-0.837
Std Dev In-degree dist A	2.7	2.303	0.275	1.447
Skew In-degree dist A	0.521	0.114	0.329	1.234
Std Dev Out-degree dist A	4.955	5.171	0.42	-0.513
Skew Out-degree dist A	0.333	0.59	0.217	-1.182
Global Clustering Cto A	0.293	0.252	0.024	1.685
Global Clustering Cti A	0.488	0.479	0.046	0.201
Global Clustering Ctm A	0.492	0.45	0.035	1.206
Global Clustering Ccm A	0.234	0.244	0.035	-0.276
Std Dev In-degree dist B	1.844	1.678	0.154	1.083
Skew In-degree dist B	0.806	0.645	0.254	0.631
Std Dev Out-degree dist B	3.788	3.768	0.513	0.039
Skew Out-degree dist B	2.154	2.108	0.128	0.361
Global Clustering Cto B	0.153	0.154	0.026	-0.027
Global Clustering Cti B	0.543	0.613	0.076	-0.919
Global Clustering Ctm B	0.543	0.541	0.061	0.025
Global Clustering Ccm B	0.146	0.143	0.043	0.077

251

Case 2 Socialising vs. Nominations

Statistics	Observed	Mean	StdDev	t-ratio
ArcA	104	103.969	15.329	0.002
ReciprocityA	19	18.854	3.757	0.039
2-In-StarA	174	182.253	50.143	-0.165
2-Out-StarA	266	278.87	81.888	-0.157
3-In-StarA	187	230.953	110.724	-0.397
3-Out-StarA	493	553.206	276.898	-0.217
Mixed-2-StarA	319	317.895	75.12	0.015
030TA	158	152.681	40.453	0.131
030CA	22	22.843	7.678	-0.11
SinkA	12	12.694	2.191	-0.317
SourceA	3	4.352	1.876	-0.721
IsolatesA	8	5.996	2.34	0.856
AinS-A(2.00)	106.531	106.548	22.566	-0.001
AoutS-A(2.00)	129.735	129.536	26.407	0.008
AinAoutS-A(2.00)	56.452	53.582	8.014	0.358
Ain1outS-A(2.00)	157.656	150.256	30.212	0.245
1inAoutS-A(2.00)	113.034	113.973	20.737	-0.045
AKT-TA(2.00)	110.813	109.987	24.943	0.033
AKT-CA(2.00)	50.625	49.993	13.998	0.045
AKT-DA(2.00)	100.906	101.442	23.744	-0.023
AKT-UA(2.00)	84.75	82.885	17.3	0.108
A2P-TA(2.00)	256.938	247.965	54.453	0.165
A2P-DA(2.00)	197.094	211.648	59.222	-0.246
A2P-UA(2.00)	110.781	123.472	32.304	-0.393
Matching A Arc-Completed	75	78.48	11.55	-0.301
Matching A Arc-DrNon Doctor	80	74.319	13.744	0.413
Matching A Arc-Role	38	37.694	11.087	0.028
Matching A Arc-Gender	75	75.092	14.05	-0.007
Matching A Arc-Ethnicity	93	93.869	15.266	-0.057
Matching A Arc-Full timePart Time	73	68.698	12.051	0.357
Matching A Arc-Duration at Practice	26	28.534	6.032	-0.42
Matching A Arc-Age	37	25.388	5.511	2.107
Mismatching A Arc-Completed	29	25.489	7.155	0.491
Mismatching A Arc-DrNon Doctor	24	29.65	8.306	-0.68
Mismatching A Arc-Role	66	66.275	11.573	-0.024
Mismatching A Arc-Gender	29	28.877	5.276	0.023
Mismatching A Arc-Ethnicity	11	10.1	3.175	0.283
Mismatching A Arc-Full timePart Time	31	35.271	7.435	-0.574
Mismatching A Arc-Duration at Practice	78	75.435	12.812	0.2
Mismatching A Arc-Age	67	78.581	12.576	-0.921
Matching A Reciprocity-Completed	19	18.854	3.757	0.039

Matching A Reciprocity-DrNon Doctor	16	15.407	3.902	0.152
Matching A Reciprocity-Role	7	8.377	3.372	-0.408
Matching A Reciprocity-Gender	12	12.593	3.415	-0.174
Matching A Reciprocity-Ethnicity	16	15.993	3.707	0.002
Matching A Reciprocity-Full timePart Time	12	11.557	3.155	0.14
Matching A Reciprocity-Duration at Practice	4	5.104	1.793	-0.616
Matching A Reciprocity-Age	9	4.586	1.712	2.579
Mismatching A Reciprocity-Completed	0	0	0	-1.#IO
Mismatching A Reciprocity-DrNon Doctor	3	3.447	2.352	-0.19
Mismatching A Reciprocity-Role	12	10.477	2.933	0.519
Mismatching A Reciprocity-Gender	7	6.261	1.854	0.399
Mismatching A Reciprocity-Ethnicity	3	2.861	1.365	0.102
Mismatching A Reciprocity-Full timePart Time	7	7.297	2.347	-0.127
Mismatching A Reciprocity-Duration at Practice	15	13.75	3.325	0.376
Mismatching A Reciprocity-Age	10	14.268	3.233	-1.32
ArcB	69	69.147	4.895	-0.03
ReciprocityB	8	7.929	1.189	0.06
2-In-StarB	78	74.803	8.172	0.391
2-Out-StarB	443	462.935	65.969	-0.302
3-In-StarB	49	43.212	6.756	0.857
3-Out-StarB	1755	2001.912	442.183	-0.558
Mixed-2-StarB	230	229.654	26.52	0.013
030TB	140	134.743	19.325	0.272
030CB	14	14.084	3.266	-0.026
SinkB	21	21.47	1.754	-0.268
SourceB	0	0.053	0.224	-0.236
IsolatesB	16	15.511	1.754	0.279
K-In-StarB(2.00)	57.25	56.142	5.618	0.197
AoutS-B(2.00)	118.002	118.258	9.787	-0.026
AinAoutS-B(2.00)	17.998	17.975	0.812	0.029
Ain1outS-B(2.00)	121	121.049	11.729	-0.004
1inAoutS-B(2.00)	35.994	35.85	2.39	0.06
AKT-TB(2.00)	91.25	91.181	10.376	0.007
AKT-CB(2.00)	28	27.711	4.649	0.062
AKT-DB(2.00)	90.5	90.479	11.09	0.002
AKT-UB(2.00)	35.67	35.278	2.591	0.151
A2P-TB(2.00)	162.5	163.512	14.4	-0.07
A2P-DB(2.00)	325.688	349.325	45.996	-0.514
A2P-UB(2.00)	19.825	19.697	0.489	0.262
Matching B Arc-Completed	42	42.915	2.706	-0.338
Matching B Arc-DrNon Doctor	30	28.203	2.062	0.872
Matching B Arc-Role	11	9.299	0.996	1.707
Matching B Arc-Gender	27	27.644	2.718	-0.237
Matching B Arc-Ethnicity	52	53.22	4.142	-0.295

253

Matching B Arc-Full timePart Time	48	45.182	4.164	0.677
Matching B Arc-Duration at Practice	27	28.832	3.135	-0.584
Matching B Arc-Age	24	22.129	2.472	0.757
Mismatching B Arc-Completed	27	26.232	3.832	0.2
Mismatching B Arc-DrNon Doctor	39	40.944	4.558	-0.427
Mismatching B Arc-Role	58	59.848	4.823	-0.383
Mismatching B Arc-Gender	42	41.503	3.49	0.142
Mismatching B Arc-Ethnicity	17	15.927	2.498	0.43
Mismatching B Arc-Full timePart Time	21	23.965	1.964	-1.51
Mismatching B Arc-Duration at Practice	42	40.315	3.266	0.516
Mismatching B Arc-Age	45	47.018	3.629	-0.556
Matching B Reciprocity-Completed	4	5.167	0.847	-1.377
Matching B Reciprocity-DrNon Doctor	8	7.929	1.189	0.06
Matching B Reciprocity-Role	3	2.451	0.689	0.797
Matching B Reciprocity-Gender	3	3.468	0.586	-0.799
Matching B Reciprocity-Ethnicity	5	4.902	0.936	0.105
Matching B Reciprocity-Full timePart Time	5	4.467	1.034	0.515
Matching B Reciprocity-Duration at Practice	3	3.164	0.761	-0.215
Matching B Reciprocity-Age	2	1.507	0.539	0.915
Mismatching B Reciprocity-Completed	4	2.762	1.062	1.165
Mismatching B Reciprocity-DrNon Doctor	0	0	0	0
Mismatching B Reciprocity-Role	5	5.478	0.968	-0.494
Mismatching B Reciprocity-Gender	5	4.461	1.027	0.525
Mismatching B Reciprocity-Ethnicity	3	3.027	0.828	-0.033
Mismatching B Reciprocity-Full timePart Time	3	3.462	0.644	-0.717
Mismatching B Reciprocity-Duration at Practice	5	4.765	0.899	0.261
Mismatching B Reciprocity-Age	6	6.422	1.06	-0.398
ArcAB	19	18.82	3.373	0.053
ReciprocityAB	22	21.982	4.317	0.004
ReciprocityAAB	10	12.493	2.788	-0.894
ReciprocityABB	6	11.078	2.541	-1.998
ReciprocityAABB	1	4.136	1.344	-2.333
In2StarAB	197	186.226	30.066	0.358
Out2StarAB	351	362.61	83.087	-0.14
Mix2StarAB	353	353.538	72.55	-0.007
Mix2StarBA	187	185.604	32.197	0.043
TABA	58	52.99	14.348	0.349
TABB	72	93.462	21.171	-1.014
TBBA	122	102.37	19.334	1.015
TBAB	56	52.598	12.041	0.283
TAAB	127	87.207	22.297	1.785
TBAA	51	69.666	18.428	-1.013
CAAB	63	60.434	17.552	0.146
CBBA	67	59.242	14.15	0.548

254

IsolatesAB	2	2.339	1.487	-0.228
AT-T-ABA(2.00)	36.938	36.487	7.917	0.057
AT-C-ABA(2.00)	38.938	40.509	9.376	-0.168
AT-D-ABA(2.00)	68.75	53.067	9.837	1.594
AT-U-ABA(2.00)	23.281	36.484	7.409	-1.782
AT-T-BAB(2.00)	36.25	34.834	6.976	0.203
AT-C-BAB(2.00)	42.375	37.699	8.111	0.577
AT-D-BAB(2.00)	76.688	67.07	11.624	0.827
AT-U-BAB(2.00)	19.777	25.286	5.053	-1.09
Matching ArcAB-Completed	14	15.311	2.803	-0.468
Matching ArcAB-DrNon Doctor	14	14.231	2.907	-0.079
Matching ArcAB-Role	4	4.462	1.354	-0.341
Matching ArcAB-Gender	6	6.635	1.574	-0.404
Matching ArcAB-Ethnicity	12	12.894	2.983	-0.3
Matching ArcAB-Full timePart Time	11	10.709	2.586	0.113
Matching ArcAB-Duration at Practice	6	7.35	1.941	-0.696
Matching ArcAB-Age	7	4.694	1.488	1.55
Mismatching ArcAB-Completed	5	3.509	1.784	0.836
Mismatching ArcAB-DrNon Doctor	5	4.589	2.667	0.154
Mismatching ArcAB-Role	15	14.358	3.103	0.207
Mismatching ArcAB-Gender	13	12.185	2.808	0.29
Mismatching ArcAB-Ethnicity	7	5.926	2.18	0.493
Mismatching ArcAB-Full timePart Time	8	8.111	1.86	-0.06
Mismatching ArcAB-Duration at Practice	13	11.47	2.517	0.608
Mismatching ArcAB-Age	12	14.126	2.852	-0.745
Matching ReciprocityAB-Completed	15	17.189	3.509	-0.624
Matching ReciprocityAB-DrNon Doctor	14	16.652	3.609	-0.735
Matching ReciprocityAB-Role	4	5.669	1.541	-1.083
Matching ReciprocityAB-Gender	9	8.894	2.059	0.051
Matching ReciprocityAB-Ethnicity	16	15.634	3.492	0.105
Matching ReciprocityAB-Full timePart Time	13	13.11	3.144	-0.035
Matching ReciprocityAB-Duration at Practice	3	8.394	2.139	-2.522
Matching ReciprocityAB-Age	9	6.072	1.766	1.658
Mismatching ReciprocityAB-Completed	7	4.793	1.692	1.304
Mismatching ReciprocityAB-DrNon Doctor	8	5.33	2.808	0.951
Mismatching ReciprocityAB-Role	18	16.313	3.785	0.446
Mismatching ReciprocityAB-Gender	13	13.088	3.093	-0.028
Mismatching ReciprocityAB-Ethnicity	6	6.348	2.183	-0.159
Mismatching ReciprocityAB-Full timePart Time	9	8.872	2.048	0.062
Mismatching ReciprocityAB-Duration at Practice	19	13.588	3.188	1.698
Mismatching ReciprocityAB-Age	13	15.91	3.395	-0.857
Std Dev In-degree dist A	2.152	2.193	0.287	-0.145
Skew In-degree dist A	0.448	0.699	0.344	-0.728
Std Dev Out-degree dist A	3.002	3.052	0.424	-0.118

255

Skew Out-degree dist A	1.064	1.056	0.295	0.028
Global Clustering Cto A	0.297	0.28	0.049	0.353
Global Clustering Cti A	0.454	0.426	0.07	0.403
Global Clustering Ctm A	0.495	0.481	0.059	0.248
Global Clustering Ccm A	0.207	0.217	0.057	-0.171
Std Dev In-degree dist B	1.63	1.575	0.065	0.857
Skew In-degree dist B	0.519	0.431	0.137	0.645
Std Dev Out-degree dist B	4.477	4.568	0.314	-0.292
Skew Out-degree dist B	2.368	2.533	0.103	-1.601
Global Clustering Cto B	0.158	0.146	0.016	0.733
Global Clustering Cti B	0.897	0.899	0.063	-0.023
Global Clustering Ctm B	0.609	0.586	0.033	0.703
Global Clustering Ccm B	0.183	0.183	0.032	0.001

Case 1 Trust vs. Nominations

Statistics	Observed	Mean	StdDev	t-ratio
ArcA	169	168.245	14.29	0.053
ReciprocityA	30	29.931	4.545	0.015
2-In-StarA	417	394.237	67.637	0.337
2-Out-StarA	750	690.019	108.013	0.555
3-In-StarA	736	621.141	178.9	0.642
3-Out-StarA	2386	1969.918	501.148	0.83
Mixed-2-StarA	777	769.499	115.135	0.065
030TA	362	303.11	52.536	1.121
030CA	58	53.684	12.342	0.35
SinkA	15	14.309	1.437	0.481
SourceA	0	0.603	0.785	-0.768
IsolatesA	0	0.782	0.852	-0.918
AinS-A(2.00)	206.639	205.434	25.25	0.048
AoutS-A(2.00)	252.285	250.597	26.432	0.064
AinAoutS-A(2.00)	76.43	75.937	5.747	0.086
Ain1outS-A(2.00)	302.973	300.904	31.077	0.067
1inAoutS-A(2.00)	193.097	195.881	22.627	-0.123
AKT-TA(2.00)	205.063	203.582	27.873	0.053
AKT-CA(2.00)	109.219	108.467	19.722	0.038
AKT-DA(2.00)	207.672	199.019	27.388	0.316
AKT-UA(2.00)	148.793	149.894	19.987	-0.055
A2P-TA(2.00)	532.625	564.232	73.684	-0.429
A2P-DA(2.00)	505.133	501.036	65.156	0.063
A2P-UA(2.00)	226.699	238.075	36.12	-0.315
Matching A Arc-Role	83	82.702	8.789	0.034
Matching A Arc-Gender	121	120.431	12.186	0.047
Mismatching A Arc-Role	86	85.543	12.663	0.036
Mismatching A Arc-Gender	48	47.814	7.749	0.024
Matching A Reciprocity-Role	19	20.537	3.63	-0.423
Matching A Reciprocity-Gender	21	20.931	3.929	0.018
Mismatching A Reciprocity-Role	11	9.394	3.535	0.454
Mismatching A Reciprocity-Gender	9	9	2.674	0
ArcB	60	59.299	7.754	0.09
ReciprocityB	4	3.87	1.541	0.084
2-In-StarB	82	70.65	16.14	0.703
2-Out-StarB	290	284.357	79.49	0.071
3-In-StarB	67	49.004	17.6	1.022
3-Out-StarB	897	886.431	404.531	0.026
Mixed-2-StarB	164	160.449	35.117	0.101
030TB	89	86.97	24.704	0.082
030CB	8	7.903	3.179	0.031

257

SinkB	15	16.062	2.443	-0.435
SourceB	0	0.221	0.443	-0.499
IsolatesB	17	15.938	2.443	0.435
K-In-StarB(2.00)	55.125	50.569	9.973	0.457
AoutS-B(2.00)	96.089	94.689	15.46	0.091
AinAoutS-B(2.00)	19.162	19.043	1.668	0.071
Ain1outS-B(2.00)	91.75	93.079	16.833	-0.079
1inAoutS-B(2.00)	35.734	33.676	4.571	0.45
AKT-TB(2.00)	67	65.501	15.504	0.097
AKT-CB(2.00)	19	18.468	6.171	0.086
AKT-DB(2.00)	61.5	63.968	15.39	-0.16
AKT-UB(2.00)	32.797	31.564	4.93	0.25
A2P-TB(2.00)	131	124.321	22.35	0.299
A2P-DB(2.00)	206.688	215.554	53.965	-0.164
A2P-UB(2.00)	28.121	27.234	2.002	0.443
Matching B Arc-Role	11	12.847	2.569	-0.719
Matching B Arc-Gender	50	42.565	6.631	1.121
Mismatching B Arc-Role	49	46.452	7.397	0.344
Mismatching B Arc-Gender	10	16.734	3.985	-1.69
Matching B Reciprocity-Role	2	2.699	1.379	-0.507
Matching B Reciprocity-Gender	2	2.699	1.379	-0.507
Mismatching B Reciprocity-Role	2	1.171	1.03	0.805
Mismatching B Reciprocity-Gender	2	1.171	1.03	0.805
ArcAB	10	10.066	3.328	-0.02
ReciprocityAB	10	9.985	3.579	0.004
ReciprocityAAB	0	4.16	2.145	-1.939
ReciprocityABB	3	2.629	1.813	0.205
ReciprocityAABB	0	0.658	0.781	-0.843
In2StarAB	285	260.81	48.701	0.497
Out2StarAB	198	229.874	71.092	-0.448
Mix2StarAB	331	330.164	86.73	0.01
Mix2StarBA	199	194.993	52.283	0.077
TABA	14	33.205	12.988	-1.479
TABB	45	44.425	17.436	0.033
TBBA	76	58.743	23.052	0.749
TBAB	28	23.739	9.472	0.45
TAAB	119	79.814	26.415	1.483
TBAA	21	27.691	12.577	-0.532
CAAB	37	36.722	14.399	0.019
CBBA	30	24.943	10.042	0.504
IsolatesAB	0	0.313	0.542	-0.578
AT-T-ABA(2.00)	13	24.49	8.138	-1.412
AT-C-ABA(2.00)	27.063	26.404	9.078	0.073
AT-D-ABA(2.00)	69.43	54.751	14.359	1.022

258

AT-U-ABA(2.00)	10.813	16.542	6.146	-0.932
AT-T-BAB(2.00)	19.75	18.125	6.303	0.258
AT-C-BAB(2.00)	23.75	19.606	7.076	0.586
AT-D-BAB(2.00)	48.375	45.74	16.313	0.162
AT-U-BAB(2.00)	14.691	16.254	4.686	-0.333
Matching ArcAB-Role	3	5.722	2.108	-1.291
Matching ArcAB-Gender	8	8.294	2.872	-0.102
Mismatching ArcAB-Role	7	4.344	2.397	1.108
Mismatching ArcAB-Gender	2	1.772	1.481	0.154
Matching ReciprocityAB-Role	4	5.432	2.262	-0.633
Matching ReciprocityAB-Gender	8	7.417	2.813	0.207
Mismatching ReciprocityAB-Role	6	4.553	2.573	0.562
Mismatching ReciprocityAB-Gender	2	2.568	1.861	-0.305
Std Dev In-degree dist A	2.572	2.315	0.269	0.953
Skew In-degree dist A	0.603	0.236	0.321	1.144
Std Dev Out-degree dist A	4.913	4.568	0.366	0.944
Skew Out-degree dist A	0.755	0.547	0.209	0.997
Global Clustering Cto A	0.241	0.22	0.022	0.958
Global Clustering Cti A	0.434	0.387	0.042	1.131
Global Clustering Ctm A	0.466	0.394	0.034	2.119
Global Clustering Ccm A	0.224	0.209	0.035	0.431
Std Dev In-degree dist B	1.844	1.667	0.158	1.128
Skew In-degree dist B	0.806	0.669	0.25	0.548
Std Dev Out-degree dist B	3.788	3.716	0.492	0.147
Skew Out-degree dist B	2.154	2.11	0.14	0.314
Global Clustering Cto B	0.153	0.155	0.027	-0.044
Global Clustering Cti B	0.543	0.61	0.074	-0.913
Global Clustering Ctm B	0.543	0.536	0.062	0.103
Global Clustering Ccm B	0.146	0.145	0.043	0.036

Case 2 Trust vs. Nominations

Statistics	Observed	Mean	StdDev	t-ratio
ArcA	184	183.788	15.787	0.013
ReciprocityA	37	36.885	4.937	0.023
2-In-StarA	492	458.02	76.845	0.442
2-Out-StarA	820	867.169	131.85	-0.358
3-In-StarA	932	751.54	205.665	0.877
3-Out-StarA	2384	2867.493	706.378	-0.684
Mixed-2-StarA	975	969.697	141.863	0.037
030TA	480	435.283	65.799	0.68
030CA	76	78.627	15.497	-0.17
SinkA	16	14.877	1.501	0.748
SourceA	0	0.407	0.643	-0.633
IsolatesA	0	0.719	0.858	-0.838
AinS-A(2.00)	232.865	232.406	28.058	0.016
AoutS-A(2.00)	283.981	283.704	29.107	0.01
AinAoutS-A(2.00)	77.536	77.197	6.104	0.056
Ain1outS-A(2.00)	336.433	341.871	33.714	-0.161
1inAoutS-A(2.00)	230.624	219.265	25.504	0.445
AKT-TA(2.00)	264.188	263.903	31.08	0.009
AKT-CA(2.00)	141.719	141.104	21.981	0.028
AKT-DA(2.00)	256.609	257.795	30.467	-0.039
AKT-UA(2.00)	195.445	182.053	22.81	0.587
A2P-TA(2.00)	631.313	647.449	84.775	-0.19
A2P-DA(2.00)	515.766	582.604	76.449	-0.874
A2P-UA(2.00)	244.215	240.235	38.714	0.103
Matching A Arc-Role	89	88.757	9.121	0.027
Matching A Arc-Gender	129	129.076	12.876	-0.006
Mismatching A Arc-Role	95	95.031	15.068	-0.002
Mismatching A Arc-Gender	55	54.712	8.785	0.033
Matching A Reciprocity-Role	25	23.878	3.77	0.298
Matching A Reciprocity-Gender	27	24.772	4.139	0.538
Mismatching A Reciprocity-Role	12	13.007	4.343	-0.232
Mismatching A Reciprocity-Gender	10	12.113	3.059	-0.691
ArcB	60	60.13	8.099	-0.016
ReciprocityB	4	3.909	1.512	0.06
2-In-StarB	82	72.303	16.52	0.587
2-Out-StarB	290	293.114	84.718	-0.037
3-In-StarB	67	50.276	17.798	0.94
3-Out-StarB	897	930.609	440.593	-0.076
Mixed-2-StarB	164	163.478	37.059	0.014
030TB	89	89.446	26.098	-0.017
030CB	8	7.967	3.25	0.01
SinkB	15	16.127	2.441	-0.462

SourceB	0	0.201	0.423	-0.475
IsolatesB	17	15.873	2.441	0.462
K-In-StarB(2.00)	55.125	51.677	10.263	0.336
AoutS-B(2.00)	96.089	96.349	16.151	-0.016
AinAoutS-B(2.00)	19.162	19.103	1.647	0.036
Ain1outS-B(2.00)	91.75	94.595	17.53	-0.162
1inAoutS-B(2.00)	35.734	33.867	4.54	0.411
AKT-TB(2.00)	67	67.125	16.236	-0.008
AKT-CB(2.00)	19	18.607	6.301	0.062
AKT-DB(2.00)	61.5	65.494	16.243	-0.246
AKT-UB(2.00)	32.797	31.861	4.906	0.191
A2P-TB(2.00)	131	126.235	23.515	0.203
A2P-DB(2.00)	206.688	220.955	57.134	-0.25
A2P-UB(2.00)	28.121	27.376	1.869	0.398
Matching B Arc-Role	11	13.176	2.578	-0.844
Matching B Arc-Gender	50	43.233	6.821	0.992
Mismatching B Arc-Role	49	46.954	7.606	0.269
Mismatching B Arc-Gender	10	16.897	3.971	-1.737
Matching B Reciprocity-Role	2	2.844	1.396	-0.604
Matching B Reciprocity-Gender	2	2.844	1.396	-0.604
Mismatching B Reciprocity-Role	2	1.065	1.03	0.907
Mismatching B Reciprocity-Gender	2	1.065	1.03	0.907
ArcAB	11	11.161	3.976	-0.04
ReciprocityAB	10	9.937	3.399	0.019
ReciprocityAAB	3	4.978	2.377	-0.832
ReciprocityABB	4	2.801	1.935	0.62
ReciprocityAABB	1	0.823	0.851	0.208
In2StarAB	306	277.506	50.027	0.57
Out2StarAB	262	268.438	90.637	-0.071
Mix2StarAB	285	281.664	68.456	0.049
Mix2StarBA	243	241.672	61.956	0.021
TABA	45	43.205	17.667	0.102
TABB	52	43.934	18.469	0.437
TBBA	82	70.278	26.721	0.439
TBAB	29	26.99	11.259	0.179
TAAB	99	77.936	25.73	0.819
TBAA	28	37.427	16.924	-0.557
CAAB	32	40.269	15.254	-0.542
CBBA	27	24.546	9.817	0.25
IsolatesAB	0	0.289	0.562	-0.514
AT-T-ABA(2.00)	24.938	29.32	10.155	-0.432
AT-C-ABA(2.00)	22.25	27.53	9.088	-0.581
AT-D-ABA(2.00)	63.063	53.214	14.421	0.683
AT-U-ABA(2.00)	14.406	19.123	6.836	-0.69

261

AT-T-BAB(2.00)	20	20.404	7.544	-0.054
AT-C-BAB(2.00)	22	19.101	6.775	0.428
AT-D-BAB(2.00)	56.25	53.737	18.475	0.136
AT-U-BAB(2.00)	16.676	15.549	5.039	0.224
Matching ArcAB-Role	4	5.783	2.301	-0.775
Matching ArcAB-Gender	9	9.117	3.407	-0.034
Mismatching ArcAB-Role	7	5.378	2.9	0.559
Mismatching ArcAB-Gender	2	2.044	1.606	-0.027
Matching ReciprocityAB-Role	5	5.564	2.419	-0.233
Matching ReciprocityAB-Gender	9	7.393	2.728	0.589
Mismatching ReciprocityAB-Role	5	4.373	2.426	0.258
Mismatching ReciprocityAB-Gender	1	2.544	1.845	-0.837
Std Dev In-degree dist A	2.7	2.303	0.275	1.447
Skew In-degree dist A	0.521	0.114	0.329	1.234
Std Dev Out-degree dist A	4.955	5.171	0.42	-0.513
Skew Out-degree dist A	0.333	0.59	0.217	-1.182
Global Clustering Cto A	0.293	0.252	0.024	1.685
Global Clustering Cti A	0.488	0.479	0.046	0.201
Global Clustering Ctm A	0.492	0.45	0.035	1.206
Global Clustering Ccm A	0.234	0.244	0.035	-0.276
Std Dev In-degree dist B	1.844	1.678	0.154	1.083
Skew In-degree dist B	0.806	0.645	0.254	0.631
Std Dev Out-degree dist B	3.788	3.768	0.513	0.039
Skew Out-degree dist B	2.154	2.108	0.128	0.361
Global Clustering Cto B	0.153	0.154	0.026	-0.027
Global Clustering Cti B	0.543	0.613	0.076	-0.919
Global Clustering Ctm B	0.543	0.541	0.061	0.025
Global Clustering Ccm B	0.146	0.143	0.043	0.077

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