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DOCTOR OF EDUCATION

An Exploration of Motivation, Relevance and Realism in Simulation Based Medical Education
"I don't want to look like an idiot"

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An Exploration of

Motivation, Relevance and Realism

in

Simulation Based Medical Education:

'I don't want to look like an idiot'

By

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A Thesis submitted to the University of Dundee

For the Degree of

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Abstract

The use of simulation in medical education, as well as the literature in the area, has increased dramatically in the past two decades. There is emerging evidence that simulation can be effective and the features of simulation which result in improved training and patient outcomes are becoming clearer. It is known that attitudes and motivation influence learner behaviour and outcomes, yet there is a paucity of evidence for the effectiveness of simulation which takes this into account. This work offers an original contribution by providing a theoretically underpinned insight into motivation for simulation. It also adds to the literature by reviewing current evidence on the effectiveness of simulation, reviewing the literature on motivation in medical education and qualitatively exploring the factors which can enhance or hinder motivation for simulation in a range of medical professionals. Twenty-three doctors and senior medical students, sampled in existing learning groups, including medical students, foundation doctors, anaesthetists and general practitioners, participated in seven group interviews: transcribed interviews were analysed for content and theme using framework analysis. The results demonstrated a range of simulation experiences, positive and negative value perceptions and pragmatic factors which can enhance or undermine motivation. Positive value perceptions of simulation included providing a rehearsal opportunity, an opportunity to experience rare situations, a trigger for feedback and reflection, and an opportunity for team-working, in a context free from the risk of patient harm. Negative value perceptions included anxiety about role play, peer scrutiny, and making mistakes whilst observed by peers: 'I don't want to look like an idiot', and issues about appropriate degree of realism. Some groups of learners, such as GPs indicated that simulation based courses were less relevant to their learning needs, in contrast with anaesthetic mid-career doctors who considered simulation highly relevant and a normal part of their experience. Pragmatic moderators were also identified, such as time, cost and location. These findings were consistent with existing theories of learner motivation. This thesis makes a further original contribution to the literature by identifying the importance of realism (particularly semantic realism) as a factor influencing motivation. In this study the influence of realism on learner motivation was not readily mapped to existing theories of learner motivation, identifying a gap in the literature. This thesis highlights the importance of recognising anxiety in simulation, and ensuring appropriate realism. It recommends addressing anxiety as part of briefing and de-briefing for simulation, and recommends that course designers enhance internal consistency and semantic realism within simulation scenarios. Future research should take motivation and other learner attitudes into account when evaluating the effectiveness of simulation based educational interventions.

Declaration

I, Lysa E. Owen, declare that I am the author of this thesis entitled 'An Exploration of Motivation, Relevance and Realism in Simulation Based Medical Education: "I don't want to look like an idiot"'.

This thesis is a record of research work that I have undertaken and has not previously been accepted for a higher degree. I declare that I have consulted all references cited within this thesis.

 Signed:

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Abbreviations

ABCDE	Airway, Breathing, Circulation, Disability, Environment/Exposure	ERIC	Education Resource Information Centre
AEI	Australian Education Index	FA	Framework Analysis
ALS	Advanced Life Support	FY	Foundation Year
ALSG	Advanced Life Support Group	GM	Groundedness Measure
APLS	Advanced paediatric Life Support	GP	General Practitioner
ATLS	Advanced Trauma Life Support	GTA	Gynaecology Teaching Associate
AMS	Academic Motivation Scale	ICU	Intensive Care Unit
BASICS	British Association for Immediate Care Scotland	IV	Intra Venous
BEI	British Education Index	MeSH	Medical Subject Headings
BEME	Best Evidence Medical Education	METI	Medical Education Technologies Incorporated
CAQDAS	Computer Assisted Qualitative Data Analysis Software	OSCE	Objective Structured Clinical Examination
CASE	Comprehensive Anaesthesia Simulation Environment	PBSGL	Practice Based Small Group Learning
CET	Cognitive Evaluation Theory	PGY	Post Graduate Year
CINAHL	Cumulative Index to Nursing and Allied Health Professional Literature	PROMPT	Practical Obstetric Multi-Professional Training
CME	Continuing Medical Education	SBE	Simulation Based Education
CPD	Continuing Professional Development	SBME	Simulation Based Medical Education
CPR	Cardio Pulmonary Resuscitation	SDT	Self Determination Theory
CRM	Crew Resource Management	SP	Simulated/ Standardized Patient
CSA	Clinical Skills Assessment	ST	Specialty Trainee
CVC	Central Venous Catheter	UG	Under Graduate
DP	Deliberate Practice	VR	Virtual reality

1. INTRODUCTION

This chapter introduces the thesis submitted for the professional doctorate in education. It introduces the theme of the thesis followed by the rationale of the subject choice. This chapter then outlines the background to the subject, the author's motivation for the subject matter, discusses the original contribution made to the academic community and finally gives an overview of the structure of the thesis.

1.1. Theme of this thesis

This thesis focusses on simulation in medical education. It is widely accepted that simulation plays an important role in training healthcare professionals (Ziv et al., 2006). There is a widely recognized need to improve both the quantity and quality of robust evidence for its effectiveness in the acquisition and retention of skills and the subsequent impact on patient care (Glavin, 2007, Issenberg et al., 2011, Dieckmann et al., 2011) . There is also wide acceptance and a body of literature supporting the concept that learner motivation and attitudes to learning have a significant impact on the outcome of learning (Kusurkar et al., 2013, Mann, 1999). There is, however, sparse published literature which addresses learner attitudes in general, and motivation in particular, to engagement with simulation based education (SBE) in medicine (Issenberg et al., 2011). Some work has been done on barriers, motivation and influencing factors during simulation (Dieckmann et al., 2012). This thesis focuses on this area and on the relationship between motivation, relevance and realism in the specific context of simulation based medical education, and in the context of decisions to participate, as a deeper understanding of these factors will inform course and curriculum designers as they consider both the influencing attitudes, the process of simulation based learning as well as the generation of robust evidence for its effectiveness.

1.2. Background and motivations

There has been a dramatic increase in the use of simulation based education in healthcare education in general and medical education in particular during the past three decades (Bradley, 2006). This has been accompanied by a rapid increase in the published literature on simulation based medical education (Bradley, 2006, Issenberg et al., 2005a). There have been highly influential reports identifying error in healthcare (Donaldson, 2002, Leape, 1994) and calling for more use of simulation to create safe, experiential learning opportunities for novice practitioners as well as experts in medicine, nursing and the professions allied to

medicine (Walton et al., 2010, Ziv et al., 2000, Donaldson, 2009) . There have been many publications reporting the theoretical advantages of simulation in healthcare training (Gaba, 2004, Gordon et al., 2010, Ziv et al., 2005). As a practising medical clinician with day to day responsibility for patient care, and as a medical educator engaged in teaching and learning using simulation the author has a personal interest in critically appraising the current state of simulation based medical education. This includes scholarship relating to the practice of SBE as a technique. In addition there is an imperative to engage fully with the research community to critically appraise and apply contemporary practice in teaching and learning and to generate original contributions to existing knowledge.

1.3. Aim

In 2011 an influential group of international experts on simulation met in order to reach a consensus on the current state of research into, and to set a research agenda for simulation based healthcare education (Dieckmann et al., 2011). They outlined that *'Although the use of simulation as a methodology for learning continues to grow at a rapid pace, throughout all of the healthcare professions and disciplines, research in this field is still at an early stage.'* Additionally the current priority research agenda devised in this setting focusses on issues that are poorly addressed and need further investigation and includes the research questions: 'How does learner motivation affect the acquisition and retention of skills in simulation based activities?' And 'How do theoretical concepts and empirical findings about learning in non-medical domains such as cognitive psychology and sociology apply in healthcare education settings?' The expert group state that

> *'A critical appraisal of the literature pertaining to simulation based medical education revealed that there were gaps in the area of learner characteristics, as "most simulation based research studies only include details such as profession, level of training, previous experience, skills level and gender and too often include subjects who volunteer or who understand there will be little or no consequence to their overall grade, promotion or licensure status based on their performance."'*

There is a clear need for research which moves beyond descriptions of how local institutions use simulation to train learners and to meaningfully contribute to discussions of 'why did it work? Or why did it not work?' Similarly Glavin (2007) emphasizes the need for academic maturity by both qualitative and quantitative researchers to generate robust evidence and to move beyond 'happy scores' of low level (Kirkpatrick et al., 2006) course evaluation. Consequently the following research questions were formulated.

'What motivating and demotivating factors in simulation based medical education do doctors and medical students describe?'

And

'What is the relationship between motivating and demotivating factors, perceived relevance and realism in decisions to participate in simulation based medical education?'

For this thesis the first research question was formulated, planning took place, and data collection took place during January and February 2013 in Dundee, in the context of medical undergraduate and post graduate education. Having collected the data the second research question was subsequently formulated in a bi-directional manner during data analysis and conceptualisation during 2013-14. The primary aim of the study was to identify the widest range of motivating factors or barriers to engagement with simulation based medical education described by a broad range of medical professionals, both at undergraduate level and through a range of post graduate stages and specialties.

1.4. Rationale

It is generally accepted, although some might argue, unproven, that enhanced skill acquisition and retention will inevitably result in positive outcomes for patient care (Okuda et al., 2009). The fact that so many simulation centres have been created in the last ten years by organisations for healthcare training demonstrates the wide acceptance of the role simulation can play in skill training. Nevertheless most experts in the field agree that the evidence for effective transfer of skills from the simulator to improved patient care or outcomes is inadequate in terms of quantity and quality, with much of the published literature based on low levels of evidence such as learner opinion (Dieckmann et al., 2011). There has been a clear call for more robust evidence for effectiveness, and cost effectiveness, as well as a call for appropriate theoretical underpinning. There is clear consensus that *'The no.1 research issue was to study the impact of medical school simulation learning on residents' performance'* (Issenberg et al., 2011). Should this evidence become available then there would be powerful drivers for even wider adoption of the tools and techniques of simulation. This would involve appropriate allocation of resources as simulation is not cheap to set up (Kurrek and Devitt, 1997, Ker et al., 2010). Clinical skills and simulation centres are expensive to set up and run and most often require dedicated facilities and appropriately trained faculty. In the financially competitive world with finite resources, this can only be justified when the evidence is clear for effectiveness as well as cost effectiveness. As the next chapter will show, the vast majority of the published literature in simulation based medical education focusses heavily on either the

process of the simulation learning activity or on the *outcome* of the learning in terms of attitudes, skills, or patient outcome. This thesis argues that in order to produce robust evidence for outcome measures for simulation based learning it is imperative that the *input* factors are also carefully considered and evaluated. Only with detailed understanding and consideration of learner motivation and barriers to engagement can the process of learning be thoroughly understood and properly evaluated. Although this study was carried out in the context of medical education, the results and conclusions could be of value to the academic community utilising or researching simulation based education in multi-disciplinary settings.

1.5. Original contribution

Because of the paucity of empirical studies related to learner motivation for simulation based medical education there is a need for a robust study that critically appraises the motivating and demotivating factors involved in learner attitudes and decisions to participate. This study addresses this need by being theoretically underpinned, methodologically concordant and broader than the previous studies (Savoldelli et al., 2005, Chambers et al., 2000, Decarlo et al., 2008) which will later be shown to be too narrow in focus, simplistic or not related to theoretical considerations. The original aspects of this thesis are that;

- It is a qualitative study exploring motivation for simulation based medical education

- It includes participants at various stages of medical training from undergraduate to experienced specialists in post graduate

- It includes doctors from a range of medical specialties who have diverse experiences and expectations of simulation

There is a hope that the use of simulation as a robust, evidence based and cost effective learning tool in a competitive and litigious healthcare climate might offer part of the solution to the huge challenges faced in contemporary healthcare education, and this thesis will contribute to the robust analysis of simulation in healthcare education, not just in helping answer the question 'Does it work'?, but with utility in answering the questions 'For whom does it work?' and 'How can we make it even better?'

1.6. Structure of the thesis

This thesis is presented in six chapters which cover the following aspects:

Chapter 1: Introduction - presents the topic and the focus of the thesis, setting out the stated aims, rationale and the original contribution which it makes to the academic community with an interest in the use of simulation in healthcare education.

Chapter 2: Literature Review - is presented in two parts, the first emphasising simulation and the second with a focus on motivation. Part 1 - Simulation: The literature review sets the thesis into the context of historical aspects of medical education in general and the development of simulation as learning technology over the past 3 decades. It then outlines the definitions of simulation and identifies the classification and typology of simulators. It critically appraises the key empirical studies, meta-analyses and reviews reporting evidence for effectiveness of simulation in skills acquisition and transfer to patient care and outcomes. The chapter also explores the literature seeking to identify the features of simulation which lead to improved outcomes. Finally it identifies the current gaps in the literature. Part 2 - Motivation sets the historical context for motivation theory and the key publications in theoretical understanding of motivation in medical education and the important contemporary theory of motivation and associated empirical studies which are relevant to this study.

Chapter 3: Methodology - describes the methodological design and paradigm and justifies the choice made, and gives details of the context and location of the study. Participant selection and recruitment is discussed, and the process of data analysis is described in detail. This chapter also discusses steps taken by the author to enhance validity of the findings.

Chapter 4: Reflection - provides a bridge between the methodology chapter and the results chapter. This is to increase transparency and to enable the reader to understand the lens through which the results have been presented and interpreted.

Chapter 5: Results - presents the results of the research demonstrating the themes and sub-themes which emerged from the data.

Chapter 6: Discussion - discusses the results presented in the previous chapter and relates them to the literature review (chapter 2). The chapter emphasizes the emergent themes which can help answer the specific research questions. It explains the results in the context of the gaps identified in the literature and reveals how this empirical research can address these gaps. The chapter discusses the strengths and limitations of the results. The chapter concludes with implications for policy and practice, and recommendations for future research.

Chapter 7: Conclusion - summarizes the main arguments of the thesis and reviews how the findings contribute to answering the research questions and thus makes an original contribution to existing knowledge.

Chapter 8: References - lists all references referred to in the body of text in alphabetical order

Appendices - a peer reviewed Journal publication by the author is included (appendix 1). A letter of approval from The University of Dundee Research Ethics Committee is appended (appendix 2) as well as the participant information and consent forms (appendices 3 & 4) and the interview schedule (appendix 5).

2. LITERATURE REVIEW

The purpose of this literature review is to identify knowledge which is relevant to the topic of motivation and learner characteristics which influence participation in simulation. It will identify work which has already been done in this topic area, to synthesize existing ideas and concepts, to identify key issues and identify gaps, and develop new insight. It will situate this work into the existing body of knowledge and understanding and conceptualisations of other researchers in this area. In addition, the search has sought to identify literature which is related to methodology and data collection techniques. This is detailed in Chapter 3: Methodology (p. 65). It was expected that the literature which addresses *both* of the issues of motivation and simulation was likely to be sparse so this literature review is presented in two parts: **Part 1 Simulation**, and **Part 2 Motivation**. The aims of this literature review are to

- Part 1 Simulation: Identify and appraise the literature on the effectiveness and outcomes of simulation based medical education and to identify whether this literature takes account of learner characteristics particularly in relation to motivation or learner attitude.
- Part 2 Motivation: Identify and appraise the literature on motivation in medical education

2.1. Part 1: Simulation

Part 1 of this chapter is presented as follows. Firstly the key questions which the literature review seeks to answer are explicated. This is followed by a description of the steps taken in the literature search, including which databases and sources were used, the search terms utilized and inclusion and exclusion criteria. The organisation of the findings of the review are sequenced by offering a historical overview of the literature where learning theories in simulation, and the historical development of simulation offer the reader a context for exploring the review level and empirical literature then discussed in the section on key publications. The final section draws together the various shortcomings of the literature to demonstrate the gaps which this thesis addresses.

2.1.1. Key questions the literature review seeks to answer

The importance of the review question in a critical review is articulated by Pawson et al (2005): *'…the review question must be carefully articulated so as to prioritize which aspects of which interventions will be examined.'* The following questions were therefore used to guide the search process and analysis and review of the literature.

Question 1: What evidence does the literature present for effectiveness, impact and outcome of simulation based medical education?

Question 2: To what extent does the evidence identified in Question 1 take account of, or measure, values related to attitude or motivation?

2.1.2. Methodology - how the search was done

It is recognized that this professional doctorate crosses disciplinary boundaries of education and medicine and therefore the literature review encompasses diverse traditions and assumptions. Consequently the searches involved the use of multiple databases. In a Best Evidence in Medical Education (BEME) guide on searching for evidence in medical education, Haig and Dozier (2003) offer a list of the databases most commonly used in peer reviewed published literature searches in medical education. Others (Maggio et al., 2011) have critically appraised published medical education reviews and similarly made recommendations regarding appropriate databases. The following databases have therefore been used in this review. Table 2-1 Medical education databases lists the databases with a brief description of their stated scope.

DATABASE	BRIEF DESCRIPTION
Medline®	The U.S National library of Medicine Database: a very large database scoping biomedicine and health and related educational activities, used frequently for medical searches, and indexed by National Library of Medicine. Medical Subject Headings (MeSH) includes medical education as a subject heading.
Cochrane library	Six medical databases containing citations including randomized controlled trails, quality assessed systematic reviews, expert guidelines. Contains references where simulation has been a theme in controlled trials
CINAHL	Cumulative Index to Nursing and Allied Health Professional Literature. A database with citations relating to nursing and allied health care professions. CINAHL uses the same subject headings as Medline.
ERIC	Education Resource Information Centre is U.S. National Library of Education database. It is a large education database with a focus on primary and

DATABASE	BRIEF DESCRIPTION
	secondary education in North America but it also indexes higher education and medical education citations.
BEI	EBSCO information service host the British Education Index - British equivalent of ERIC
AEI	Australian Education Index is produced by the Australian Council for Educational Research and represents the Australasian equivalent of ERIC as above. Includes higher and medical education
Social Sciences citation index	Hosted by Thomson Reuters, Scientific citation database. Useful as contains both forward and backward citations, so can be useful for searching 2nd generation citations

Table 2-1 Medical education databases

The various databases use different controlled languages. Medline®, for example uses Medical Subject Headings (MeSH), which are shared with the Cumulative Index to Nursing and Allied Health Professional Literature (CINAHL) subject headings. Medline offers the option of exploding these headings. The Education Resource Information Centre (ERIC) database has a controlled language function using a dedicated thesaurus. The social sciences citation index has no controlled language function, and therefore requires a free text approach, with appropriate Boolean operators, to searching.

In medicine there is an emphasis on systematic reviews and meta-analyses in the approach to literature reviewing. The Cochrane Library (n.d.) is a highly valued collaboration which publishes and evaluates reviews of research in healthcare and health policy. They state that a '*systematic review attempts to collate all the empirical evidence that fits pre - specified eligibility criteria to answer a specific research question.*' However, it is widely accepted that systematic reviews are time-consuming and resource intensive (Norman and Eva, 2013). The systematic review approach is deeply influenced by both the (often unstated) positivist tradition in the field of medicine, particularly the evidence based medicine movement, as well as the expectation that new drugs or treatments be experimentally evaluated in a transparent, scientific and replicable way. It is suggested that the systematic review can reduce bias by adopting explicit procedures for reviews. This has had widespread influence in clinical medicine and consequently influences the field of medical education. Whilst systematic reviews can be considered highly desirable for comparisons of outcomes of, for example, new treatment modalities such as drug therapy, this methodology poses potential problems in education research due to differing theoretical approaches. Medical research may often explore a single variable and typical research questions may take the form 'What works?' This

is less useful in social science as issues rarely involve a single variable, and the systematic review methodology can be criticized as being too bureaucratic, excessively time consuming, excessively reductionist and failing to allow interpretivism and creating an artificially limited scope (Bryman, 2008). In fact, it has been argued that this type of approach in medical education actually amounts to silliness (Norman and Eva, 2013). They argue:

'*It is embarrassingly easy to find examples in medical education that, on a moment's reflection, exemplify the silliness of attempts to reduce the complexity of human interaction in an educational setting to a 'treatment' that half receive and half do not, and an 'outcome' such as pass or fail on an examination.*'

Additional problems with systematic reviews are the poor quality of studies in medical education, few meeting eligibility criteria, and heterogeneity of outcome and low yield of studies. Therefore in medical education a 'critical review' approach to the literature can form a sound theoretical basis for a high quality medical education review and is more in keeping with a mixed methods approach. Eva (2008) argues:

'*A good educational research literature review … is one that presents a critical synthesis of a variety of literatures, identifies knowledge that is well established, highlights gaps in understanding, and provides some guidance regarding what remains to be understood. The result should give a new perspective of an old problem… The author … should feel bound by a moral code to try to represent the literature (and the various perspectives therein) fairly, but need not adopt a guise of absolute systematicity.*'

This part of the review therefore adopted a critical review approach. This approach offered an opportunity to incorporate a wide variety of literature from differing traditions, which will *include* systematic reviews as well as others, and so fulfil the stated aims of the literature review as well as pulling together work that is considered unrelated (Bryman, 2008).

The search process and search terms are described here for the purpose of transparency, but it should be understood that this is not intended to be a systematic review, and so is not reported in that form. An initial scoping exercise using Google Scholar comprising the search terms simulat* AND medical education in 2014 generated 54,000 returns. A fully comprehensive review was therefore considered beyond the scope of this thesis. This approach led to a literature search focussed on identifying and appraising the review level literature and some of the publications considered as key papers by the academic community. The review level literature includes systematic reviews, critical reviews and Best Evidence Medical Education (BEME) reviews. BEME reviews (Association for Medical Education in Europe, 2014) were developed to promote evidence informed education in the medical and

health professions, and use systematic review derived methodology to generate best evidence.

As well as a number of review level publications, two papers were included, which were syntheses of an international research consensus summit on simulation in healthcare. Both of these papers were considered highly significant and influential because they brought together international experts on simulation in healthcare and used an Utstein methodology (Cummins et al., 1997), which is a consensus methodology used in healthcare and services research to help make decisions where there may be insufficient information as a means to harness insight of experts to allow decision making. The aim was to identify state of the art educational simulation based research, and reach a consensus on the research agenda for the academic community. Publications between January 1970 and present were included in the original search. Simulation as a teaching strategy is a relatively recent development, and contemporary evaluation and evidence are of greatest interest, so these inclusion dates may be expected to capture important historical aspects as well as the most relevant published material. The following inclusion criteria were applied:

- Systematic reviews, BEME reviews, meta-analysis of simulation in healthcare education

- Literature reviews of evidence in simulation in healthcare education

- Syntheses of simulation research in healthcare education

- Healthcare professionals in training or learning are the primary subjects

- Articles which evaluate primary data pertaining to outcome measures for learning e.g. knowledge, skills, patient outcomes.

The following exclusion criteria were applied:

- Position papers and opinion

- Use of simulation as a methodology to evaluate non-teaching interventions.

The review level publications are discussed below. In addition to considering the review level literature some primary empirical studies which were commonly cited in the review articles, and hence considered by the academic simulation community as offering robust evidence for the effectiveness of simulation, were subsequently appraised. In addition the reference lists for all articles were examined for additional relevant papers. Papers from the author's own existing files, as well as departmental files were also added for consideration. The articles were managed using a citation management software programme (Endnote®).

Before proceeding to the findings of the literature review, it will be helpful to outline the learning theories which are most influential in simulation, by setting out the historical aspects of simulation, and articulating the classifications which the literature uses in describing simulation interventions. The subsequent section then critically appraises the key authors and papers in the field, and summarizes the findings of the literature review.

2.1.3. History - how the literature has evolved to the present

This section situates the current literature review and research into historical and theoretical contexts. This is done by considering the predominant learning theories which explicitly or implicitly influence the research and practice of simulation based medical education and then by outlining the history and development of simulation in medical education.

2.1.3.1. Learning Theory in Simulation

The content in this section is based on a section of a published book chapter co-written by the author of this thesis (Harrison et al., 2014). An educational theory is a group of assumptions and ideas which help understanding of a phenomenon. A theory should be *'comprehensive, coherent and internally consistent, and helpful in informing and guiding practice in medical education in general'* (Rees and Monrouxe, 2010) and in understanding, planning, delivering and evaluation of simulation based medical education (Prideaux and Spencer, 2000). Some authors have criticized medical education and simulation as lacking adequate theoretical underpinning (Campbell and Johnson, 1999, Rees and Monrouxe, 2010, Buniss and Kelly, 2010). There are relatively few peer reviewed published papers which emphasize theoretical concepts in simulation (Kneebone, 2005, Davis and Conaghan, 2002, Zigmont et al., 2011b).

This literature review has identified that in the historical development of simulation as a teaching tool in medical education four educational theories predominate in relation to medical education in general, and simulation in particular. Of course, learning to become a doctor is a highly complex endeavour which could not be explained by any one single theory, but various facets of medical learning have been conceptualized by a number of theorists. The predominant four theories which will be discussed here are Kolb's experiential learning model (Kolb, 1984), social cognitive model (Bandura, 2001), deliberate practice (Ericsson, 2004) and situated learning (Lave and Wegner, 1991). This section offers a brief description of each of these theories and how they have been applied in the context of simulation based medical education.

Kolb's (1984) model emphasizes learning based on the individual's experience, and although it has been criticized as an over simplification, it has often been applied as a theoretical underpinning of simulation. Kolb's experiential learning model identifies the main trigger for

learning as being a concrete experience where the learner must engage in a transaction with their environment, which the learner may reflect upon and form abstract conceptualisation, which leads to critical reflection and active experimentation. Experience in this context can have dual meaning as both subjective and personal, as well as objective and environmental, these two forms of experience *'interpenetrate and interact in very complex ways'* (Kolb, 1984). Simulation offers just such a concrete experience which is sensed through scenario based experiences and most simulation experiences offer structured opportunities for reflection and formulation of abstract conceptualisation which can be symbolic and abstracted and lead to extension and active experimentation and rehearsal of the newly formed concepts. The simulated setting allows the concrete experience to occur in a setting which is safe, both from the point of view of patient safety as well as safe from the learning perspective. The teacher role is that of a facilitator who guides the learner through both the experience and the reflection to enable connections and abstraction to be made. The power of using plural analogical examples, rather than dependence on single case examples has been highlighted as important in deep learning and transfer to novel situations (Norman et al., 2007).

Social cognitive theory (Bandura, 2001) brings together both behaviourist and cognitivist approaches to understanding learning. The behaviourist approach emphasizes the external behaviour of people and their reactions to situations. It addresses the concept of a stimulus–response relationship where a given stimulus, if rewarded will be repeated whereas unrewarded responses will become reduced. In behaviourist theories no account is taken of internal processes. In the context of simulation it is feedback from both consequential clinical happenings as well as faculty or peer feedback which serves to offer the 'reward' for desirable behaviours. Skills and drills in resuscitation training are typical examples of this approach. The cognitivist approach also emphasizes the interaction of the learner with their environment as they assimilate new experiences into their existing concepts and understanding in order to build or challenge existing knowledge or application of knowledge. Bandura however emphasizes human agency as a core value. He asserts that the power to originate actions is a key feature of personal agency. Personal agency is extended through intentionality and forethought, self-regulation, and self-reflectiveness about one's capabilities, quality of functioning, and the meaning and purpose of one's life pursuits. Personal agency operates within a broad network of socio-structural influences. Bandura argues that self–efficacy (the personal agentic belief of ability to control future actions) is an essential element in learning. The application of Bandura's principles in simulation is most often described with reference to self-efficacy: rehearsing a skill or complex procedure or behaviour should both enhance self-efficacy and provide a trigger for reflection.

Deliberate practice is a term introduced by Ericsson et al. (1993) where they identified the development of psychomotor skills in experts in terms of hours of deliberate practice, as a means of explaining variation in individual performances. The theory describes stages of development of skills competence from novice towards mastery and finally to autonomy. Deliberate practice is the repetitive performance of intended cognitive or psychomotor skills in a focused domain, coupled with rigorous skills assessment that provides learners with specific, informative feedback that results in increasingly better skills performance, in a controlled setting. Although this initial work was carried out in relation to speed typists and musicians the concepts have been applied in the context of medical education and simulation (Ericsson, 2004). Much of the literature suggesting advantages of simulation focuses on the opportunity that simulation offers for repetition and practice. This is discussed further in section 2.1.4 (p43)

Situated learning (Lave and Wegner, 1991) is one of several theories where participation in a group, in a socio-cultural setting is key to learning. It is a theory which enables understanding of the apprenticeship model of learning, where a whole community contribute to the development of the apprentice, rather than a single expert. The learning which occurs is through collaboration, social interaction and connectivity with the practice community. This theory suggests that when a new learner enters the community of practice they do so at the periphery. Lave and Wegner (1991) called this legitimate peripheral participation. The novice observes, performs less vital tasks and gradually, with increasing skill and experience moves towards the centre of the community of practice as they learn the knowledge, values and discourse of the whole group which will include experts, peers and more advanced apprentices. The participation in discourse (or talk) within the community is vital to learning. Situated learning theory encompasses cognitive apprenticeship theory and informal learning theories. It is also closely related to the experiential learning model as it includes learning by doing and participating in the shared experience of the community.

Kaufman and Mann (2014) discuss a number of theoretical approaches to medical education. They suggest an approach to applying these to medical education contexts often is, and should be, both opportunistic and pragmatic. They offer a very helpful summary of themes which connect many of these differing theoretical positions to inform practice. These are shown in Table 2-2 Common features of learning theories.

SUMMARY OF COMMON FEATURES OF LEARNING THEORIES IN MEDICAL EDUCATION
All theoretical frameworks view the learner as an active contributor in the learning process
The entire context of learning is more important that any one variable alone

SUMMARY OF COMMON FEATURES OF LEARNING THEORIES IN MEDICAL EDUCATION
Learning is integrally related to the solution and understanding of real life problems
Individual past experience and knowledge are critical in learning, actions and acquiring new knowledge
Learner's values, attitudes and beliefs influence their learning and actions, and building learner's self-awareness in this area is important for their development
Individuals as learners are capable of self-regulation that is, of setting goals, planning strategies and evaluating their progress
The ability to reflect on one's practice (performance) is critical to lifelong self-directed learning
Learning occurs not only individually, but in collaboration with others

Table 2-2 Common features of learning theories. (Kaufman and Mann, 2014)

Papers by Kneebone (2005) and Zigmont (2011b) both offer an overview and exploration of educational theories which are particularly applicable to simulation based learning, with the purpose of enhancing understanding. The benefits of theory, however, are more significant than simply enabling understanding of a particular phenomenon, but rather a robust theory should also enable an academic community to make valid predictions in relation to that phenomenon. In a compelling editorial Norman (2004) argues that poor use of theory functions *'much as a drunkard uses a lamppost, more for support than for illumination'*. He challenges the medical education community to conduct and report research which goes beyond using theory as a support or justification of assertions or interventions and to conduct research which is capable of both testing and challenging theory. He exhorts educational research to enable not just understanding of the phenomenon but generation of theory which can enable predictions to be made. If there is a paucity of simulation literature exploring theoretical constructs in a way which enhances understanding of the phenomenon, there is even less research in the field which develops, tests or challenges theory. Dieckmann et al. (2007) have however made an important contribution in this area with work on developing a theory of immersion and engagement with simulation based learning, both at the level of the individual practitioner and as a learning community. They explore what reality means in the context of a fully immersive simulation experience. The nature of reality is a profound question of ontology and is beyond the scope of this thesis. It is however clearly an important issue to address in any role play or simulation as the degree of engagement, or immersion into the created world of simulation will have a profound impact on the nature and quality of learning. He draws on theoretical work from psychology and from his interviews and video analysis of high fidelity immersive simulation behaviour, and has developed a theoretical framework for

reality and immersion in simulation. This will be outlined and discussed and compared with other conceptual frameworks from entertainment and fiction.

As has already been seen, much research and literature focusses on enhancing realism, in spite of the argument that that more (physical) realism does not necessarily lead to better learning (Norman et al., 2012). It has been proposed that immersive simulation is essentially a social activity and a social learning experience and it has been compared to immersive experiences in entertainment (Dieckmann et al., 2007), which is discussed further in this chapter. Dieckmann et al. (2007) have created a conceptual framework for reality based on three domains of physical, semantic and phenomenological realism. Physical reality refers to the properties of the simulation which can be sensed or are measurable, through sight, sound, feel, for example a blood pressure recording, a laboratory test result, heart sounds on auscultation. The physical realism domain considers the question 'Does this *look, sound or feel* like the real thing?' Semantic realism addresses the question 'Would it *happen* like this in the real world?' This refers to issues of sequencing, timing, changes in physiological parameters, availability of help when required, or the roles played within teams and the degrees of expertise exhibited. The third domain of realism is phenomenological. This refers to how the participant feels and experiences the simulation. It addresses the question 'Would I *feel* like this in the real situation?' This empirical work suggests that semantic realism is much more important to participants than physical realism and that participants have a higher tolerance for physical realism limitations, but yet seem less tolerant of limitations in semantic realism. These three domains of realism are summariszed in Table 2-3 Domains of realism :

DOMAIN of REALISM	DESCRIPTION
Physical realism	Can be measured, sensed E.g. auscultatory heart sounds, vital signs on a chart
Semantic realism	Sequencing, timing, changes, roles and responsibilities consistent
Phenomenological realism	If the learner experience feels as it would in the real situation, stress, emotions, responses

Table 2-3 Domains of realism (Dieckmann et al., 2007)

Pelletier and Kneebone (2015) argue that medical simulation has been studied in terms of learning outcomes or the community of practice, and the construction of knowledge. They argue that if medical simulation is considered as situated in the field of play and game-studies then the cooperative work involved in maintaining the fictional world helps us to see the wider benefits of simulation beyond learning outcomes associated with improved clinical skills, better

educational or patient outcomes. They also suggest that simulation has been used to provide a *'sweet wrapping to disguise an unappetizing educational content'*. The same authors go on to encourage the consideration of simulation as play, as narrative, and as drama, indicating that *how* the simulation is played determines *what* is learnt. They strongly challenge the concept that simulation is an inherently impoverished version of authentic practice, but rather that the fantasy world can be creative and make medicine more meaningful, especially when the emotional elements are deconstructed and de-briefed. The empirical research identified multiple examples of debates about realism arising during de-briefs, especially when 'error' was identified or challenged. They suggest that this may be a more constructive way to deal with the 'simulation deniers': those who say it can never be like the real thing, than justifying the reality breakdowns, in the context of challenging mistakes. Interestingly they also identify that much simulation raises a challenge of the dichotomy of the clinician-as-detective in the narrative versus the rehearsal of protocol and the conflict this raises between autonomy and agency. This acknowledgement of the cooperative work involved in creating and maintaining belief in the fantasy leads towards the second lens through which reality can be considered.

Another helpful insight can be gained from a different context which can be considered analogous to immersive simulation; that is the entertainment industry. This is helpful both in terms of a language of realism and also conceptualisation. The terminology of 'suspension of disbelief' is very helpful. An audience choose to believe that the fiction created is 'real' even when they 'know' it is a fictional representation. This leads to another helpful framework, which is derived from insights of the famous fiction writer J.R.R Tolkien (Owen, 2015a). In an essay 'On Fairy Stories' (Tolkien, 1964) where he discusses his creation of fantasy kingdoms in relation to reality, he introduces the idea of primary and secondary realities. The primary reality might be the location and facilities provided for learning, the secondary reality is another world or kingdom created as a fictional entity entirely hence analogous with the simulation scenario. Tolkien asserts that the characteristics of the secondary reality can be as creative or even fanciful, as the author wishes, but stresses that the internal consistency of the secondary world is essential in the suspension of disbelief. This concept of primary and secondary realities could provide a helpful, additional framework for considering simulation. As Tolkien's conceptualisation suggests, if the reality of the created world i.e. the simulation is internally consistent then one can fully engage in the secondary reality. Understanding of, and attention to detail in, creating internal consistency within the secondary reality may lead to more effective engagement and consequently better learning, as well as more cost-effective use of resources in simulation based learning. Interestingly, Tolkien also emphasizes that through the use of fantasy, the reader is able to experience a world which is consistent and rational, under rules other than those of the normal world. Tolkien suggested that fairy stories

allow the reader to review his own world from the 'perspective' of a different world. This concept, which shares much in common with phenomenology, Tolkien calls 'recovery.' Recovery in the sense that one's unquestioned assumptions might be recovered and changed by another perspective. This thesis represents, then, not just a description of a phenomenon, but empirical research which deepens understanding of simulation as well as testing, challenging and developing existing theory even further.

2.1.3.2. History of simulation in medical education

Having discussed how the simulation literature presents learning theory, this chapter now outlines the historical and developmental aspects of medical education. It begins with an overview of the history of medical education, it then outlines how important changes and events became drivers for reform and the development of simulation, before finally describing the emergent classification and descriptions of various types of simulators and simulations. The section which follows, therefore, may be of most interest to the reader less familiar with simulation in medical education.

Medical education has historical roots going back thousands of years. Hippocrates in Ancient Greece (c.460-370 BC) is widely regarded as the father of both the practice of, and training in, modern medicine. Until the Victorian era and early part of the 20th century, medical education occurred as an apprenticeship and teaching occurred almost exclusively at the bedside and using patients as the primary teaching subject material (Fulton, 1953). This model followed a pattern where a learner would be closely associated with an expert, would observe practice, and under expert supervision would gradually begin to participate in practice with increasing degrees of complexity. *'See one, do one, teach one'* attributed to WS Halstead, a surgeon at Johns Hopkins University (Bergamaschi, 2001) was the maxim of medical education for decades.

As the 20th century progressed medical education gradually moved away from the bedside and the apprenticeship model, to a higher education model and this was associated with both a physical move into the classroom and towards dedicated teaching facilities. Bedside teaching was preceded by didactic teaching in lectures. This was associated with increasingly formalized recruitment of, training of, and delivery by, dedicated teaching faculty. Flexner, in the United States and Osler in Britain were considered pioneers in medical education in this era and were the first to formally promote the structure of medical curricula (Cooke et al., 2006). This curricular model continued as the predominant model for more than a century, and was typified by early introduction to scientific method, the study of anatomy, physiology and biochemistry of normal human structure and function, followed by a second phase, the study of disease in pathology, pharmacology and disease management, and a final phase,

the clinical phase of applying the basic sciences to individual cases under the mentorship of experienced clinicians (Gleeson, 1993).

Higher education was also undergoing significant change during the latter part of the 20th century. With the development of more access for lay people and learners to information which had previously been accessible only to the traditional professional groups, the role of the professional-expert to deliver information to passive receiver-learners was becoming outdated, and the role for the professional educator evolved to that of mentor and coach engaging in productive and challenging dialogue with learners, with a greater emphasis on learning to reason, appraise and create knowledge rather than rote learning of information. The emergence of evidence from educational psychology on how learners can learn effectively also led to a reduction of teaching and learning activities such as lectures and an increase in contextual learning, learning through application, and experience, critique and analysis and skills needed for the creation of new knowledge.

Medical care and the practice of medicine itself have undergone rapid change. New treatments and technologies have become available, our knowledge of illness, disease processes and treatment options have become ever more complex. Modern curricular reform in medical education saw curricula become variously influenced by moves towards patient–centeredness, improving doctor-patient communication skills, team based and problem based learning approaches, and greater integration of doctors as members of the multi-professional skills team (Spencer, 2003). Other changes which have had major influences on the content and process of medical education in the late 20th and early 21st century include changes in working time for doctors and changes to the structure of training. This has led to a reduction in the total training time for doctors from graduation to autonomous practitioner, as well as reducing the available time for expert faculty to dedicate to teaching and mentoring activities (Illing et al., 2008). Demand grew for alternative strategies which could be readily programmed into timetables, were reproducible, available on demand and provide greater time efficiency.

The availability of teaching and training 'subjects' was also decreasing. Cadavers and animal carcasses were less available (McLachlan and Patten, 2006). Patients were no longer kept in hospital for prolonged periods of convalescence and those who were in hospital were more unwell, and therefore less able to participate in the teaching and training of students and junior doctors (Department of Department of Health, 2002). Non-consenting patients had historically been used as teaching and learning subjects, particularly for intimate examinations (Feldman et al., 1999, Rees and Monrouxe, 2011). It became clear that this was neither ethical, nor acceptable to the public and the combination of these changes reduced the availability of patients as teaching material.

The later part of the twentieth century also saw a number of public scandals and enquiries highlighting failings by individual practitioners, teams and regulatory bodies. In 2000 a previously respected General Practitioner (GP) Harold Shipman was found to have murdered up to 250 of his patients over a period of 15 years without detection by colleagues, police, the coroner or the regulatory bodies (Smith, 2005). In Bristol in the 1990's many babies died after undergoing complex heart surgery, where there was a culture of secrecy about surgeons' performances, lack of leadership and lack of regulation (Smith 1998). More recently the Francis report (2013) revealed that in a Mid-Staffordshire hospital substandard care, appalling conditions and inadequacies went undetected amid a toxic culture of poor leadership and lack of compassion for patients and their families, resulting in an estimated 400-1200 more deaths than would have been expected for a hospital of this size. At an individual, team and institutional level, the reports into Shipman, Bristol Heart, and Mid-Staffs failings have had a profound influence on societal expectations and the prevailing political agenda (McIndoe, 1998). Among the many types of failings identified, it appeared that the existing models of medical education were inadequate.

The report by the United States Institute of Medicine, 'To err is Human' (Kohn et al., 2000) revealed the true extent of failing in the healthcare system, as well as the extent and cost of errors. An expert report exploring the National Health Service (NHS) in Britain, commissioned by the Chief Medical Officer for England and Wales 'An organisation with a memory' (Donaldson, 2002) identified similar concerns and concepts in the UK setting. The concept of healthcare causing patient harm, an anathema to the Hippocratic imperative to 'first do no harm' heralded the rise of a modern move which became known as the patient safety movement. In parallel with the wide societal changes in expectations of the medical profession and its regulators, the emerging patient safety movement and apparent failures of the traditional learning models, new technologies for learning and simulation were becoming available. The developing medical simulators played an integral role in the patient safety movement because the techniques appeared to offer a safe environment to learn, rehearse and assess the complex skills needed for practitioners and teams to offer the safe medical care required. In his annual report the chief medical officer for England wrote *'Simulation training in all its forms will be a vital part of building a safer healthcare system'* (Donaldson, 2008). The next section describes this development of simulation technologies for medical education.

Medical simulation is not new and just as medical education has ancient historical roots, so too does simulation. It has been reported that the ancient Mesopotamians used sheep lungs and liver to create simple models to train disciples in the skills required for temple priesthood duties (Kunkler, 2006). In ancient Greece circa 200 A.D. Galen created human body models

for instructing in the medical crafts (Kunkler, 2006). Recently the technological transformation has allowed the replication of ever more realistic human body functions and complex clinical settings for individual learners and teams. This development is advancing more rapidly than in any other period of history. In the early 1950's a family company in Norway who manufactured children's toys and dolls, discovered that the newly available soft plastics made their products much more life-like than the porcelain and wooden predecessors (Tjomsland and Baskett, 2002). Their company Laerdal® used a death mask from a beautiful young woman found dead in mysterious circumstances in the River Seine in Paris to create the first life-sized doll which could be used as a substitute for real patients in training in mouth to mouth resuscitation. There can be little doubt that the wide availability of this low cost model revolutionized modern practice in cardiopulmonary resuscitation (Tjomsland and Baskett, 2002). Development of products continued as computing and virtual reality technology advanced.

Ker and Bradley (2007) have illustrated that this increasing availability of new technology was at the centre of the dramatic increase in the use of simulation in medical education, but they also identify many of the other drivers outlined in the previous section which have also influenced this rapid increase. These include political changes in higher education, reduced availability of patients as "teaching material", reduced working time, public scandals and changing patient expectations and the rise in the patient safety movement, and the influence of aviation and other high risk industries. They describe the development of a new model by Abrahamson and Denson which had advanced physiological functionality as early as 1960, but assert that simulation was not readily adopted to a large extent at that time because the need for anything other than an apprenticeship model of learning had not been defined, until the emergence of the socio-political issues described above (Bradley, 2006). The relationship between these driving factors is illustrated in Figure 2-1.

Figure 2-1 Drivers for development of simulation (Ker and Bradley, 2007)

Another important historical influence on the development of the patient safety movement and increased utility of simulation was the transformation taking place in the aviation industry (Burke et al., 2004, Anon, 2007, Helmreich, 2000). Military, space, aviation, nuclear and off-shore industries were demonstrating a commitment to simulation programmes. What these industries had in common with each other and with medical practice was that training or testing in the real world was either too costly or too dangerous (Reason, 2000, Helmreich, 2000).

In aviation the first manned flight happened in 1903 and within twenty years the first flight simulator had been developed to meet the need for safer and cheaper skills training for potential pilots. The primitive simulation technology of the 'blue box' or 'Link' flight simulator, pioneered by Ed Link, gained rapid adoption into commercial use during world wars I and II when demand for skilled fighter pilots peaked. Air travel was increasing throughout the 20th century, but a number of aviation tragedies during the 1970's were carefully analysed using 'Black Box' technology. When aviation tragedies were carefully analysed, the most significant factor contributing to harm was not mechanical failures, but rather, failures in human factors such as team communication, situational awareness, and resource management. The aviation industry was influenced by work initiated by the National Aeronautics and Space Administration (NASA). Aviation teams were then required to undergo mandatory training in the simulator, not just for personal or technical skills, but for human factors training in team

work and team communication. There was a growing evidence base for the positive impact of crew resource management (CRM) training on aviation safety (Salas et al., 1998).

Pioneers in medical education recognized the many similarities between systems, processes and cultures in aviation and in the healthcare system and began to explore how similar technology, process and understanding could be utilized to make healthcare safer (Gaba et al., 2001). Gaba pioneered the development of a whole body, physiologically functioning simulator: the comprehensive anaesthesia simulation environment (CASE), later to become known as 'Medsim' at Stanford in the USA (Gaba and DeAnda, 1988) and integrated its use into critical care training with an emphasis on human factors. This group adapted Crew Resource Management (CRM) in response to the success of the model in aviation (Gaba et al., 2001) In parallel, Good and Gravenstein were developing the Gainsville Anaesthesia Simulator (GAS), later to become METI® Man (Medical Education Technologies Inc.) (Good and Gravenstein, 1989). These complex simulators were designed for training in the technical skills of anaesthesia, ventilation and invasive procedures, as well as the non-technical skills or human factors. The timeline illustrating the parallel developments in cardiopulmonary resuscitation training, anaesthesia simulation development and medical educational reform is shown in Figure 2-2 The major movements of the late 20th century driving the adoption of simulation (Bradley, 2006).
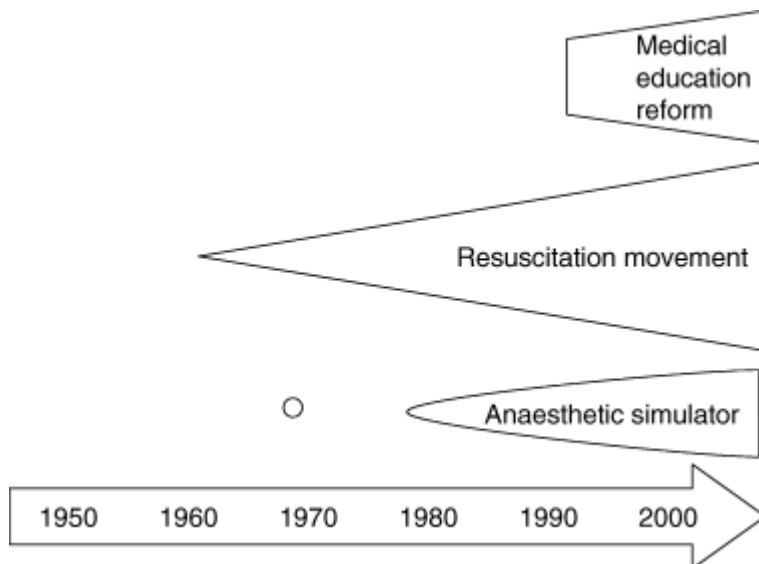
Figure 2-2 The major movements of the late 20th century driving the adoption of simulation (Bradley, 2006)

As well as the historical development of models and mannequins, medical educators were using the principles of role play to create realistic learning scenarios using volunteer human subjects: simulated patients. A simulated patient (SP) is an individual who is trained to portray the symptoms or signs of an illness or state of mind which they do not actually have, for the

purpose of teaching or assessment. Howard Barrows (1968) pioneered the use of simulated patients and published a description of their use in the context of physical examination in patients with neurological conditions. He continued to develop the work and published a landmark paper describing the advantages, training and utility of the simulated patient (Barrows, 1968). The seminal moment of this development is described (Wallace, 1997):

> *The director… made rounds on his patients… he interviewed a patient known to everybody as Sam, who had syringomyelia. When asked about the examination, Sam remarked that there had been no particular problem except for the physician who had examined him last. Sam indicated that that physician had been quite hostile and had performed a very uncomfortable neurological examination. The Director said that he was sorry to hear that, but Sam said 'Don't worry I fixed him I put my Babinski on the other foot and changed my sensory findings.*

Whereas Barrows work had focussed on the SP as teaching material to be used in a learning setting, led by expert faculty, others further developed the role of non-medical trained individuals by developing the skills of these para-professionals such that they could offer feedback and teaching to learners on their skills whilst using their own bodies as learning material (Wallace, 1997). The SP could become the teacher as well as the subject. In a similar way to the rapid adoption of mannequins into medical education, the 1970's onwards also saw a dramatic increase in the adoption of SP's into undergraduate and postgraduate medical education, along with a corresponding increase in published literature describing their use, benefits and evaluation of this teaching. Between 1966-1976 the number of citations found relating to SP's was 5, this had increased to 149 by the decade 1987-1996, and the role and use of SP's in medical education was described as the single most studied simulation tool in medical education (Ziv et al., 2000).

The literature reflected this increase in the use of simulation by describing the advantages of simulation over the apprenticeship model (Maran and Glavin, 2003, Laiou, 2010, Ker and Bradley, 2007). Advantages were proposed by a number of authors (Ziv et al., 2005, Okuda et al., 2009, Gaba, 2004) and a summary of these advantages is illustrated in Table 2-4 Advantages of simulation below.

ADVANTAGES OF SIMULATION PROPOSED IN THE LITERATURE
• Training poses no risk of harm to patients.
• Learners can engage in repeated practice of scenarios and actions.
• Learners are allowed to make mistakes, explore the consequences of their actions, react to rectify deviations and learn from these.

> - Learners can practice rare or infrequent events so training can offer exposure to 'patients' with all the disease states that health professionals need to be able to recognize and manage.
> - Team training and crisis management can be practiced in a controlled environment using a full range of the health care personnel involved in such cases.
> - Training times can be real or altered to suit the training needs of the learners.
> - The level of complexity can be altered to suit the training level of the learner.

Table 2-4 Advantages of simulation (Laiou, 2010)

Finally, having outlined the historical development of simulators, this section will provide the reader with an understanding of the classification of medical simulators and simulations and offer some illustrative examples. A number of publications have outlined models for classifying medical simulators and simulations in terms of technical aspects (Issenberg et al., 2005b, Bradley, 2006, Maran and Glavin, 2003). Another classification (Meller, 1997) differentiates components of a simulation in relation to the direction of interaction between each component, the components being

- The patient or disease process

- The procedure, test or equipment

- The physician or other practitioner (learner)

- The expert practitioner (teacher)

The educational approach, as well as the nature of the interaction between participants and artefacts in a simulation is clearly of great importance, nonetheless it is classifications which use the physical descriptor of the type of simulator or technology used which remain the most prevalent and the most commonly used in the literature. The most prevalent classification of simulation is that described by Maran and Glavin (2003) which is summarized in Figure 2-3 Classification of simulators and further descriptions of each type are discussed in more detail below.

> - Part task trainers
> - Computer based systems
> - Virtual Reality and haptic systems
> - Simulated patients
> - Simulated environments
> - Integrated Simulators
>   - instructor driven simulators
>   - Model driven simulators

Figure 2-3 Classification of simulators (Maran and Glavin, 2003)

Although this commonly used classification system uses physical properties of simulators as the primary means for classification, and the associated short hand terminology of high-, mid- or low-fidelity, it has been argued that physical characteristics are not the most important feature in simulation in terms of educational outcome. The assertion that higher fidelity is better for learning than low fidelity has been vigorously challenged (Norman et al., 2012) and the debate on the importance of level of fidelity is discussed in detail in section 2.1.4 (p38) . Along with new technology the development of a new language has occurred. Gaba (2004) defines simulation as a technique '*to replace or amplify real experiences with guided experiences that evoke or replicate substantial aspects of the real world in a fully interactive manner.'* Language is important, and can carry high value. It is essential in research, practice and publication that reader, learner and listener share the understanding. One of the most powerful pieces of language in simulation is fidelity. Fidelity (from the Latin *fides* - faithful) is defined by the Oxford English Dictionary as the degree of exactness with which something is copied or reproduced. In lay terms the word 'fidelity' was popularized in relation to quality of sound and music reproduction. Hi-Fi became an aspirational term. In terms of medical education however this is more complex and challenging. Interestingly, attempting to classify simulated patients in this way has caused some difficulty in definition of fidelity level. The problem with the concept of fidelity is that often the constructed meaning is in relationship to physiological and technical approximations to reality. Dieckmann et al (2007) and others have analysed the psychological aspects of reality, realism and immersion in simulation scenarios, and proposed that physical reality may be of much less importance in learner engagement than semantic or phenomenological realism. This was discussed in section 2.1.3.1 above.

It may be that a new terminology which embraces simulation, going beyond the technical implications of fidelity, one which can embrace the semantic and phenomenological aspects of the learning experience is required. In simulation based learning we are seeking educational and clinical integrity. Integrity (from Latin *integritas* - intact) is the condition of being unified or sound in construction: It has been demonstrated that low technical fidelity can generate highly authentic learning contexts where integrity - *sound construction* - built on appropriate learning outcomes is achieved. For example, in the author's own institution, increasing experience in ward simulation exercises at undergraduate (Ker et al., 2003) and post graduate levels (Ker et al., 2005), uses high integrity simulation in preparing students for learning in hospital, outpatient and community settings (Owen et al., 2008). Others (Crichton et al., 2000) have described the use of high integrity learning using tactical decision games to allow deliberate practice of decision making under pressure. Also simulation has been used to study and teach ethical reasoning in highly authentic complex ward based settings (Lewis et al., 2016). These examples illustrate that the use of a new terminology of integrity may

reflect the true value of an ever more diverse range of simulation based education strategies. The debate in the literature about whether high-fidelity simulation is superior to low-fidelity simulation is discussed in detail in section 2.1.4 (p38), but examples and descriptions of various types of simulators are discussed in the section which now follows.

Part task trainers are models of specific anatomically based body parts which allow the deliberate practice of specific tasks or skills to be carried out by the learner. Examples of this type of training model include arm models which are used for skills involving gaining access to veins either for venepuncture (removal of a small sample of blood for the purpose of diagnostic tests) or insertion of intravenous (iv) devices to allow the administration of drugs or fluids. The model is an anatomically based layered model with components to represent veins, blood, and skin and sub cutaneous connective tissue. Other typical examples would be models replicating the anatomical structures and relationships of the human patient pelvis and rectum in order to teach and practice the skill of performing a digital rectal examination for diagnostic purposes. An example is shown below in Figure 2 4 Part task trainer
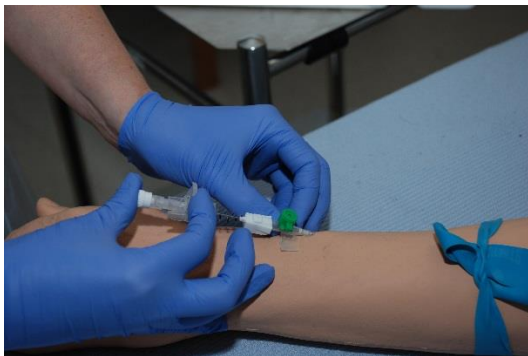
Figure 2-4 Part task trainer (image © University of Dundee)

Computer based systems have been developing in line with technological advances. They provide an interface which can allow interaction between a learner and group of learners and typically relate to basic science knowledge and understanding, for example physiological function. The materials allow interactions and relevant feedback to reinforce learning. Virtual reality generates images representative of objects or environments with which the user interacts and which respond to those actions. Haptic systems additionally generate kinaesthetic and tactile sensation (Ker and Bradley, 2007). These simulations are commonly in use in surgical simulations of endoscopic, laparoscopic or interventional radiology procedures, but are not emphasized in this thesis.

A simulated patient (SP) is defined and discussed above. It has been suggested that an advantage of the use of these individuals in teaching communication and clinical skills is the ready replicability and ability to offer a standardized teaching and assessment experience to

a large number of students time after time - and so the term standardized patients is also used (Wallace, 1997). Although some might argue there is a subtle difference, the terms simulated patient and standardized patient will be used interchangeably in this thesis. Because simulated patients are human beings with physical and affective attributes and responses they could arguably be identified as the highest available fidelity. The use of SPs in undergraduate and post graduate medical education has, however been mainly restricted to doctor-patient communications skills teaching, learning and assessment of professionalism. The integration of simulated patients with part task trainers in order to enhance integration of procedural skills with the essential communication skills required for procedures in novice learners has also been described (Kneebone et al., 2002) and illustrated in Figure 2-5 Integrated part-task trainer and SP below.

Figure 2-5 Integrated part-task trainer and SP (Kneebone et al., 2002)

Another specific and specialized group of simulated patients known variously as patient educators, gynaecology teaching associates (GTAs) and professional patients comprise a group of trained individuals who use their own bodies as the primary teaching medium for intimate examinations of male and female genitalia (e.g. rectum, breast, scrotum or vagina) and are specifically trained to provide feedback to the learner on technique and anatomical understanding, from the patient perspective.

When learning cannot take place in the real clinical setting due to interference with on-going clinical care, safety issues or the likelihood of distraction a variety of clinical workplace settings have been replicated in a dedicated teaching and learning venue (Ker et al., 2003) These have included replications of hospital wards (Ker et al., 2003), operating theatres (Kassab et al., 2012), intensive care/high dependency units (Allan et al., 2010), dental practices (Shefet et al., 2007), roadside and motor vehicle settings and domestic environments (Shefet et al., 2007). An example of a simulated ward is shown below. Simulated learning environments may incorporate multiple simulation modalities; simulated patients, part task trainers, full body mannequins and integrated simulators.

Figure 2-6 Simulated ward environment (image © University of Dundee)

The historical development of integrated simulators is described in section 2.1.3. Integrated simulators are full size human boy replicas with computerized controls that have the capacity to control physiological parameters such as pulse rate, pulse strength, blood pressure, heart sounds and breath sounds which can be varied within scenarios. The sub-classification of simulators in this group is into model driven or instructor driven (Maran and Glavin, 2003).In the model driven simulator the model itself is programmed to generate appropriate responses to medical interventions in a sophisticated range of illnesses and diseases. It is often referred to as a high fidelity simulator.

Figure 2-7 Instructor driven integrated model (image © University of Dundee)

These high fidelity simulators are almost always accommodated in dedicated facilities with dedicated teaching faculty and specialized technical support. This type of simulator was originally designed with the medical specialty of anaesthesia and it strongly associated with anaesthetic training and similar acute and critical care specialties such as emergency medicine. Use of this type of simulator has also been described in the teaching of basic

sciences to early medical undergraduates, particularly physiological responses to environment or illness (Rosen et al., 2009). Instructor driven integrated simulators are known as mid- or intermediate-fidelity simulators, and require the instructor to intervene to alter the physiological parameters. This can be done directly via the controlling computer keyboard interface or by programmed pre-written scenarios in a computer algorithm. Simman® is a typical example of this type of simulator. The instructor driven integrated simulators may also be used with wireless technology and so are fully portable and can be used in generic teaching or dedicated simulation facilities, as well as in-situ simulations.

Having outlined the learning theories influencing simulation, and setting this research within the historical context of medical education and simulation development over time, and finally outlining the classification of simulators, the next section critically appraises the key authors and papers in the field, before summarising the findings of the literature review.

2.1.4. Critical Discussion of key literature

This section proposes a working definition of simulation before critically appraising the key literature. The noun 'Simulation' is derived from the Latin *simulatus* - meaning 'copied, represented'. Various definitions of simulation have been used in the context of medical and healthcare related education and training. A simple definition of simulation according to Ker and Bradley (2007 p.2) is:

> *"a technique of imitating the behaviour of some situation or process (whether economic, military, mechanical...) by means of suitably analogous situation or apparatus, especially for the purpose of study or personnel training.'*

Rosen (2008) similarly defines simulation as: *'An imitation of some real thing, state of affairs or process for the practice of skills, problem solving and judgement.'* A more detailed description (Entwhistle, 1991) elaborates simulation in the specific context of teaching and learning as: *'A working representation of reality; it may be abstracted, simplified or accelerated model of the process. It allows students to explore systems where the real thing cannot be used for teaching purposes because it involves other people; it is too expensive, complex, dangerous, fast or slow'.* These three definitions are not contradictory as they all embrace the concept of a created representation of reality for practice or training. The latter definition will be used in this thesis as it captures more elements that are distinctive about simulation when compared with other teaching modalities, for example, it may be of importance for experiential learning that simulation can allow alteration of time constraints for the purposes of teaching, when the real situation cannot be developed in the same manner, as patient care may be compromised or indeed endangered. Also, this definition hints at the advantages of simulation

which are shown in more detail in Table 2-4 Advantages of simulation (Laiou, 2010). When Gaba (2004) describes simulation as being '*a technique – not a technology – to replace or amplify real experiences with guided experiences that evoke or replicate substantial aspects of the real world in a fully interactive manner*', he also captures an important aspect of defining simulation in terms of *how* technology is used as well as the physical description of the devices or technology involved.

Having proposed a working definition of simulation, this section will discuss a number of key publications on simulation in medical education. Table 2-5 Summary of review level papers below shows a summary of the key publications which have been included in the section.

AUTHOR	YEAR	INCLUDED STUDIES	SUMMARY	CONCLUSIONS
Byrne et al.	2008	10	BEME review: Which simulations modalities are most effective, compared with each other?	Insufficient evidence to recommend one modality over another
Cook et al.	2011	609	Comparing simulation with no- or traditional teaching methods	Technology enhanced learning resulted in better outcomes. Large effect size for knowledge, skills and behaviour
Issenberg et al.	2005	109	Features of high-fidelity medical simulations that lead to most effective learning	9 features identified
Gurusamy et al.	2008	23 RCTs	VR training for laparoscopic surgery	VR reduces surgery time, errors and complications
Sutherland et al	2006	30 RCTs	Compared simulator training for laparoscopic surgery	Studies were poor, subject to bias and inconclusive
McKinney	2013	18	Cardiac auscultation skills	Studies of poor quality, simulation effective for cardiac auscultation.
Sturm et al.	2008	11	Skills transfer to operating after VR training	Low quality studies, but skills were transferable to workplace
McGaghie et al.	2011	14 studies	Meta-analysis of simulation with deliberate practice versus	Simulation with deliberate practice

AUTHOR	YEAR	INCLUDED STUDIES	SUMMARY	CONCLUSIONS
			traditional models. Including 633 medical learners	results in better skill outcomes

Table 2-5 Summary of review level papers

The reviews by Byrne et al. (2008), Sutherland et al. (2006), Gurusamy et al. (2008), Sturm et al. (2008), McKinney et al. (2013) and Cook et al. (2011b) summarized in Table 2-5 Summary of review level papers will be discussed in this section as they deal with the quest for evidence for the effectiveness of simulation. Following the discussion of these review level articles, some of the most important empirical research included in the reviews is also discussed. The review by Issenberg et al. (2005b) seeking evidence for the features of simulation which lead to effective learning and McGaghie et al. (2011a) are discussed later in this section (p40). The subject of the quality and quantity of evidence for effectiveness of simulation as a teaching and learning technology has been vigorously debated over the past decade. This section seeks to appraise both review level and primary empirical literature to appraise the evidence and arguments of this debate.

Byrne et al. (2008) used systematic review methodology to review studies that compared at least two training methods in the three specific clinical skills of venous cannulation, intubation and central venous line insertion. The authors sought to establish if there was sufficient evidence to recommend one form of teaching as effective in teaching psychomotor clinical skills. Ten studies were included and all contained some form of simulation. Eight studies were prospective and one was retrospective. Some of the studies compered animal model practice with computer based techniques, or mannequin versus animal model, and in some cases practice on a model versus an unstructured programme. They extracted data on the quality of the studies, identified if randomization was used and if the outcomes were measured using a validated instrument. The limitations which they encountered were that many of the studies had methodological weaknesses and small numbers (range n=26-163). Most used non-validated assessment tools, and they identified that participants were often from different groups without a clear indication given of the participants' prior skills. In summary, this review was not able to conclude that any teaching method was superior to another, and was unable to provide evidence to answer the question of *which* method is best for teaching the skills mentioned. Their conclusion that there was insufficient evidence for recommending a particular teaching method for these skills is valid. The studies included in this review however did not compare simulation methods against non-simulation based methods and therefore did not offer any evidence in answering this particular question.

Many systematic reviews are specific to a particular medical specialty, or with a focus on a particular skill or skill set. Systematic reviews of the use of simulation in surgical training practice have sought to demonstrate the benefit of simulation based training (Gurusamy et al., 2008, Sturm et al., 2008, Sutherland et al., 2006) in this particular domain. One team (Sutherland et al., 2006) set out to evaluate the randomized controlled trials of surgical simulation compared with other methods of surgical training. They included 30 trials in their analysis, and although they stated that the quality of the trials was poor, they concluded that there may be a benefit in the use of models, but that there was not yet sufficient evidence to conclude that simulation training was better than other forms of training, such as the use of video.

Three years later another team (Gurusamy et al., 2008) reviewed the use of virtual reality (VR) training in laparoscopic surgery to establish whether this type of simulation could supplement or even replace traditional surgical training. Twenty-three randomized controlled trails were included in their Cochrane review. Their analysis included randomization protocols, the blinding of assessors, and the sequence of educational interventions. Although they considered only three trials had a low risk of bias, other studies were included in their review. Sample sizes of the included studies ranged from 10 to 65. The review was of high quality in terms of the systematic review process, but is mainly limited by the small sample size of the included studies. They concluded that VR training resulted in a greater reduction in operating time, error and unnecessary movements than standard laparoscopic training and could therefore supplement standard laparoscopic surgical training. Around the same time Sturm (Sturm et al., 2008) sought to use systematic review methodology to identify not simply if simulation training in surgical skills improved assessed performance of surgeons, but whether this skill was transferable into the workplace setting. They too identified issues in relation to quality of studies, but did include 10 randomized studies and 1 non-randomized study in their review. They concluded that skills were transferred from the simulator to the operating room setting. Their methodology was appropriate and their conclusions appear justified.

Another group (McKinney et al., 2013) performed a systematic review with the objective of examining effectiveness of simulation-based medical education (SBME) for training health professionals in cardiac physical examination and to examine the relative effectiveness of key instructional design features. There were 18 Studies included. Once again they noted the studies to be of poor quality. A range of healthcare professionals were involved. The included studies either compared the simulation to no intervention or with simulation as an addition to traditional teaching. Although there were inconsistencies in the effect of the interventions in some of the included papers, the authors suggest that this may be due to variation in the amount of hands-on time with the simulator, and the quantity of

delberate practice. They concluded that simulation was effective in teaching cardiac ausculation with an effect size of 1.10.

Another important review was done by Cook et al. (2011a), who performed an extensive and rigorous systematic review and meta-analysis to seek evidence for the outcomes of simulation in medical education in comparison to no intervention. The quality of this review was considered high with planning and reporting to Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standards (Moher et al., 2009), which are criteria widely accepted as quality measures in systematic review methodology. This paper was particularly strong as it included a very large number of studies (609), in all languages, and for all forms of simulation and included a wide range of types of study, randomized, two group non-randomized, case control, cross-over and studies with simulation as an adjuvant. Outcomes measures were broad and included knowledge, skills, behaviours and patient effects. The training stage of learners was extracted and an assessment of methodological quality was graded using the medical education research study quality instrument, (MERSQI), a tool specifically developed to help determine the quality of quantitative research in the field (Reed et al., 2007). Of 10,903 potential studies identified, 609 were included covering a wide range of clinical topics including minimally invasive surgery, resuscitation/trauma training, endoscopy and ureteroscopy, other surgery, physical examination, intubation, communication and team skills, vascular access, obstetrics, anaesthesia, endovascular procedures, and dentistry. They concluded that technology-enhanced simulations, in comparison with no intervention or when added to traditional practice, were, with only rare exceptions, associated with better learning outcomes. They also state that pooled effect sizes were large for knowledge, skills, and behaviours, and confidence intervals excluded small associations. Effect sizes for patient related outcomes were smaller but still moderate. The conclusions are supported by their data and this thorough and robust study does appear to offer evidence of the effect of simulation on learning outcomes. The limitations of this study however should be understood. This analysis included only studies where simulation was compared to no intervention. One could make the case that in professional education every intervention should have a positive effect on learning outcome: *'we can pretty well assume that….education is going to result in more learning than none….and in the end a demonstration that students learnt something after a course reveals nothing about the contribution of any specific aspect of the course'* (Norman and Eva, 2013). Comparisons therefore with no intervention must be interpreted with caution. This problem has been addressed however by looking at the degree of effect size. Lipsey and Wilson (1993), Hattie (2012) and others have established that the average effect size for an educational intervention is in the region of 0.45, so effect sizes in this meta-analysis ranging from knowledge 1.20, time

skills 1.14, process 1.09, behaviours 0.81, and patient care 0.50 would seem to offer compelling evidence for technology assisted learning providing a sufficiently positive effect size as to be conclusive. There is little doubt that the large number of included papers and the thoroughness and systematic nature of the review make this a widely cited and highly influential paper in the quest for evidence for effectiveness of simulation in positive learning outcomes for healthcare education.

The systematic review by McGaghie (2011b) had the objective of comparing the effectiveness of traditional clinical education toward skill acquisition goals versus simulation-based medical education (SBME) with deliberate practice (DP). They reported the findings using well established reporting convention and their search strategy was transparent. Of 3,742 articles identified, only 14 met inclusion criteria of (1) feature SBME with DP as an educational intervention, (2) have an appropriate comparison group featuring traditional, clinical education or a pre-intervention baseline measurement for single-group designs, (3) assess trainee skill acquisition rather than knowledge or attitudes, and. (4) present sufficient data to enable effect size calculation. The overall effect size for the 14 studies was 0.71. They concluded that although the number of reports analysed in this meta-analysis was small, these results show that SBME with DP is superior to traditional clinical medical education in achieving specific clinical skill acquisition goals. They do caution that their results only apply to psychomotor skills and did not address issues such as team work, or decision making which are also important physician attributes. They conclude that SBME is a complex educational intervention that should be introduced thoughtfully and evaluated rigorously.

Having identified influential review level papers this chapter examines some of the most influential primary empirical studies cited in the review literature. Seymour et al. (2002) reported a double blind randomized controlled trial which demonstrated evidence that simulation was as effective in training surgeons for laparoscopic cholecystectomy as training on patients. The authors' research question was whether virtual reality (VR) skills training on a laparoscopic simulator could transfer to the operating room environment. The study included sixteen surgical resident trainees (PGY 1-4) but the authors do not indicate how the participants were recruited, and whether or not this represented a whole training scheme cohort of trainees. Participants had baseline psychomotor abilities assessed, then were randomized to either VR training until a predetermined level was achieved (n = 8), or control non-VR-trained (n = 8). The outcome measure was performance of laparoscopic cholecystectomy with a surgeon blinded to training status and scored for errors and tissue damage. No differences in baseline assessments were found between groups. Successful completion of the operation of gall bladder removal (cholecystectomy) was 29% faster for VR-trained residents. Non-VR-trained residents were nine times more likely to transiently fail to

make progress (P < .007, Mann-Whitney test) and five times more likely to injure the gallbladder or burn tissue (chi-square = 4.27, P < .04). Mean errors were six times less likely to occur in the VR-trained group. The authors' conclusion was that the use of VR surgical simulation significantly improved the performance of residents during laparoscopic cholecystectomy. Some limitations of the study are the small number of participants, selected from within a highly specialized field and trained for a specific single procedure only. However, the results are convincing that VR reduces delay, reduces damage to tissue and reduces error. This is justifiably regarded as a landmark paper in establishing VR training for minimally invasive surgery training and has been cited 1455 times. Trainee surgeons at Yale could be assumed to be motivated, ambitious and committed to learning the skill, so although the paper offers evidence of mastery of psychomotor skills it does not offer any suggestion of generalizability to other skills a surgeon may need such as knowledge of anatomy, decision making or non-cognitive skills. Neither can the findings be generalized to other domains of medical practice. There would even be concern whether the conclusions would be transferable to trainee surgeons in less competitive or less well-resourced institutions as there was insufficient description of the characteristics of the participants to understand their attitudes or motivations for participation.

A further piece of influential research identified better patient outcomes for angioplasty following simulation based training (Chaer et al., 2006). They describe a prospective randomized controlled trial comparing a programme of didactic teaching with didactic plus two hours mentored simulator training in endovascular procedures in a study involving 20 general surgery trainees without prior endovascular experience. The two groups had similar biographical data and pre-intervention scores for visuospatial skills. The intervention group demonstrated improved performance on global scores as well as checklist criteria when assessed by blinded assessors. Although they did not formally state this to be the case, it could be assumed their data was not normally distributed. Although the study sample size was small, the conclusion that simulator training is beneficial seems supported, when compared to no additional training. The authors acknowledge extra training may have benefitted because of time spent with the mentor, so perhaps a control group who had non-simulator training of the same quality and duration as the intervention group would have provided evidence of the simulation accounting for the improvement. The conclusion is that adding simulation training to an existing programme generates better outcomes is supported, but by comparing simulation to other options such as (operating room) mentoring, or further didactic teaching would have offered more robust evidence of causality. Additionally the authors acknowledge the high cost of training facilities and a lack of cost -benefit analysis. One again there was no exploration of prior attitudes or motivations in the participants.

A large randomized trial of training using simulation for managing shoulder dystocia has been reported (Crofts et al., 2006). Shoulder dystocia is a rare, unpredictable but potentially life-threatening complication of birth which has not shown any improvement in management in the past 20 years in spite of calls for improved training of midwives and obstetricians. The researchers analysed four different training strategies in a 2x2 factor design: local training using low fidelity mannequins or high fidelity simulation centre course, with or without formal team skills training. The participants were recruited on a voluntary basis from a large number of hospitals and included midwives and obstetricians. Those who already had training were excluded. From more than 900 eligible, 240 potential participants were approached and invited to participate, but only 130 were recruited. So an important limitation on the conclusions of the study is how representative participants were of the eligible population and hence how generalizable are the results. The authors give no data regarding the motivation or attitudes of participants, but did do an assessment of baseline skills in the technical task. Statistical analysis was done using the McNemar test which is appropriate for paired nominal data to identify differences in outcomes of the interventions. Strengths of the study include the time spent in training and group size was equal for all interventions. The assessment was done using clear objective outcome measures, although the skills were assessed using the high fidelity mannequin, so the results could be confounded by participant familiarity with the mannequin and it still leaves the unanswered question 'can skills demonstrated in the simulated setting transfer into the workplace'? The teamwork aspect of the training was not discussed further in this paper. Subsequent work by the same team sought to answer the question raised about workplace transfer, and most importantly if skills training using simulation could impact on patient outcomes. This is discussed below.

In the field of obstetrics two publications (Draycott et al., 2006, Draycott et al., 2008) demonstrated good evidence for the effectiveness of a simulation based training programme with better patient outcome measures quantified as improved APGAR scores (American Academy of Pediatrics, 2014) and better patient outcomes in cases of peri-natal shoulder dystocia. This was a very large retrospective observational study of management of shoulder dystocia in almost 600 births over a period of 8 years across a whole hospital before and after introduction of mandatory training for all staff. No further data is given on the nature or characteristics of the participant staff, apart from stating that 100% of delivery staff were trained during the intervention period. Data on management, complications and neonatal outcomes were collected using a well-established obstetric database and analysis of the medical notes, and were compared before and after the introduction of the simulation based programme. There was good evidence of statistically significant improvement in neonatal outcomes. Potential shortcomings of the study are dependence on contemporaneous notes

and other confounding factors such as changes in consultant level staff availability, however the authors acknowledge these and justify their conclusions. This study shows good evidence of improved neonatal outcome if all staff are trained, in multidisciplinary teams using simulation as part of the programme with simplified protocols. Authors acknowledged uncertainty about which component is the 'magic ingredient', but this paper would support the role of simulation at team level in improving patient outcomes. Other authors (Siassakos et al., 2009, Smith et al., 2013) developed the work further and analysed a number of reports of large simulation based interventions and the reported improved patient or other positive outcomes in order to identify common content in interventions with demonstrated improved patient outcomes. Some of the outcome measures they included were reduction in neonatal hypoxia, reduced incidence of Erb's palsy in shoulder dystocia, reduction in low APGAR scores, as well as non-patient positive outcomes such as reduced malpractice claims and reduced absenteeism in midwifery staff. The active content of the successful interventions identified is summarized in the Table 2-6 Common features of effective programs below.

COMMON FEATURES OF EFFECTIVE TRAINING PROGRAMMES
Multi-professional training
Training of all staff in an institution
Training staff locally within the unit in which they work
Integrating teamwork training with clinical teaching
Use of high-fidelity simulation models
Institution-level incentives for training (e.g., reduced hospital insurance premiums)

Table 2-6 Common features of effective programs (Smith et al., 2013)

Another area where there appears to be good evidence for improved patient outcomes is Central Venous Catheter (CVC) associated line infection and insertion complications as reported in two studies (Barsuk et al., 2009, Barsuk et al., 2010). These papers offer a strong argument for the effectiveness of a simulation based programme for residents on insertion of central venous catheters, showing that when residents were trained using simulation, this resulted in a dramatic reduction in the rate of complications. It was an observational educational cohort study of infection rates before and after the introduction of a simulation programme. The traditional training was via a lecture and opportunistic bedside teaching and mentoring. In order to exclude confounding factors the infection rate in another unit in the same hospital was included for comparison. CVC infection is rare so the rate pre-intervention, post intervention and compared with the surgical intensive care unit (ICU) were compared. The authors demonstrated an 84.5% reduction in infection rate after the training programme,

and conclude this was due to the simulation programme compared with the traditional model used previously and still used in the comparison ICU. There is little doubt that the training programme worked, in that patient outcomes clearly improved. The authors acknowledge that CVC associated infection is a rare phenomenon and suggest it would be even more compelling to monitor rates over an even longer period of time. Similarly to other studies it is not certain which aspect of the simulation intervention is the 'magic ingredient'.

An important question in the field is whether simulation can have an impact, not just on knowledge, skills or behaviours but if there is a positive impact on patient care. This was explored in the following paper (Wayne et al., 2008). They demonstrated that the use of high fidelity simulation training does impact on actual clinical performance. They did a quasi-experimental retrospective study of adherence to standard Advance Cardiac Life Support (ACLS) resuscitation protocol for in-hospital cardiac arrest. They introduced a high fidelity simulation based training programme for new residents and therefore had access to a quasi-experimental control and intervention group for their study to compare simulator trained group versus non-simulator trained group. They identified improved adherence to the protocol by a factor of 7, but because overall survival rates from cardiac arrest to discharge from hospital are very poor there was insufficient evidence to show improved patient outcome of survival to hospital discharge. Although they do not give large amounts of detail on the control groups' training, the control group had attended two previous courses that did not involve high fidelity simulation. The intervention group only had one training course. This could be interpreted as evidence of a positive effect being the high-fidelity simulation as opposed to other papers where the control group got nothing.

Having discussed the important debate in the literature on the evidence for the effectiveness of simulation, another important debate in the literature is now discussed. There is significant debate about whether high fidelity simulation is superior to low-fidelity simulation. On the one hand the concept of same-context advantage is discussed (Koens et al., 2005b) where learners demonstrate improved recall if material is presented and tested in the same physical setting compared to learners who were tested in a different physical location to where the to-be-learned material was initially presented. The limitations of this work include the fact that the material learned and tested was a simple list of words and the skills involved in medical education are much more complex. There is some possibility that the physical cues of the environment context may aid recall. Schuwirth and Van Der Vleuten (2003) argue that the closer the simulation to reality, the more valid the assessment. Another publication (Issenberg et al., 1999) reports a 33% improvement in auscultation skills in medical trainees when trained using Harvey - a high fidelity cardiovascular simulator - supporting the value of high fidelity simulation. Similarly when Ewy et al. (1987) compared the cardiac auscultatory skills of those

trained using high fidelity simulators they found improved transfer to real patient skills. These papers have, however, been criticized as failing to quantify what bedside, traditional teaching actually meant, especially in terms of time spent on instruction and range of pathologies encountered.

Conversely other authors have challenged the assertion that higher fidelity translates to better learning (Norman et al., 2012, Kneebone, 2005). Kneebone suggests that one reason why lower fidelity simulation may be superior for learning is that lower fidelity strategies, being associated with significantly fewer resource requirements, may allow improved access for learners to teaching resources, and consequently more practice and improved skills. Scerbo et al. (2007) suggests that high fidelity simulators can, in fact hinder performance, and suggests effectiveness as a more significant consideration in design. De Giovani et al. (2009) did a prospective randomized study to explore this question, in the context of learning cardiac auscultatory skills. They compared skills transfer from teaching to real patients, both immediately after teaching and six weeks later. In one group they provided training on Harvey® - a cardiovascular clinical skills high fidelity simulator, in the other group an equivalent training session using a CD demonstrating the sounds associated with cardiac auscultation. The test assessed ability to recognized previously trained sounds and new sounds, as scored by a blinded clinical observer. The group's ability to diagnose murmurs in actual patients was compared. The CD trained group did as well as the Harvey group. Their results support their conclusion that training with Harvey resulted in a moderate, but not quite statistically significant, advantage in interpreting clinical signs in real patients on auscultation, but the two groups were very close in diagnostic accuracy after six weeks. One possible explanation suggested for the effect of CD in this case was that the CD gave multiple examples of each single condition, whereas Harvey only provided a single example of each. The authors were unable to conclude that high fidelity was superior to low fidelity.

In the specialty of obstetrics Crofts et al. (2006) also sought to answer this question in the context of delivery of neonates in births complicated by shoulder dystocia. They did this by doing a comparison of low-fidelity training with high fidelity training for staff managing the condition and concluded that that high fidelity training was superior as it was shown to reduce neonatal brachial plexus injury and the degree of measured force applied compared with low fidelity training. This paper is also discussed elsewhere (p 36). It appears that in certain circumstances high fidelity is superior to low fidelity simulation, but in other cases this has not been shown by empirical research, so still remains a point of debate.

There has been a dramatic increase in the quantity of published literature pertaining to simulation in medical education over the past two decades. Much of the literature has been

criticized as being mainly descriptive, and evaluating outcomes at the lower end of Kirkpatrick's levels (Kirkpatrick et al., 2006): evaluating student experiences and self-reported perceptions (Ker and Bradley, 2007). The simulation research community have identified the key areas of simulation research which already offer robust evidence for the effectiveness of simulation as well as identifying the key gaps in our knowledge and understanding and areas where further research is needed (Dieckmann et al., 2011). Medical education is also known to cross boundaries between the traditions of natural science and the social sciences and although some have argued that randomized controlled trails are not the only way of generating sufficiently robust and persuasive evidence of educational effectiveness and workplace transfer (Dieckmann et al., 2007, Monrouxe and Rees, 2009) (Eva, 2010, Eva, 2009). The methodologies of systematic reviews and meta-analysis are the most widely cited as evidence of effectiveness of simulation. The wider medical education community however, seek to understand not just which specific specialist skills have evidence for effect of simulation, but which aspects of simulation based training contribute to a positive educational impact and a positive transfer to patient outcomes (Issenberg et al., 2011).

A key publication was a Best Evidence Medical Education (BEME) Review in 2005 (Issenberg et al., 2005b) with the stated aim of reviewing and synthesizing existing evidence in educational science that addresses the question 'What are the features and uses of high-fidelity medical simulations that lead to most effective learning?' 109 studies over 34 years of publications were included in the review which identified that, at that time, the quality of the research was weak and there was a paucity of evidence for simulation skills transfer to patient outcomes. They did conclude that there were a number of features of high fidelity simulation that were associated with good evidence of positive impact on learning. It should be noted that their working definition of high fidelity included any simulation where the model or mannequin generated feedback for the learner, in other words, only static models were excluded. These features are shown in Table 2-7 Features and.

FEATURES AND USES	NO. OF STUDIES	STRENGTH OF FINDINGS	COMMENTS
Feedback is provided during learning experience	51	3.5	Slows decay in skills over time; Self-assessment allows individual to monitor progress; Can be 'built-in' to simulator or provided by instructor immediately or later via videotaped debriefing
Learners engage in repetitive practice	43	3.2	Primary factor in studies showing skills transferring to real patients; Shortens learning curves and leads to faster automaticity; simulator must be made available-convenient location, accommodates learner schedule
Simulator is integrated into overall curriculum	27	3.2	Simulator fully integrated into overall curriculum-e.g. ACLS, ATLS, CRM, basic surgical training
Learners practice with increasing levels of difficulty	15	3.0	Increasing degree of difficulty increases mastery of skill
Adaptable to Multiple Learning Strategies	11	3.2	Simulator used instructor large-group & small-group settings; independent small-group and individual settings
Clinical Variation	11	3.1	Can increase the number and variety of patients a learner encounters; Provides equity to smaller training programs; Provides exposure to rare encounter
Controlled Environment	10	3.2	Learners make and detect mistakes without consequences; Instructors can focus on learners through 'teachable moments'; Reflects educational 'culture' focused on ethical training
Individualized Learning	10	3.3	Provides reproducible, standardized experience for all learners; Learner is active participant, responsible for his/her own learning
Outcomes / Benchmarks Clearly	7	3.1	Learners more likely to master skill if outcomes are clearly defined and appropriate for learner level of training
Validity of Simulator	4	2.9	Face validity-realism provides context for understanding complex principles/tasks, increases visio-spatial perceptual skills, learners prefer realism; Concurrent validity-ability on simulator transfers to real patient

Table 2-7 Features and uses of high fidelity simulation leading to effective learning

The provision of feedback was noted to be the most important characteristic of simulation leading to effective learning. The authors conclude that feedback also slows skills decay and

allows learners to self-assess and monitor their progress toward skill acquisition and maintenance. The sources of feedback included in the analysis were either 'built in' to a simulator, given by an instructor in 'real time' during educational sessions, or provided post hoc using video replay. Further detail about models of feedback used was not provided. In spite of this it has been found that feedback was not always a feature emphasized in programmes using simulation to teach cardiac auscultatory skills (McKinney et al., 2013). In simulation, debriefing is commonly used to describe the process of attempting to bridge the natural gap between experiencing an event and making sense of it. In other words 'post experience analysis' or guided reflection in the cycle of experiential learning. The models of debriefing referenced in simulation are derived from military origins (Fanning and Gaba, 2007). In spite of the importance of feedback, there is a scarcity of empirical research in simulation, offering evidence to support the 'Who, what, where, when and why?' of debriefing (Raemer et al., 2011). Fanning and Gaba (2007) outline an *'ethical obligation for the facilitator in simulation-based learning to determine the parameters within which behaviour will be analysed, thereby attempting to protect participants from experiences that might seriously damage their sense of self-worth'*. The importance of setting ground rules, reflecting on learning objectives and considering the individuals' previous frames and life experiences is emphasized. They explore the many debriefing models used and attempt to identify commonality. A tension identified is in the role of the facilitator. The tension arises as there is a need to extract maximum learning, in tension with the need for the learner to be active and responsible for their own learning. Gentle guidance is considered the highest form of facilitated debrief, with relatively low facilitator involvement. Stafford (2005) draws an important distinction between de-roling and debriefing: de-roling being the discarding of aspects of the assumed role and discharging any associated emotion to return to one's true self, before debriefing as defined above. Zigmont (2011a) also refers to an initial emotional phase as part of post experience reaction and learning in the '3D' model for debriefing: Defusing, Discovering and Deepening. The role played by the educator and participant interactions in debriefing have been studied empirically (Dieckmann et al., 2009) with the authors identifying a gap between ideal, aspirational, practice, which is facilitatory and inclusive, with observed practice where debriefing was seen as dyadic and often based around information giving.

Other authors have challenged the emphasis and practices of feedback and debriefing as unhelpful when considered through an understanding of motivational theory. Although motivational theory is discussed in detail in part 2 of this chapter, it will be mentioned here in the context of feedback in simulation. The tension between desiring feedback, but fearing disconfirming feedback, and fearing that authentic feedback might disrupt relationships has

been discussed (Mann et al., 2011). Ten Cate (2013), in the context of workplace learning, asserts that *'despite approaches to feedback that start with stressing the strengths of the trainee, or that sandwich corrective feedback between supportive statements, feedback is basically aimed at something to improve'* so cannot stimulate intrinsic motivation as the emphasis is on failure and so competence is not enhanced.

Another important feature of simulation leading to educational effectiveness was deliberate practice. In one reported study (Butter et al., 2010) medical students who engaged in deliberate practice using simulation acquired improved skills in cardiac auscultation in when compared with a comparison group. Deliberate practice is the intense and focussed performance of an intended cognitive or psychomotor skill with informative feedback. The principles of deliberate practice were discussed earlier in section 2.1.3.1. The same team who described the features of high fidelity simulation leading to effective learning outcomes, as described above, subsequently extracted 31 of the papers included in their original analysis to identify whether there was a quantitative association between hours of repetitive practice and skills outcome (McGaghie et al., 2006). They concluded that hours of practice, was the main variable and accounted for differences in outcomes of the included studies, supporting their hypothesis that repetitive practice involving medical simulation results in a dose-response relationship with better outcomes. These features are often reported as being incorporated into program and design considerations as can be seen from the high number of citations for Issenberg's review (Issenberg et al., 2005b) review [1844 citations as of April 2016 according to google scholar]. Ericsson's model of deliberate practice emphasizes the importance of feedback from the instructor, and hence may explain why, although feedback is seen as important, it does not always result in the degree of beneficial effect on long term learning one might expect (Hattie and Timperley, 2007, Ten Cate, 2013).

Much of the research in simulation is about simulation processes and simulation results, but research about barriers to simulation are much less commonly reported. Hutchinson (1999) encourages researchers that robust research generating evidence for the effectiveness of educational interventions is imperative, but reminds us of the complexity of measuring success and in particular reminds the academic community to consider all the factors which can influence the success of educational outcomes. These factors are summarized in Figure 2-8 Factors which may influence the effectiveness of educational interventions (Hutchinson, 1999).
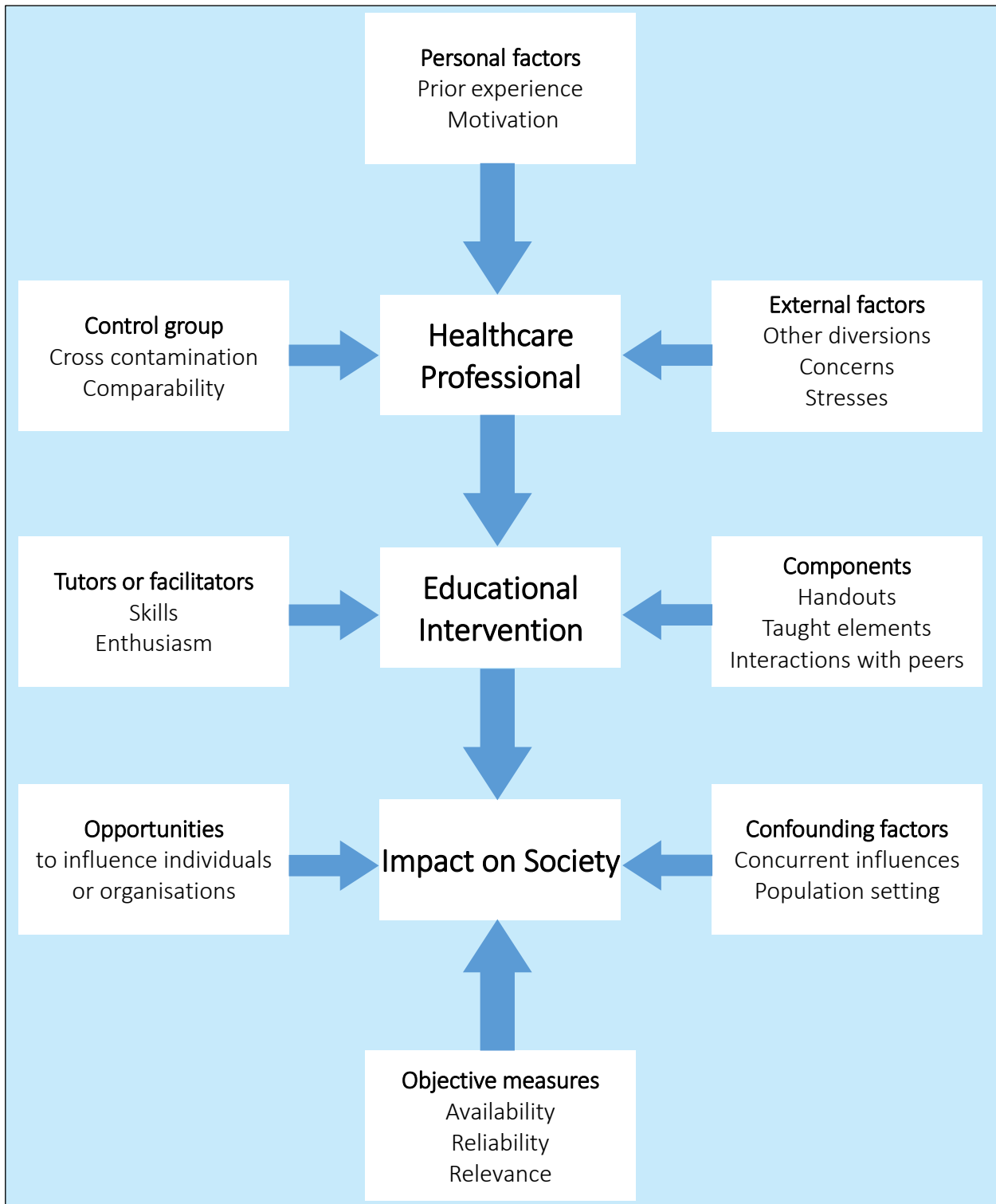
Figure **2-8 Factors which may influence the effectiveness of educational interventions (Hutchinson, 1999)**

Much of the key literature described above failed to take into account the prior experience or motivation or other personal factors into consideration when researching the effectiveness of the particular educational intervention. Examples of some of the very few publications where these factors were explored will be discussed in the following section.

A key paper (Savoldelli et al., 2005) did identify a gap in the literature, in that there is little understanding of the factors which may influence participation in simulation based educational activities. Their paper addressed the input factors for simulation. The purpose of their study was to *'investigate anaesthesiologists' previous experiences, perceptions, motivations and perceived barriers related to simulation as an educational modality, and to determine if the level of training of the responders influences their opinions.'* They did their empirical research in the context of a research conference for anaesthesiologists in a large North American city. They included only medical staff in this one specialty. They started with the hypothesis that the level of training of an anaesthetic specialist would have an influence on their attitudes to simulation and the barriers to engagement with simulation based educational opportunities. They used a forty-item questionnaire. Although quantitative questionnaire based research can be limited in terms of depth of response and risk missing some of the nuance of other methods, the authors did use a process of developing the questionnaire through 10 pilot questionnaires. The pilot questionnaires did offer an opportunity for respondents to give their views using open questions and free text responses. The open comments and free text responses were then used to form the final study questionnaire, which was analysed quantitatively. The results demonstrated that most (92%) of those who had participated in simulation agreed that it was valuable for education, and 86% found it an enjoyable experience. Perceptions or relevance were explored by asking respondents to rate a selection of course contents according to the relevance for the participant's own education. The educational content considered most relevant to this group were courses offering opportunities to manage clinically rare events, followed by courses offering non-technical skills such as crew resource management and decision making skills and then courses offering practice and learning of guidelines and management algorithms such as airway, ACLS, ATLS skills. When exploring willingness to return to the simulator, trainees had much greater scores than more experienced specialists. This is interpreted by the authors as higher perceived relevance of simulation training to trainees than more senior specialists. The list showing 'what would increase your likelihood of attending a simulation based course' the following factors were identified, with the percentage responses.

1. The provision of an individual evaluation profile (strengths and weaknesses) for my personal use (64%)
2. If the course were given in my own hospital (e.g., mobile simulation centre in a trailer) (48%)
3. The provision of a certificate that would reduce malpractice insurance premium (43%)
4. If more [credits] were given per hour of simulation time (36%)
5. The provision of a ranking that compares my performances to others (for my personal use) (34%)

Respondents then identified any barriers that would prevent them pursuing simulation education. Eighty-one percent of the respondents identified at least one significant barrier. Compared with trainees, senior anaesthesiologists were more likely to perceive at least one barrier. The barriers identified were as follows

1. Lack of free time (55% senior staff 33% trainees)
2. Financial consequences of missing work (18 % 0%)
3. Lack of training opportunities (23% 39 %)
4. Stressful/intimidating environment (25% 22%)
5. Fear of educator's/peer's judgments (25% 18%)
6. Fear of inaccurate reflection of clinical ability (25% 12%)
7. Distance to simulation centre (8% 8%)

Although there was variation seen in the values between senior staff and trainees, only the lack of free time, and financial consequences of missing work showed a statistical significant difference between the two groups. Savoldelli and colleagues conclude their paper as follows:

> *'Our results indicate that anaesthesiologists value simulation-based education. However, they perceive barriers to this type of training. A significant proportion of the responders feared educators' or peers' judgments and were concerned by the stressful and intimidating environment created in the simulator setting. Compared with trainees, staff anaesthesiologists had less experience with simulators, found it less relevant for their current training, and perceived more barriers.'*

Drawing on the work above Decarlo (2008) used an adaptation of the same survey instrument to identify potential barriers educators may face when introducing nurses, rather than anaesthetists to simulation. They specifically sought to determine whether the perceived barriers were influenced by prior simulation exposure, years of professional nursing experience, or area of hospital practice. The researchers did a postal survey adapted from

that used with anaesthetists. The authors do not indicate any use of prior literature or theoretical considerations in the survey design. They did collect demographic variables: prior simulation experience (yes versus no), years of clinical experience (0–5 vs. over 5 years), and area of employment (acute care vs. non-acute care). Responses were via a Likert scale. The results demonstrated a 54 % response rate, and showed that issues most commonly selected as major barriers included 'being video-taped,' 'unfamiliar with equipment,' and 'stressful environment.' The issues least commonly selected as major barriers included 'training with non-nurses,' 'not the real thing,' and 'inaccurate reflection of skills.' The rate at which individual issues were selected as barriers was fairly consistent across all subgroups evaluated. Although there was an opportunity for free text comments, this yielded no extra barriers or priorities. Interestingly those nurses who had prior experience with simulation stated fewer barriers in total. Nurses with prior simulation exposure generally selected fewer barriers than nurses without simulation exposure, but nurses who viewed 'not the real thing' as a significant barrier were more likely to have had prior simulation training compared with those who did not select this as a barrier. These two papers offer rare contributions to an important area, and clearly demonstrate a need for more research to better understand the issues raised. This leads to the next section discussing the gaps in the literature and questions which are still unanswered.

2.1.5. Conclusion and outstanding questions to be answered

Although there has been a dramatic increase in the number of publications relating to simulation based medical education, this literature review has demonstrated that the published literature has made some impact in creating and disseminating evidence of simulation as an effective learning tool. There is also an emerging acceptance that the time spent in repetitive practice and the provision of effective feedback are likely to be important variables which quantitatively influence outcomes. However, much of the published literature is based on positivist epistemology (although this is rarely explicated), has either a lack of sound theoretical underpinning, or is insufficiently methodologically robust, as can be seen by the small numbers of studies included in the systematic reviews. The literature base is also weak in the sense that only a small portion of the empirical research goes beyond Kirkpatrick's lower levels of evaluation: curriculum or course description, instructor evaluation, or participant feedback. Self-reported confidence and competence in knowledge or skill do not correlate well. When considering the fact that there is a poor correlation between self-reported confidence and actual outcome measures of competence this is not to assert that confidence is unimportant. In fact, confidence is an important domain in and of itself which educators should seek to support and develop in education. Confidence is closely linked with the motivating factors which are discussed in the following section discussing motivation.

Research demonstrating what it is about simulation which results in educational effectiveness is limited to a relatively small number of studies. Before and after studies are often flawed by confounding factors. Randomized controlled trials whilst highly valued within the medical literature and considered very robust and offering credible evidence of positive outcomes for simulation based learning are often of limited value in helping develop understanding not just of whether simulation works, but how it works, for whom and in what context (Eva, 2009). Participants in all of these studies have been recruited from a pool of practitioners already participating in simulation based activities, and this might therefore create a significant bias and limitation to the generalizability of these studies to larger population groups. In particular, certain groups of medical practitioners are currently under-represented in these studies and in participation in simulation based activities.

In summary, the literature has either tended to be descriptive, reiterating the claims of advantages of simulation over conventional non-simulation activities, with an over-emphasis on creating or approximating as closely as possible the physical simulated environment. There is a paucity of empirical research discussing the impact of degrees of realism in simulation. In addition there are ongoing calls for further evidence demonstrating effectiveness or output of SBE. There are also continued calls for deeper exploration of what it is about simulation that results in effective learning, for whom and in what context. Much of the existing literature focusses on either the process of simulation, or the desire for more robust evidence for outcome measures of simulation. Hutchinson's illustration of factors influencing the effectiveness of educational interventions has been adapted by the author, to illustrate the relationship of these factors. It is shown in Figure 2 9: Process Model of Simulation below.

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┌─────────────────┐
│                 │
│      Input      │
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│                 │
│     Process     │
│                 │
└─────────────────┘
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┌─────────────────┐
│                 │
│     Output      │
│                 │
└─────────────────┘
```
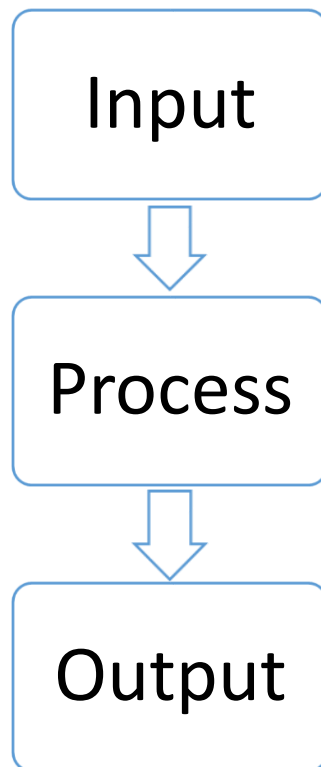
Figure 2-9: Process model of simulation

This thesis will argue that in order to robustly and effectively understand the learning and process aspects of SBE, and in order to generate the best quality evidence for effectiveness of the process of SBE, leading to positive outcomes, it is imperative for researchers to have a deep understanding of input factors: their learners, their motivation, preconceptions, and values. The current state of the literature offering evidence for effectiveness could be criticized as failing to explicate that both the researchers themselves and the participants are a selected group who may already have significant bias in favour of SBE. If SBE is then becoming mandatory part of training for much wider and generalized groups we cannot be assured by the current body of literature that these reported outcomes are as positive as they may seem and are truly generalizable. This thesis asserts that in order to have a robust output measure for SBE effectiveness researchers must take into account the input factors for participants, and identify whether these characteristics are generalizable to the medical learner in the wider population. For example if a highly motivated group participate in course or programme which appears to be highly effective in terms of knowledge, skill or attitude output measures, there may still be remaining doubt as to whether the same educational impact would still exist if the course or programme was disseminated more widely or even made a mandatory component of training. A powerful argument is made that almost all educational interventions have a positive effect (Hattie, 2013), but that to justify substantial investment and wide adoption that

effect ought to be greater, not just than no intervention, but rather should be shown to have better outcome measures than the 'average' educational intervention.

In summary, the shortcomings of the existing body of literature pertaining to simulation based medical education are

- Most research has been done with volunteer participants, limiting generalizability
- Over-emphasis on output measures or process at the expense of input factors
- Much of the work is descriptive, low level output measures such as learner satisfaction
- Emphasis on work from positivist epistemology
- Lack of theoretical underpinning
- Large gap in consideration of learners prior experiences, attitudes, motivation and barriers

This thesis explores, in depth, the input factors that influence motivation, affective states and barriers to SBE, which have been very poorly described to date. This exploration and discovery will guide researchers and programme designers by indicating areas that must be taken into account. The next chapter 3 (p65) outlines how this study recruited a very wide range of medical practitioners, at the beginning, middle and towards the end of their career development, from a very broad range of medical specialties to an in-depth qualitative exploration of input factors to construct a meaningful understanding of these factors for all learners.

2.2. Part 2: Motivation

2.2.1. Key questions the literature review seeks to answer

Motivation is an important topic in medical education and for medical educators as it has been shown to be a predictor for learning, academic success, persistence, continuation in study and well-being (Vansteenkiste et al. 2004; Hustinx et al. 2009 as quoted in Kusurkar et al., 2011)). This part of the literature review will use a narrative approach. The purpose of this review is to seek a broad understanding of existing theory relating to the topic of motivation in medical education and to locate this research within that domain rather than to test a hypothesis. This inductive approach has been used because the author's prior assumptions in explicating detailed search terms *a priori* could lead to a narrower review*.* Although theory-based literature is in the minority in the field of medical education it has been argued that a theoretical perspective enhances knowledge, brings new insights that may direct how the academic community think about things (Hodges and Kuper, 2012, Rees and Monrouxe, 2010) . It is

also suggested that when theory forms a basis for scientific knowledge it creates a more dynamic quality than simply proving or disproving a hypothesis (Norman, 2004, Eva and Lingard, 2008).

Therefore the research question which this part of the literature review seeks to answer is:

> What are the attitudes/motivating factors/barriers to engagement in medical education?

This chapter will describe how the search was done, followed by situating the current literature into the historical context of the development of motivational theory, before discussing some of the key papers relevant to medical education and to simulation.

2.2.2. Methodology - how the search was done

In 'Theory of Learning' Cotton (1995) defines motivation as the force which turns intentions into actions. For the purposes of this literature review the following was used as a working definition of motivation: A reason or reasons for acting or behaving in a particular way; desire or willingness to do something; enthusiasm. Synonyms: incentive, stimulus, inspiration, inducement, incitement, spur, provocation, drive, ambition. This part of the literature review used a narrative approach, and, as described previously, although the databases searched and examples of the search terms and inclusion and exclusion criteria are described, this is for the purpose of transparency, and not to indicate that this is a systematic review.

To explore the question 'What are the attitudes/motivating factors/barriers to engagement in medical education?' Medline, ERIC, BEI and AEI were searched (using the proQuest search tool for the education databases. The search using the following terms:

Search terms in Medline:

> Motivation (as MeSH heading)
>
> OR Motivation (as major concept)
>
> OR aspiration (psychology)
>
> OR drive
>
> OR goals
>
> OR intention

And Search Terms:

    Medical education (as subject heading)

    OR education, medical as keyword

    OR Education, Medical, undergraduate

    OR education, medical graduate

    OR education, medical, continuing

Step 1 and step 2 were combined to give results including motivation and medical education. Search terms used in ProQuest were Motiv* AND (medical Education) with limits applied: all dates, peer reviewed, English language, articles, dissertation/thesis, conference papers, book, book chapter, government reports. Finally, ProQuest search using terms Simul* AND (medical education) was done with the same limits applied.

These results were screened initially by title. Those which appeared might be relevant then had the abstracts examined. Publications describing the dominant theoretical positions and important historical papers were included in the review. The following Inclusion criteria were applied:

1. Empirical studies on motivation in healthcare education

2. Review level papers on motivation in medical education

3. Papers contributing to theory of motivation in medical education

4. Studies identifying self-determination theory in medical undergraduate or postgraduate education

5. Only items published in the English language were included.

6. Items related to human subjects were included

7. Articles with abstract available.

The following exclusion criteria were applied:

1. Studies which did not have clear description of methodology or contribution to theory

2. Studies on motivational interviewing or behaviour change modelling such as smoking cessation.

3. Animal studies were excluded

4. Studies discussing patient or simulated patient motivation for participation in clinical teaching, assessment or clinical trials.

5. Papers discussing motivation of faculty to teach.

As the literature review progressed the predominant contemporary theory of motivation appeared to be Self Determination Theory (SDT) as described by Ryan and Deci. To generate a broad understanding of SDT in education further searches were carried out using the education specific databases. A search of the education databases using the term 'Self-determination theory' with limits English language, peer reviewed, all dates, articles, conference papers, dissertation/theses yielded additional results, where SDT has been described in a variety of educational contexts such as early year's education (Erwin and Brown, 2003), continuing education and sports education (Spray et al., 2006). The results were organized and managed using citation management software (Endnote ®Thomson Reuters). After the following section which will outline the historical context and development of understanding of how the literature has described motivation, the most important papers are discussed in detail.

2.2.3. History - how the literature has evolved to the present

In the modern study of psychology, theories to explain reasons for actions and behaviour have been evolving since the late 1800's. Weiner (1990) gives a helpful overview of this historical development. Historically one of the key 20th century writers on motivation was Maslow (Maslow, 1970). His approach was humanist in nature and he theorized that motivation is created by unmet needs in a hierarchical manner, where previous thinking had focussed on motivation being determined by physiological needs at the level of human tissue. He theorized that psychological needs created human drive, with some needs dominant over other needs at particular times and that as some needs are filled other needs in the hierarchy become predominant. Maslow's hierarchy of needs is illustrated in Figure 2-10 Maslow's Needs Hierarchy below.

Figure 2-10 Maslow's needs hierarchy

Physiological needs as described by Maslow include factors such as adequate food, rest and shelter and these will be moderated by social and societal norms. Once these needs have been met the hierarchy proposed that safety needs then become the predominant drive: safety needs include both physical and psychological safety. Social needs then address the sense of belonging. The following step up in the hierarchy is the need for esteem: the public recognition of success or achievement. Cognitive needs which include the intrinsic satisfaction of exploring and problem solving then lead to the highest levels of self-actualisation. Miller's needs hierarchy (1967), similar to the humanist approach of Maslow, developed a hierarchical approach where needs were differentiated between primary needs and secondary needs, and positive factors and negative factors. In other words he established that rather than a simple hierarchy with each successive level as outlined in Maslow's hierarchy, certain circumstances could exert negative or demoting forces as well as positive or motivating forces.

In the same time period achievement motivation (Ausubel et al., 1968) was discussed in terms of three components, firstly, in terms of cognitive drive - finding a task interesting, secondly, in terms of ego enhancing - feelings about self-worth, status, being adequate, having success and finally in terms of affiliative - gaining approval of peers/others. Ausubel was therefore introducing the concept that motivation was not simply an isolated or individualized construct, but that there needed to be an understanding of the role of groups, society and community on the values and aspirations of the individual. Ausubel's concept of ego related values such as sense of self-worth was further articulated and developed by Bandura (2001). He proposed a model of self-efficacy, which he defined as a person's belief in having the power to succeed. In his theory he hypothesized that low self-efficacy led individuals to avoid challenge and tended to lead to missing opportunities. In addition, Bandura proposed the importance of

agency which he defined as the ability to control one's own self development, adaptation and self-renewal or even destiny, and further that personal agency operates within a network of sociocultural influences. The elements of agency are intentionality, forethought, self-reactiveness, self-reflectiveness and agentic management of fortuity. Human agency is not confined to personal agency, but involves personal, proxy and collective elements.

The various related theories of this time period have been summarized as the expectancy - value theories and all had in common the concept that motivation was determined by what one expected to get and the likelihood of getting it (Weiner, 1990). The concept that motivation was not simply an isolated or individualized construct, but that there needed to be an understanding of the role of groups, society and community on the values and aspirations of the individual was articulated by Bandura (2001). Pintrich (2000) also made an important contribution to the understanding of motivation, particularly in the context of educational achievement. Two goals are often simultaneously present in educational activity: a general goal such as mastery of a skill or superiority, being seen to be superior to a peer or competitor, the second type of goal is a specific goal by which one may be judged, such as grade achieved. Pintrich does point out that in empirical studies mastery goals and performance goals may not necessarily be positively correlated. This achievement goal theory perspective, although important for curriculum designers and policy makers is important in guiding understanding of goal setting, because the emphasis is more on achievement and results rather than decision making to participate in particular types of educational opportunity as this thesis does, it will not be further discussed here. In the more contemporary studies of motivation there is greater emphasis on topics such as the cognitions of causal attributions, self-efficacy, and learned helplessness; the individual differences of need for achievement, anxiety about failure, locus of control, and attributional style; and the environmental variables of competitive versus cooperative contexts, intrinsic versus extrinsic rewards.

Self-determination theory (SDT) (Deci and Ryan, 1985) brings a convergence of a variety of scholarly approaches: self-determination, competence and relatedness. This evolving theory appears to offer coherence and is compelling both because it builds on the historical theories outlined above, but also because the theory has been tested in empirical studies (Deci and Ryan, 1985, Deci et al., 1991, Ryan and Deci, 2000b, Ryan and Deci, 2000a, Williams et al., 1999). SDT has been described as *'building on the tradition of empirical psychology and is an organismic theory rather than tissue physiological level and challenge the consummatory idea of drive and satiety concept drive theories couldn't explain exploration and manipulation without reward'.* (Deci and Ryan, 1985). One theme which differentiates self-determination theory (SDT) from other theories is that SDT does not view motivation as a linear concept where degree of motivation varies from low levels of motivation to higher levels of motivation,

but rather describes that motivation can be of variable qualities or orientations. SDT theorizes that people naturally tend towards self-determination and that motivation can be regarded on a continuum with intrinsic motivation at one end and amotivation (absence of motivation) at the other. Intrinsic motivation to act is driven by the pursuit of an activity for the pleasure and satisfaction of the activity in and of itself, without any external driving force or incentive. They state that *'Because intrinsic motivation results in high-quality learning and creativity, it is especially important to detail the factors and forces that engender versus undermine it'* (Ryan and Deci, 2000a). Towards the other end of the spectrum extrinsic motivation is that which is identified by a defined external outcome separate from the activity itself such as to obtain a reward, or avoid a loss.

Having created a historical overview of the development of theories of motivation through the last century the following section will discuss self-determination theory in greater detail as a key theory that will influence and underpin this thesis.

2.2.4. Critical discussion of key literature

One of the key concepts to emerge across the main theories including self-efficacy, self–regulation and self-determination theory is the importance of the individual's constructed values and characteristics. An essential concept is that individuals will achieve more in terms of deep learning, satisfaction with learning if they are self-regulated, and have high levels of self-efficacy. These characteristics appear to be important predictors for academic success, persistence, continuation of study, life-long leaning and wellbeing (Kusurkar et al., 2011).

A sub-theory of SDT is Cognitive evaluation theory (CET) (Ryan and Deci, 2000b). This sub-theory relates to intrinsic motivation only. CET aims to address variability in internal motivation - the factors which facilitate or undermine the innate human capacity for intrinsic motivation. CET depends on the human need for both competence and autonomy. It is proposed that social-contextual events (e.g., feedback, communications, and rewards) that conduce toward feelings of competence during action, enhance intrinsic motivation for that action. Freedom from demeaning feedback is an important social-contextual variable in enhancing intrinsic motivation. Both positive and negative feedback influence intrinsic motivation, with perceived competence mediating the response. However, feelings of competence alone will not enhance intrinsic motivation unless they are accompanied by autonomy or an internal perceived locus of causality. Potential sources of such influences could either be immediate contextual support as feedback supporting competence and autonomy or abiding internal resources. Interestingly empirical research has shown that all extrinsic tangible rewards contingent on task performance do undermine intrinsic motivation. Likewise threats, imposed

deadlines, directives, imposed goals and pressured evaluations also undermine intrinsic motivation. In summary CET framework suggests that

> *'Social environments can facilitate or forestall intrinsic motivation by supporting versus thwarting people's innate psychological needs. Strong links between intrinsic motivation and satisfaction of the needs for autonomy and competence have been clearly demonstrated, and some work suggests that satisfaction of the need for relatedness, at least in a distal sense, may also be important for intrinsic motivation. It is critical to remember, however, that people will be intrinsically motivated only for activities that hold intrinsic interest for them, activities that have the appeal of novelty, challenge, or aesthetic value. For activities that do not hold such appeal, the principles of CET do not apply.'*

Although intrinsic motivation has always been regarded as the 'best' type of motivation, SDT proposes that, rather than extrinsic motivation being pale and impoverished, that there are various forms of extrinsic motivation; some of which are impoverished, but some of which may also be, both powerful and active and agentic. It is therefore important to understand influences on extrinsic motivation. They argue as follows:

> *'Students can perform extrinsically motivated actions with resentment, resistance, and disinterest or, alternatively, with an attitude of willingness that reflects an inner acceptance of the value or utility of a task. In the former case—the classic case of extrinsic motivation—one feels externally propelled into action; in the latter case, the extrinsic goal is self-endorsed and thus adopted with a sense of volition. Understanding these different types of extrinsic motivation, and what fosters each of them, is an important issue for educators who cannot always rely on intrinsic motivation to foster learning. Frankly speaking, because many of the tasks that educators want their students to perform are not inherently interesting or enjoyable, knowing how to promote more active and volitional (versus passive and controlling) forms of extrinsic motivation becomes an essential strategy for successful teaching.'*

The three primary psychological needs composing SDT are self-determination, relatedness and competence. Self-determination is the capacity to choose, and to have choices, rather than reinforced contingencies, drives, or any other forces or pressures, being the determinants of one's actions; SDT illuminates the human need for control. There appears to be an important human need for control in the sense of one's behaviour having an outcome on the environment and self-determination means having a choice. For example SDT hypothesizes that people may be satisfied to not be in control as long as they have a choice. '*It is not the*

need for competence alone that underlies intrinsic motivation; it is the need for self-determined competence where the need not for competence alone but self-determined competence' (Deci and Ryan, 1985). This builds on the concept of intentionality and will, and that control over outcomes is important to human motivation and demonstrating the positive effects of enhanced perceived control. Intrinsic motivation clearly encompasses high levels of autonomy and self-determination. Extrinsic motivation refers to behaviour which where the reason for doing it is something other than interest in the activity itself. Extrinsic motivation can improve if autonomy supporting strategies are used. Authentic (literally self-authored) or self-endorsed motivation leads to more interest, excitement, confidence, enhanced performance, persistence, creativity, vitality self-esteem, and well-being.

> *'Authentic (literally, self-authored or endorsed) and those who are merely externally controlled for an action typically reveal that the former, relative to the latter, have more interest, excitement, and confidence, which in turn is manifest both as enhanced performance, persistence, and creativity, and as heightened vitality, self-esteem, and general well-being. This is so even when the people have the same level of perceived competence or self-efficacy for the activity'. (Ryan and Deci, 2000b)*

The process of internalization is taking in a value or regulation, and integrating it so that the external regulation is transformed into the learner's own sense of self, and thus can shift extrinsic motivation from low autonomy to high autonomy. Ryan and Deci's taxonomy of Human Motivation is illustrated in Figure 2-11 Taxonomy of human motivation below. The figure illustrates that, from left to right, each type of motivation described is associated with increasing autonomy and increasing internalisation of causality.

| REGULATORY STYLES | Amotivation | | Extrinsic Motivation | | | | Intrinsic Motivation |

Regulatory styles boxes: Amotivation | External Regulation | Introjection | Identification | Integration | Intrinsic Motivation

| ASSOCIATED PROCESSES | Perceived non-contingency

Low perceived competence

Non-relevance

Non-intentionality | Salience of extrinsic rewards / punishments

Compliance / Reactance | Ego involvement

Focus on approval from self or others | Conscious valuing of activity

Self-endorsement of goals | Hierarchical synthesis of goals

Congruence | Interest / enjoyment

Inherent satisfaction |

| PERCEIVED LOCUS OF CAUSALITY | Impersonal | External | Somewhat external | Somewhat internal | Internal | Internal |

Figure 2-11 Taxonomy of human motivation

It can be seen from Figure 2-11 above that introjected, identified and integrated forms of extrinsic motivation have increasing levels of internalisation of perceived causality and increased sense of autonomy and personal causation. Purely external regulation is when behaviours occur simply to meet an external demand or avoid a punishment. Introjection describes a controlling type of regulation where actions are undertaken to avoid guilt or anxiety, or to enhance pride. Identification occurs when an individual participates in an externally regulated task but understands and internalizes the task as helpful for achieving a personal life goal. Finally integrated motivation for an externally regulated task occurs when the individual internalizes the reasons for the task, assimilates and self-determines their participation. The authors of SDT also assert that facilitating internalization is done by providing a sense of belongingness and connectedness to the persons, group, or culture disseminating the goal: relatedness. This includes feeling respected and cared for by the teacher. Competence also enhances internalisation. A learner is more likely to internalize a goal if they have the skills to succeed at it. Thus autonomy, competence and relatedness all contribute to moving from external regulation towards wholly integrated forms of motivation. A number of important papers discuss SDT in relation to medical education specifically and will be discussed in further detail in the following section.

Mann (1999) writes with the intention of encouraging educators to allow theory to inform practice in medical education. The starting point is that many medical learners appear to have low levels of intrinsic motivation for many of the skills and behaviours valued by educators. There is also a recognition that much medical learning is rote learning. A study in 1994

(Regan-Smith as quoted in Williams and Deci, 1998) demonstrated that around half of medical students reported learning 'half or more of year 1 and year 2 material by memorizing without understanding'. This supports Mann's suggestion that assessment is one of the most powerful motivators for medical leaners yet is often focussed on knowledge and facts. Often what faculty intend to provide differs from what is actually provided. Mann emphasizes the role of opportunities to practice a skill or task in enhancing self-efficacy and competence. She also recommends practices which encourage personal goal setting and the provision of feedback on performance to allow those goals to be reached.

Similarly another article (Williams et al., 1999) urges medical educators to become well informed of motivation theory in order to enhance their own practice and improve medical learning in the widest sense. They report evidence that self-determined learners become self-determined practitioners who are better prepared to work in patient-centred ways by enhancing patients' own motivation and autonomy for their health and lifestyle decisions. They describe the concept of autonomy support being a learning climate with particular characteristics such as meaningful dialogue, listening to what students want, provision of deep and satisfying responses to student questions, offering choice and encouraging students to take responsibility for their own learning. In other words a low control environment. The authors do, however, recognize that assessment is controlling and is an extrinsic driver, but urge that evaluative feedback can be modified to be autonomy supporting. Williams (1999) articulates the case for the importance of SDT in medical education and, in particular, the importance of autonomy, rather than control in motivation and subsequent educational attainment. The dangers of highly controlling traditional learning environments are suggested to be diminishing learner initiative and missing the opportunity to help medical learners become life-long learners with patient-centred consultation styles that enable patients to make good lifestyle choices.

In a further paper the same authors reviewed studies to confirm the hypothesis that autonomy-supportive learning climates encourage medical students to become more autonomously motivated and to feel more competent, as well as being more humanistic and patient-centred in their approach (Williams and Deci, 1998). They reported a 2-year longitudinal study of 72 medical students undergoing a course in interviewing. In addition at 6 months, those who reported their instructors as more autonomy supportive became more autonomously motivated, with stronger psychosocial values. When the students were subsequently observed in a simulated consultation based on cardio-vascular risk, the students who reported higher levels of autonomy support demonstrated significantly better patient autonomy support skills than those who rated their instructors less autonomy supporting. The authors also report studies in medical students where instructors rated as showing high degrees of autonomy

support resulted both in students feeling more competent as well as being more likely to choose the particular specialty where they experienced most autonomy support. Having defended their theory that autonomy enhancing climates enhance student autonomy, motivation and well-being they also explore studies hypothesizing that these healthcare professionals could impact on patient outcomes. They report that autonomy enhancing teams working in primary care with patients with chronic illness helped patients achieve greater sustained weight loss, and more exercise and regular appointment attendance at 6 month and 23-month time intervals. Also, other studies demonstrated improved compliance with drug therapies and improved diabetes control over a one year period when teams used autonomy enhancing techniques. The authors do note that much of this empirical work is at an early stage, and has been done by a small group of researchers and they urge further research in the application of self-determination theory to other medical education contexts. This can be considered as a very important emerging concept in the provision of sustainable healthcare in systems where demand on resources is rising exponentially. In a recent report by the Chief Medical Officer for Scotland 'Realistic Medicine' (Calderwood, 2016), the need to ensure practitioners have the time and skills to help patients make realistic decisions depends on shared decision making and autonomy enhancing practitioners. This thesis explores the context of simulation based medical education through the lens of self-determination theory of motivation and so contributes to addressing this stated area in need of further research.

An important contribution is a systematic review of motivation in the medical education literature (Kusurkar et al., 2012, Kusurkar et al., 2011). The authors included 236 articles reporting qualitative research with appropriate methodology and quantitative research using specific measures of motivation. Many of the papers were focussed on motivation in highly specific areas such as rural practice, or had weak methodology so that 56 were finally included. The aim was to identify independent and dependent variables for motivation in medical education from the perspective of self-determination theory. They explicate the following specific research questions (a) How has the literature studied motivation as either an independent or a dependent variable? (b) How is motivation useful in predicting and understanding processes and outcomes in medical education? They made search terms explicit, indicated the range of databases which were searched, and set out appropriate inclusion and exclusion criteria. The results demonstrated that motivation is an independent variable influencing both what action is taken and how well it is taken. Autonomy positively influences learning and study behaviour, leads to reflection and enhances deep rather than superficial learning. It also resulted in students taking more optional course work and engaging with more extracurricular activities. Higher intrinsic motivation correlated with higher academic grades. This finding was not consistent across all the included studies, however,

as some found poor correlation between successful academic performance and motivation. The second part of the review analysed motivation as a dependent variable and differentiated the variables which cannot be manipulated from those variables which can be manipulated. Their analysis is summarized in Figure 2-12 Diagrammatic representation of variables that affect or are affected by motivation (Kusurkar et al., 2011) below.

Variables that cannot be manipulated

Age
Gender
Ethnicity
Socioeconomic status
Educational background
Year of the curriculum
Parent and teacher support

Variables that can be manipulated

Autonomy
Autonomy support
Type of curriculum
Extent of responsibility

Competence
Self-efficacy
Selection procedure
Assessment
Rewards
Knowledge acquisition
Perceived task value

Relatedness
Early patient contact
Well-being

Motivation

Outcome variables
Academic success and
   performance
Learning and study
   behaviour
Choice of medicine as
   a career
Specialty choice
Intention to continue
   medical study

Figure 2-12 Diagrammatic representation of variables that affect or are affected by motivation (Kusurkar et al., 2011)

A number of variables seen in this figure are specific to medical education such as selection procedure, or early patient contact, but are unlikely to be relevant in the context of simulation. There are however some variables influencing motivation which are likely to be relevant to the particular setting of simulation. This thesis will emphasize autonomy support, self-efficacy and perceived task value as being particularly relevant to simulation.

An important empirical study of motivation in Brazilian medical students was undertaken by Sobral (2004). The aim was to describe patterns of motivation in medical students at an early

stage in their curriculum and to examine the relationship with learning features and motivational outcomes. The author used a validated rating scale; the academic motivation scale (AMS) (Vallerand et al., 1993) to evaluate motivation of 297 medical students over 4 years. The results suggested that there were higher levels of autonomous motivation demonstrated than controlled motivation, and that higher levels of autonomous motivation correlated with more meaning orientation, reflection, academic achievements and contributions to a voluntary peer education programme. Four different student groups were identified in as having different levels and patterns of motivation. They identified that those who were more meaning orientated in their learning were positively associated with more autonomous motivation, whereas there was a positive association with amotivation and controlled motivating with more reproductive orientation to learning. Autonomous motivation also correlated with academic achievement, which was maintained from term 3 to term 6. They also identified that both controlled and autonomous motivation co-existed and interrelate in such a way as to affect one another, but those with stronger autonomous drive were more meaning orientated, had better perceptions of course quality and found greater meaning in their experiences. It was also noted that the 3 subjects who dropped out of the course all had high sores for amotivation and for controlled motivation. The author recommends the instrument for use in medical education, as those students with low or maladaptive motivation may need additional support.

Brissette and Howes (2010) performed a systematic review of the literature on motivation in medical education. They begin with speculating that although most modern medical curricula aspire to enhance the intrinsic motivation of learners who are presumed to be highly motivated to become good physicians, that there is perhaps some over simplification, in that not all medical learners display all characteristics of the adult learner, but may behave in externally motivated ways. They explicate the databases searched and their search strategy. Of more than 600 articles which had titles and abstracts reviewed they included just 10 articles in their analysis. Four of these papers examined the role of SDT in medical education. They concluded that in spite of the important role of motivation in medical education that there was little published literature and suggest there is much room for improvement and scope for potential future research.

In the very specific context of anaesthetic career grade practitioners one research project explored activities, motivation and barriers to participation in continuing medical education(CME) (Chambers et al., 2000). This study involved a postal questionnaire of career grade anaesthetists in Scotland, which had a good return rate of 84.5%. They asked about types of CME respondents had participated in, and motivating factors and barriers. Factors stated as motivation included College requirements, employer expectations, to keep up to date

with clinical practice and to keep up to date for teaching. Their paper discusses barriers to engagement with CME in anaesthesia, including pressure of clinical commitments, personal commitments, difficulty getting time off, distance to travel and cost. However, there was no correlation between stated perceived barriers and actual time spent in CME activity. The barriers stated did vary with age, and degree of seniority. Limitations of this paper include the fact that CME is discussed as a blanket term and primarily refers to meetings, there is no explicit description that simulation activity was included in this research paper, but because simulation plays such an important role in anaesthetic training it is most likely that this was included as clinical teaching activity. A further limitation is the limited depth which a postal questionnaire can bring to such a complex area as motivation.

2.2.5. Conclusion and outstanding questions to be answered

In conclusion, a review of the literature has identified, that whilst educators and curriculum designers seek to create motivated learners, motivating curricula, and learning environments which support optimum learning, empirical research is both sparse and at an early stage in medical education. There appears to be emerging evidence in education in general that autonomy-supportive learning environments may offer strategies for creating such learning environments, as well as helping identify factors which may undermine motivation. It has also been seen however, that there has been relatively little research of this in medical education, and no previous empirical work exploring motivation in the specific context of simulation. This literature review has identified a gap in the existing literature and the following chapters will describe how this thesis contributes to this area.

3. METHODOLOGY

3.1. Introduction

In the previous chapter, which reviewed the literature relating to both simulation in medical education and how self-determination has been described in the medical education literature, it was identified that there is a paucity of literature and a lack of high quality, methodologically robust and theoretically underpinned research describing or developing a conceptualisation of motivation, or barriers to engagement with simulation based medical education. This chapter will describe a plan of inquiry outlining the exact steps taken by the author in researching this area. The chapter is structured as follows, firstly the precise research question will be explicated, and then the theoretical assumptions will be addressed. This will include a discussion of the underlying personal and philosophical worldview and assumptions. There will be discussion of the reasons for selecting the methodology used. The chapter will then describe ethical considerations, the sampling process used, the participants, the instrumentation used, the procedures followed and the process of data analysis. Finally the validity and reliability of the research will be outlined.

3.1.1. Thesis Research Questions

Question 1: What motivating and demotivating factors in simulation based medical education do doctors and medical students describe?

Question 2: What is the relationship between motivating and demotivating factors, perceived relevance and realism in decisions to participate in simulation based medical education?

The first research question was developed, based on the author's prior reading and experience and by identifying the gaps in the literature as described in the previous chapter. The second research question, however, was not explicated at the outset of the research, but rather emerged during the initial collection of data. Framework analysis, which is described in further detail in the following section on research design, facilitates an approach where a research question and analytical framework can be explicated *a priori*, but also allows for the research question and analytical framework to be adapted, clarified and developed in a bi-directional manner as new and interesting concepts emerge. Specifically in this research, the author had not set out to explore the concept of realism in simulation,

but in early interviews it began to emerge as an important theme, so the second research was added at that stage. For ease of reading, the work is presented here in a linear way, although it occurred in an iterative and bi-directional manner.

3.1.2. Research Design

This research uses a qualitative approach to address the research questions and to contribute to understanding of motivating and demotivating factors to engagement with simulation based learning. It is intended that this qualitative investigation, will lead to a future quantitative study which will develop an instrument for measuring and quantifying motivation characteristics in relation to simulation, relevance and realism. This qualitative element can therefore be considered the first part of an overall mixed method approach to the problem using an exploratory sequential approach to identify, clarify terminology and concepts around doctors' and medical students' views on medical education using simulation in order to inform the subsequent development of a quantitative instrument. A mixed methods approach is research in which the investigator collects and analyses data, integrates the findings and draws inferences using both qualitative and quantitative approaches or methods in a single study or a programme of enquiry (Creswell, 2013, Tashakkori and Teddlie, 2013). The elements of the project described in this thesis represent the qualitative collection, analysis of data and inferences drawn. A frequently cited definition of mixed methods, generated by a consensus approach, states that *'Mixed methods research is the type of research in which a researcher or team of researchers combine elements of qualitative and quantitative research approaches (e.g. use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the purposes of breadth and depth of understanding and corroboration'* (Johnson et al., 2007 p.123).

It is recognized that this thesis crosses academic disciplinary boundaries in that it addresses issues which will be of interest to both the medical community and the education community. These disciplines have differing traditions of ontology, epistemology and methodology. A mixed methods approach has been chosen as most appropriate in answering the research questions as it draws on expertise from both disciplines, taking account of the differing traditions. Medical science and medical education research are typically viewed as being deeply rooted in the natural science tradition of positivism and an emphasis on controlling variables to seek causality (Monrouxe and Rees, 2009). Educational theory, in contrast, has been influenced by the parent disciplines of philosophy, sociology and psychology and qualitative inquiry based on constructivist paradigms and includes phenomenology, grounded theory, and ethnography. Schifferdecker (2009) offers a compelling case for the need for mixed method approaches in medical education precisely because it lies at the intersection of

two approaches. In addition she offers the insight that such an approach will be familiar to practising clinicians as they collect, analyse and integrate qualitative data (the patient narrative, ideas concerns and expectations) with quantitative data (physical examination findings, test results) in order to effectively manage individual patient episodes. As the author and participants represent clinicians with daily involvement in delivery of patient care this argument is compelling. Also, several other authors (Creswell, 2013, Bryman, 2008, Illing, 2014) assert that mixed methods approaches can, in fact, feasibly bring together the two traditions of enquiry, quantitative and qualitative, to produce findings which may be superior to findings generated from a single tradition. Maudsley (2011) states that some important questions in medical education *require* a mixed methods approach to adequately answer. This approach has been successfully used in medical education research for instrument development, where qualitative data are collected with the intention of developing a quantitative instrument such as a questionnaire or checklist (Greene et al., 1989). In the domain of clinical medicine Sherrat and Jones (as cited by Schifferdecker and Reed, 2009), for example, used semi structured interviews to assess areas of concern for practitioners dealing with patients who use narcotics. The identified themes were used to create a questionnaire for health care practitioners. This approach may be described as pragmatic. Creswell (2011) describes pragmatism as having concern with the consequences of actions, problem centeredness, pluralistic and real-world practice oriented. The key strands of pragmatism are

1. Methods - mixed

2. Logic - both inductive and deductive

3. Epistemology - accepts subjectivity and objectivity (epistemological relativism)

4. Ontology - accepts external reality but seeks the best explanation of outcomes

5. Causation - accepts that causal relationships are possible but yet elusive

One of the most highly respected peer reviewed journals in medicine, The British Medical Journal, suggests that a 'horses-for-courses' (Maudsley, 2011) approach, where the research question should dictate the method rather than the paradigm, would be considered rigorous (Education Group for Guidelines on Evaluation, 1999).

This thesis employs a thematic analysis for the interpretation of the data. The methodology 'framework analysis' (FA) as described by Ritchie and Spencer (2002a) has some of its basis in grounded theory and is considered an example of thematic analysis. Bryman (2008) quotes grounded theory as 'theory that was derived from data systematically gathered and analysed through research process'. In grounded theory data collection, analysis, and eventual theory

stand in close relationship to one another but theory comes after data gathering, not before as in the inductive process (Strauss and Corbin 1998). Qualitative research has been described as the 'Development of concepts which can help us to understand social phenomena in natural (rather than experimental) settings, giving due emphasis to the meanings, experiences and views of the participants' (Pope and Mays, 1995). Whilst qualitative research can offer deep insight into the studied phenomenon, one of the difficulties is that the data produced can be extensive. In this case the primary data takes the form of audio material, along with the associated transcription. FA was first developed and described in relation to social policy research and has now become established as a common tool for qualitative data analysis in healthcare. FA provides a structured way of managing large data sets to organize and analyse in a transparent and rigorous way. Framework is distinct from other types of thematic analysis in that it utilizes a framework which is established at an early stage of the process of analysis, by the researcher (and team). The framework is established based on the researchers' prior reading, knowledge of the subject matter and participants, and negotiated as an early step within a team. In this sense this approach could be considered deductive, however the framework is constantly compared with the primary data and emerging themes, through multiple iterations, and so can allow new topics and themes to emerge. Therefore this research is bi-directional in the sense of being both inductive and deductive. Framework has been described as being particularly suited to research which has specific questions, a limited time frame, a pre-designed sample and *a priori* issues (Srivastava and Thomson, 2009). Framework analysis has been described and utilized by Pope and Mays (2006), and draws upon the work of Ritchie and Spencer (2002b) and Miles and Huberman (1994). The underlying rationale behind the process is that the relatively large amounts of data produced in qualitative research need to be charted, mapped, and organized in a thorough, systematic and rigorous way, but often within specific time constraints and to answer a particular question to influence policy or practice. The framework uses the research question, the literature and the research team's prior understanding of the issues to create the framework which is used deductively and bi-directionally to create a synthesis of data in the form of a chart, table, map or other representation. Interrelationships between dimensions and themes can be demonstrated. New topics can be added and amendments can be made as the analysis proceeds. The five key steps involved in the process are illustrated and discussed in further detail later. The reasons for rejecting other methods is outlined in Chapter 5: Discussion.

3.1.3. Ethical Considerations

Ethical approval was sought and granted by the University of Dundee Research Ethics Committee. The research was designed in line with the University protocol for non-clinical

research involving human subjects. As participation was entirely voluntary and the invited participants are all practicing medical practitioners, or in their final year of training it is understood that they all have the capacity to fully understand the implications of participation. All medical graduates also have training in research ethics and therefore a good understanding of what their own participation in research involves. Participants were offered a participant information sheet at the time of invitation, and also offered again for those who came for interviews at the determined time. It was acknowledged by the author that the relationship with some of the groups of participants represented a different dynamic to others, in terms of pre-existing professional relationship. When recruiting and interviewing foundation doctors, anaesthetic registrars and primary care specialists, the relationship could be considered professionally equal. However, when recruiting and interviewing undergraduate participants it was recognized that as the author also participates in delivery of undergraduate teaching and some assessment, that there was potential for a power imbalance. This potential ethical issue was addressed by emphasising the voluntary nature of student participation, the protection of anonymity of any views shared and the emphasis of the opportunity to withdraw at any time without any impact on future professional activity or relationship. This is also discussed further in Chapter 4: Personal Reflections. Before starting interviews, participants were all asked to read the information sheet, and to indicate their informed consent by signing the consent form, in order to agree to both participation, and audio recording of the interviews and anonymized use of quotations for academic purposes. All participants agreed to participate in the group interviews and to audio-recording of the interviews and to the use of anonymized data in the doctoral thesis and academic publication. Copies of the letter of ethical approval, participant information sheet and consent form can be seen in the appendices. The signed consent forms were stored in a locked filing cabinet. No financial, nor any other reward was offered for participation, but the author did provide some light refreshments (tea, coffee, juice, biscuits) for the duration of the interviews. No ethical dilemmas arose during the research.

3.1.4. Sampling

Purposive sampling was used to recruit subjects to participate in group interviews to explore their views related to the research question and any other emergent theme. Purposive sampling has been described as the selection of sampling units within the segment of the population with the most information on the characteristic of interest, whilst deliberately seeking to include 'outliers' to allow for such deviant cases to illuminate, by juxtaposition, those processes and relations that routinely come into play, thereby enabling 'the exception to prove the rule' (Barbour, 2001). It was intended to purposively sample a wide range of medical practitioners from various career stages and areas of specialty practice in order to uncover

the fullest array of perspectives. It has been argued that qualitative research needs purposive or theoretical sampling to increase the scope or range of data exposed (random or representative sampling is likely to suppress more deviant cases) as well as to uncover the full array of multiple perspectives (Lincoln and Guba as cited in Rudestam, 2007). Ideally participants from every medical specialty would have been sought to gather maximum diversity, however, this ideal approach was constrained by the fact that the research was done by a single researcher working within constraints of time and finance. Therefore, doctors in general training at undergraduate and post graduate level, and foundation year level were considered generalist, in that they have not yet embarked on particular specialty training. General practitioners (GPs) were considered by the author to be a 'specialist' group as they have completed post graduate training in the provision of primary care and are considered a specialist group in terms of their range of knowledge, skills and likelihood of experience of simulation based medical education. Those specialties most likely to have the maximum exposure and experience of simulation are in the acute specialties of anaesthetics, critical care medicine and emergency medicine, therefore anaesthetics was selected as being likely to represent views of these specialties. The groups selected were anaesthetists; because it was expected that they would have a significant amount of experiences in simulation and could therefore base their opinions on their broad experiences. GPs were purposively sampled because they were likely to have had less exposure to simulation, tend to both work and continue their professional education and development autonomously, and would be more likely to have greater choice about what type of CPD courses or programs they would find relevant or would be motivated to engage with.

Another potential source of different experiences or views was anticipated as stage of career. As simulation has become more commonly used in the past decade, it was expected that those who are at a more senior stage of their careers would have less experience of simulation, whilst those still in training or at an earlier career stage would be expected to have more simulation as an expected normal part of their training, hence the most junior grade of participant was final year medical students, and the most senior was GPs close to retirement, at a very senior stage of their careers. Bothe of these purposive sampling strategies allowed for the inclusion of 'outliers' as described above. It was intentional to incorporate a wide range of different experiences of simulation both in terms of level of expertise and range of specialty. Sampling was purposively carried out as follows. The author made a personal approach to groups of medical students and doctors at a range of career stages and in the selected specialties of anaesthetics and general practice, whenever they were already gathered in a convenient location for the purpose of continuing professional development. The interviews were carried out in the naturally occurring learning groups of each demographic set. It was

anticipated that participants would feel most comfortable sharing their experiences with those with whom they have something in common. The nature of continuing medical education (CME) is such that these gatherings are advertised to all eligible doctors, but with an understanding that attendance will be variable, and dependent on clinical commitment. The nature of the research was briefly explained verbally and contact details for the researcher and a participant information sheet (appendix 3) were offered to any interested potential participants. CME organizers who indicated a willingness to participate were subsequently contacted in person and via email to arrange mutually convenient times and locations. Subjects were recruited if two, or more individuals from any particular group were able to commit to at least 45 minutes of interview at the same time. All the group interviews were carried out either immediately before, or immediately after an existing CME occasion or event. Sound check and recording set up time were included in the invitation timings. Because of the very unpredictable nature of attendance at CME events the author was unable to give a total number of potentially eligible participants, but is able to state that all participants who attended the targeted CME events did agree to participate. It is not known if any potential invitees chose not to attend the CME events because of the presence of the researcher. The resulting limitations to the generalizability of the results is discussed further in Chapter 6: Discussion (p128). A total of seven different groups of practitioners was identified and agreed to participate. The numbers of participating subjects, gender, medical specialty and career stage is shown in Table 3-1 Details of participants below and discussed further.

	DESCRIPTION	SPECIALTY	NUMBER	CAREER STAGE	GENDER M/F
Interview 1	Senior medical students	general	3	undergraduate	1M/2F
Interview 2	Foundation doctors	general	2	early graduate	1M/1F
Interview 3	Anaesthetic senior trainees	anaesthetics	5	mid-career	5M
Interview 4	Anaesthetic senior trainees	anaesthetics	2	mid-career	2 F
Interview 5	GP PBSGL	Primary care	5	senior	3M, 2F
Interview 6	GP PBSGL	Primary care	7	senior	7F

	DESCRIPTION	SPECIALTY	NUMBER	CAREER STAGE	GENDER M/F
Interview 7	GP PBSGL	Primary care	4	senior	4F

Table 3-1 Details of participants

Seven interviews were conducted, which included a total of 28 subjects (10 male, 18 female) in group interviews which had a range of 2 to 7 participants per interview. Undergraduate (UG) and early career general doctors in their first year following graduation - foundation year 1 (FY1). General Practice, Practice Based Small Group Learning (PBSGL) refers to Primary care practice based small group learning activity. The interviews were carried out over a 6-month period at mutually convenient times, by arrangement.

3.1.5. Setting

The research was conducted at Ninewells Hospital and Medical School at The University of Dundee or in a Primary Care Practice Based Small Group Learning (PBSGL) venue within NHS Tayside and the City of Dundee. Ninewells Hospital and medical School is a large teaching hospital and tertiary referral centre with dedicated educational facilities including a clinical skills centre with a state-of-the-art simulation centre. The clinical skills centre provides a range of educational experiences including communication and consultation skills training with simulated patients, procedural skills training such as venepuncture and cannulation, and complex simulation scenario teaching and assessment replicating a ward environment for senior medical students and junior doctors. A range of post graduate courses is also hosted. Interviews were conducted in a range of settings. Interviews with foundation doctors were carried out in an educational area within the University Institution where learning and teaching normally occur. Anaesthetic specialty trainee (ST4-ST5) interviews were conducted in the education unit of the NHS anaesthetic department, and general practice (GP) interviews were carried out before, or after PBSGL events wherever they occurred. Two of these PBSGL groups occurred in participants' own homes, one in formal primary care learning facilities within a practice building. The interviews were conducted naturalistically in the setting normally used for the learning group interviewed. The physical layout of each setting was similar- chairs were arranged in a circular arrangement facilitating group discussion. In some settings there was a working height table in the middle, in other settings there was a lower height coffee table in the centre. None of the settings had a formal teaching layout of a lecture type design.

3.1.6. Instrumentation

Possible mechanisms for gathering data to answer the research question could have included questionnaires, one-to-one interviews, group interviews, or searching for existing data sets. This section describes firstly why group interviews were chosen as appropriate method to help answer the research questions, and then goes on to describe how the interviews were carried out and the interview schedule used to conduct the interviews. Chapter 2: Literature Review discussed research into the motivation of medical students at various stages of training using a validated tool as described by Sobral (2004) who used the Academic Motivation Scale to explore levels and orientation of motivation in the participant group, and to compare this with academic progress and progression. The tool was based on self-determination theory and has been validated (Vallerand et al., 1993). Whilst this tool would have been useful for assessing levels and orientation of motivation it would not have offered the depth of understanding about what factors enhance or undermine motivation in this particular context. Interviews were chosen rather than questionnaires because an existing study exploring barriers to engagement with simulation (Savoldelli et al., 2005) using questionnaires was unable to explore this qualitatively or in sufficient depth to allow the desired level of understanding of the phenomenon. Questionnaires can offer more opportunity for free text responses which could have been analysed, and after considering the potential advantage of questionnaires in terms of potentially increased quantity of data, and less time consuming the author considered that this was outweighed by the advantages of interviews (Bryman, 2008). These include depth of response, ability to explore ideas in a deeper way, enabling cross checking of understanding, completing additional responses, allowing participants to interrupt, correct, and provoking new insights the researcher may not have considered. The disadvantages of interviews include their time consuming nature, the potential for bias, inconvenience and lack of anonymity (Ng et al., 2014 p.375). Comparing one-to-one interviews with group interviews the following aspects were considered. The method of group interviews can generate a wider range of responses than individual interviews, can be more practical than individual interviews, and less time consuming. Cross-checking of views also occurs within the group, and the process of group interviewing places value on the importance of human interaction. These advantages of group interviews were balanced against the disadvantages such as the possibility of dominance by one member, the risk of antagonism, and the views discussed representing the 'public line'. From a practical point of view transcribing group interviews can be more challenging than one to one interviews because of recognising different voices and taking account of interruptions. The transcription process is described more fully later. The term group interview is used in preference to the term 'Focus Group' as a focus group can be considered a subgroup of group interviews where the

interaction *between* participants is the primary unit of research study, rather than the dialogue between participants and interviewer in order to collect a range and diversity of views as being the primary unit of interest (Bryman, 2008). In other words this research sought content themes rather than an exploration of process related themes. The interview schedule can be seen in Table 3-2 Interview trigger questions and will also be discussed.

INTERVIEW TRIGGER QUESTIONS
What is your experience of simulation based learning?
What is good about learning using simulation?
What is not so good?
Why did you participate/not participate in simulation based learning?
Did anything prevent you learning as much as you hoped?
What do you think may hinder some doctors from participating in this type of learning?

Table 3-2 Interview trigger questions

As the literature review had not identified an already validated instrument or schedule which was capable of exploring the research questions explicated, the author used the theories and empirical research as discussed in chapter 2 to design an interview schedule for this purpose. The schedule of interview questions was designed as an aide memoir and plan of inquiry, rather than a formal list of questions, and was not intended to be followed prescriptively but for use as trigger for open discussion. For example after asking the opening question 'What is your experience of simulation based learning?' once all participants had answered this question, some groups began to discuss their perceptions of positive and negative aspects or personal incident narratives, but in groups where there was a pause at this point the next trigger question was used by the interviewer to develop further discussion. The interviewer welcomed participants developing ideas, or leading the discussions in directions not established in advance or explicated by the interview schedule. In addition to using the interview schedule as detailed here the author also used non-verbal communication to encourage all group members to participate in the discussion. The first group interview was considered a pilot, after conducting the interview and reviewing the process and interview schedule, as only minor changes were made to the interview schedule, this interview was transcribed and included in analysis of the body of data.

3.2. Procedure

3.2.1. Data Collection: Recording

All of the interviews were audio recorded using either a hand held or desk top digital device. Recording allowed the author to fully concentrate on listening to participants and use non-verbal communication to encourage participation. The audio recording was saved as a digital audio file and labelled using a naming convention based on career stage and specialty identifier, whether participants were male, female or both, and the date of recording. For example GP_MF_1_290111 indicates an audio file recorded on 29th January 2011 with a group general practitioners (GP) who were male and female (MF). This was the first interview with GP subjects (1). After recording was complete the audio files were downloaded from the recording device onto a password protected PC in a locked room, in order to protect the confidentiality of the data. The original audio recording was then deleted from the recording device.

3.2.2. Transcription

This section describes both the theoretical considerations in transcribing as well as the procedure of transcription. Although digital audio files can be used as primary data files for analysis, access to the data can be achieved more efficiently by converting the primary data set into written format, in other words the process of transcribing. Verbal utterances can be highly complex, and it wouldn't be possible to remember every nuance of verbal interaction so the process of transcription converts data into a format which is more accessible, by changing into a written format to allow one to study an utterance for as long as desired, and therefore content easier to navigate and analyse. Some of the suggested benefits of transcription include (Bryman, 2008):

- Corrects memory limitations and intuitive glosses

- Allows more thorough examination

- Allows repeated examination of responses

- Opens data to scrutiny and allows for secondary analysis

- Helps counter biases

- Allows analysis to be reused in light of new theory or analytic strategies

The differences between speech and the written form include intonation, emphasis, false starts, repetitions, pauses, interruptions and so on. The aim was to convert the audio files into

the most detailed representation of speech that is necessary to analyse to the depth required by the research aims. Too much detail however would make the transcript difficult to read in order to identify content or themes but too little could risk loss of depth (Bailey, 2008). In order to identify themes and subthemes a transcription level for content and themes was used. Transcription to the level of discourse analysis was not considered necessary in this research as it would not add additional understanding to themes and content, but would result in a data set much more cluttered and difficult for a team of users to analyse (Tilley, 2003). The level of transcription detail can also reflect the researcher's theoretical assumptions. Skukauskaite (2012) asserts that transcribing is a process that is influenced by both theoretical and methodological assumptions and that these assumptions should be transparent. The author's decision to personally transcribe data was taken - partly for reason of cost, but also acknowledging the benefits in terms of immersion in the data resulting in enhanced understanding. Audio data was anonymized during the transcription process, using a naming convention similar to that described for indexing the interviews, in other words GPF1 was a female GP. The audio files were transcribed personally by the author because repeated careful listening was the first step in data analysis. It has been argued that even where financial or time limitations do not apply, the benefit of the researcher personally transcribing provides additional rigour to the data interpretation (Tilley, 2003).

In this project the author made use of computer assisted qualitative data analysis software (CAQDAS). One advantage of using CAQDAS is that it enhances transparency by linking the transcript to the original audio file and thereby allow any reader to listen to the recording contemporaneously which allows the greater insight to meaning (Freise, 2012). The author thereby provides rapid access to surface content in addition to the augmentation of the audio without loss of continuity. A number of important questions were addressed. The questions and responses are shown in Table 3-3 Transcribing issues addressed below questions were considered

QUESTION CONSIDERED	RESPONSE
What kind of analysis is this transcript for?	Thematic Analysis: these transcripts will be used to identify themes in the data in relation to motivating factors, and barriers relevance and realism in simulation based medical education

QUESTION CONSIDERED	RESPONSE
What information will be included?	Information which is necessary to include will be identity of the speaker, a literal transcription of words spoken, transcribed using Standard English spelling. To provide clarity and ease of reading no merging will be transcribed. Punctuation will be used to enhance legibility, and a short drop of voice will be represented by a full stop Pauses will be represented as follows. Full stop in parenthesis 1 sec (.) 3 sec (…) long breaks (15)
Will emphases be included?	Emphases may indicate themes of particular importance to the participants, and demonstrating emphases within the transcript by <u>underlining</u> is not considered detrimental to readability and will therefore be indicated as such
How will dialect or vernacular be represented?	Dialect and vernacular are not considered to be relevant to the research question and will not be represented beyond the verbatim speech in standard English

Table 3-3 Transcribing issues addressed

A summary of the resulting transcribing convention is shown in Table 3-4 Transcribing convention.

Transcribing convention
Literal - transcribe words in standard written English as spoken
No merging i.e. use standard English grammar and punctuation for clarity of reading
Abrupt stop discontinuation / slash
Punctuation added to enhance legibility, short drop of voice full stop rather than comma
Pause full stop in parenthesis 1 sec (.) 3 sec (…) long breaks (15)
Emphasized words <u>underlined</u>
New speaker: new paragraph
Blank line between speakers
Time stamp at least every paragraph
Emotional noise e.g. laugh in [brackets]
Overlap indicated by square bracket at beginning and end [ ]
Inaudible or uncertainty < >
Numbers zero to twelve spelled, higher as numerals unless easily spelled
Direct speech in quotation marks 'let's see'
Notes and comments to add explanation or clarity in brackets [   ]

Table 3-4 Transcribing convention

Having described the process of transcription and explicated the transcribing convention used, the following section will describe the subsequent steps in analysis of the data.

3.3. Data Analysis

This section describes the procedure for interpretation of the data using Framework analysis. The five key steps involved in the process are illustrated in Figure 3-1 Stages of Framework Analysis (Pope et al., 2000) below, and then discussed in further detail.

> **Five stages of data analysis in the framework approach**
>
> - *Familiarisation*—immersion in the raw data (or typically a pragmatic selection from the data) by listening to tapes, reading transcripts, studying notes and so on, in order to list key ideas and recurrent themes
> - *Identifying a thematic framework*—identifying all the key issues, concepts, and themes by which the data can be examined and referenced. This is carried out by drawing on *a priori* issues and questions derived from the aims and objectives of the study as well as issues raised by the respondents themselves and views or experiences that recur in the data. The end product of this stage is a detailed index of the data, which labels the data into manageable chunks for subsequent retrieval and exploration
> - *Indexing*—applying the thematic framework or index systematically to all the data in textual form by annotating the transcripts with numerical codes from the index, usually supported by short text descriptors to elaborate the index heading. Single passages of text can often encompass a large number of different themes, each of which has to be recorded, usually in the margin of the transcript
> - *Charting*—rearranging the data according to the appropriate part of the thematic framework to which they relate, and forming charts. For example, there is likely to be a chart for each key subject area or theme with entries for several respondents. Unlike simple cut and paste methods that group verbatim text, the charts contain distilled summaries of views and experiences. Thus the charting process involves a considerable amount of abstraction and synthesis
> - *Mapping and interpretation*—using the charts to define concepts, map the range and nature of phenomena, create typologies and find associations between themes with a view to providing explanations for the findings. The process of mapping and interpretation is influenced by the original research objectives as well as by the themes that have emerged from the data themselves.

Figure 3-1 Stages of Framework Analysis (Pope et al., 2000)

3.3.1. Stage 1: Familiarisation.

This stage was conducted as follows. The author began immersion in the data thorough both the interview process itself, as well as the task of transcribing, as discussed above. The initial stage of data analysis involved repeated listening to audio recordings of the interviews as well as transcribing from audio to textual data. Items of interest were identified and listed. Some themes began to emerge, and therefore influenced the identification of the thematic framework.

3.3.2. Stage 2: Identifying a thematic framework

Two experienced qualitative researchers were recruited to listen to, and to simultaneously read transcripts of a sample of two of the initial interviews. This was done on a pragmatic basis where two interview transcripts with audio from different specialty groups were used as exemplars. The researchers were one medical educator, who is also a practising clinician, with training and experience in qualitative research in medical education, and the other a doctoral researcher in general education, with training and experience in qualitative data analysis. The three researchers did this independently of each other. The team then came together with their own notes and observations, for a half day, to discuss, compare and negotiate a framework. As well as the segments of data noted by the researchers to be of interest, a draft of the thesis research question and the researchers' existing knowledge and expertise were drawn upon, and influenced the negotiated framework. This part of the analysis was done using paper and pen charting. The first framework created by consensus was then constructed as a code book and discussed a second time with the two other researchers for agreement. Themes and sub-themes were identified. For example 'Course Description' was a key content theme, where participants described the types of courses they had experienced. A related sub-theme was 'medical emergencies' where the content and learning was described as being focussed on the management of medical emergencies. The agreed framework was converted from paper and pen format into electronic format and added into Atlas-Ti®. The resulting initial code book is shown below in Figure 3-2 Code-Book Example.
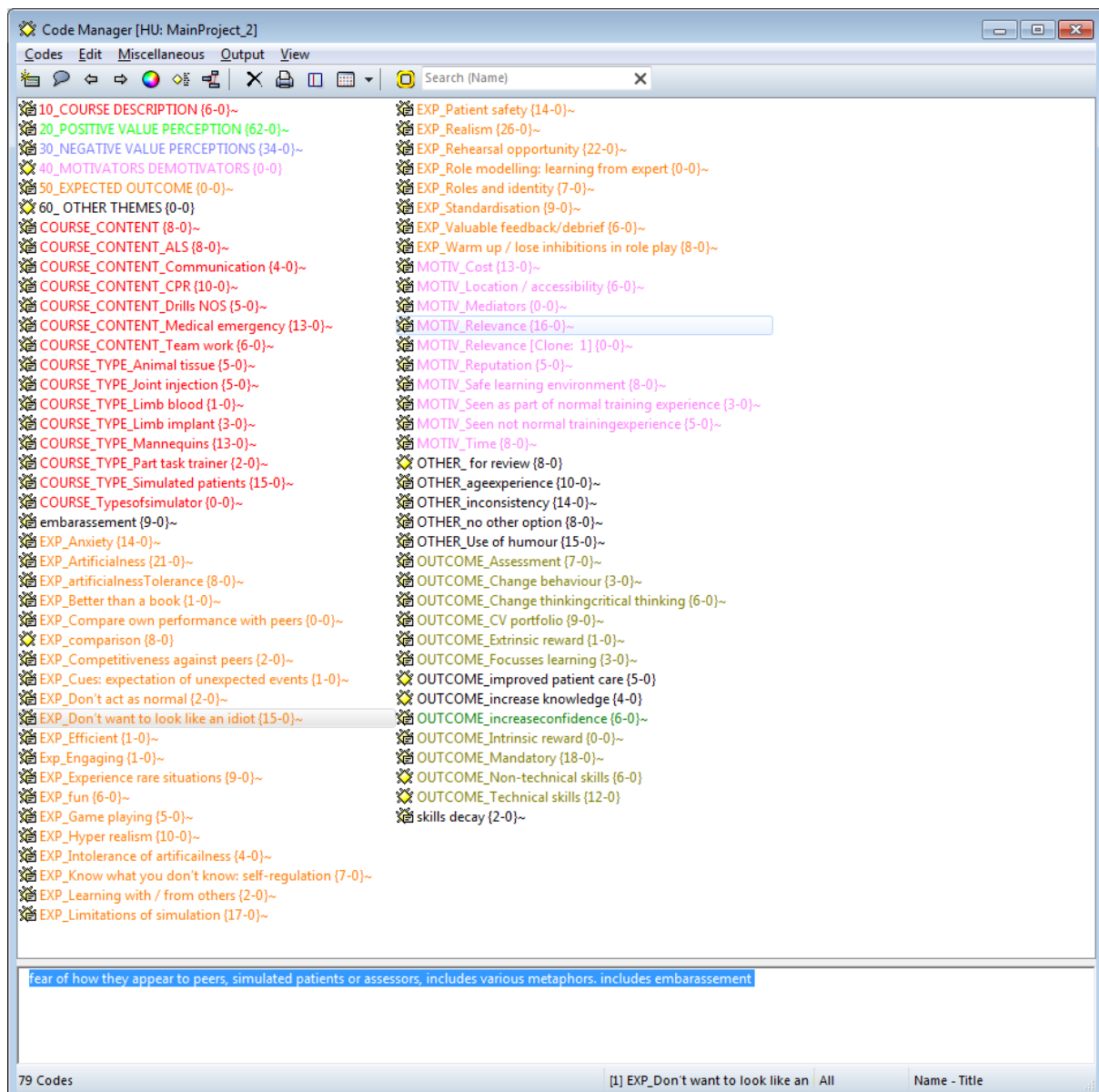
Figure 3-2 Code-book example

3.3.3. Stage 3: Indexing

The indexing stage used CAQDAS Atlas-Ti ® (version7.1, Scientific Software Development GmbH, Berlin) as both a repository for the primary data of audio files and transcribed text files, as well as a tool to facilitate organisation and visualisation of the data. The audio and transcript text files were deposited into the software package and the code book converted to an electronic format. The negotiated framework was used to identify and annotate the entire data set using the index codes. In this thesis a code is 'a word or short phrase used symbolically to assign a summative, salient, essence-capturing, and/or evocative attribute for a portion of language-based or visual data' (Saldana, 2009). Codes are researcher generated constructs symbolizing and attributing meaning to individual datum for the purpose of seeking patterns, creating categories and subsequently theorising. The code is an attempt to capture the

primary content or essence of an extract of data. In this step of coding and indexing the process is not simply labelling but also represents heuristic processing intended to lead from the data towards the idea. (Miles and Huberman, 1994 , Saldana, 2009). Each code was developed in parallel with a definition of what was meant by the code description, and for further clarity many codes had an example attached of use of that code. For example in Figure 3-2 Code-Book Example above the code 'Don't want to look like an idiot' has been highlighted. The definition can be seen below the split screen 'Fear of how they appear to others, peers, simulated patients or assessors: includes similar metaphors and embarrassment'. An example of a section of text which was associated with this code is

ANM4:   the stress is still there from the aspect of your wanting to do well [

ANM5:   yeah]

AMN4:   and wanting to not look like an idiot in front of your colleagues

If a code was thought to be ambiguous or representing a more complex phenomenon clarification statements were added and, in some cases, examples of exclusions and cases where a code which was 'not quite' the appropriate code. For example Anxiety was defined as 'Anxiety, nervousness, fear, stress, emotional reactions to a particular situation, excludes embarrassment which is coded separately. Examples of quotations coded as anxiety are shown for illustration below.

ANF1:   you remember it because it's a scary high stress situation especially if you've got like multidisciplinary teams.

UGM1:   I think for a lot of people it's purely overcoming nerves

Some examples of codes are shown in Figure 3-3 Code-book Segment below.

10	LEARNING EXPERIENCE DESCRIPTION	
	10.10	LEARNEXP_Experience rare situations
	10.20	LEARNEXP _Learning with / from others
		LEARNEXP _Role modelling: learning from expert performance
		LEARNEXP _Compare own performance with peers
		LEARNEXP _Competitiveness against peers

Figure 3-3 Code-book Segment

This example shows how segments of data where participants described their simulation based learning experience were coded. Quotations or data segments may have had one or more codes applied to the same data segment indicating other interesting elements to the quotation such as whether this aspect of the learner experience was considered positive or negative. Many of the quotations may also have had a code indicating the type of simulation learning experience or the type of equipment used, or nature of the team.

3.3.4. Stage 4: Charting

Once the whole data set had been coded the process of charting was carried out. Charting is the process of bringing together data from individuals into groups with similarities in order that it may be grouped, categorized and arranged into meaningful categories and themes within Atlas-Ti ®. The primary analysis enabled identification of the key themes of positive and negative prior experiences of simulation, the importance of realism in those experiences, motivation and barriers to engagement in simulation. The use of colour was helpful in creating visualisation of the data. This can be seen in Figure 3-2 Code-Book Example. Analysis proceeded iteratively with constant comparison between themes, codes and the data in order to explore similarities between participants' views. Differences were also explored. Once the key themes had emerged the analysis then developed the themes into domains in order to explore the inter-contextual relationships of the themes and domains.

3.3.5. Stage 5 Mapping and Interpretation

The charts developed in stages 1 to 4 above were used to define concepts, map the range and nature of the phenomena related to both simulation experiences, views and practices phenomena, as well as those related to the research question relating to motivation for participation in simulation. A full selection of the charts is shown and discussed in the results section. A typology for the relationship between the emergent phenomena was created and associations between themes were found, thus providing a basis for explanations for the findings. The process of mapping and interpretation was influenced by the original research objectives as well as by the themes that have emerged from the data themselves.

3.3.6. Reliability and validity

This section outlines the strategy used in this research to ensure quality. It has been argued that no single set of criteria is suitable for all qualitative research but *'as in quantitative research, the basic strategy to ensure rigour, and thus quality, in qualitative research is systematic, self-conscious research design, data collection, interpretation, and communication'* (Mays and Pope, 2000). Nevertheless it of value to the reader if reliability and validity are discussed in detail here. Reliability refers to the concept of whether someone else,

if analysing the same primary data as the researcher, using the same analytical approach would replicate the same results. It has been suggested that auditability could also be used to describe the same measure of dependability or trustworthiness in qualitative research as reliability is used in quantitative projects (Miles and Huberman, 1994). Reliability of this research was enhanced by including transparency in the authors underlying theoretical assumptions, the transparent description of the methodological steps taken in both transcription as well as the analysis of the data and the use of a methodology established as robust. The underlying assumptions of the author and the potential impact on the results and conclusions drawn are discussed in greater detail in Chapter 4: Personal Reflections of the Author.

The internal validity of causal inference refers to the concept asking whether the research participants actually mean what the researcher reported they meant. This might also be referred to as credibility or authenticity. Although one strategy for enhancing the internal validity would be respondent validation, this was considered impractical for participants who are busy practising clinicians. Rather internal validity was enhanced by comparing the results of different data sources. This was achieved by using data from seven different group interviews to create triangulation of data. Different types of triangulation include Investigator Triangulation: where two or more researchers explore the same phenomenon; Data Triangulation: where data is collected from multiple sources for the same study; Analysis Triangulation: where different types of analysis are applied to the same data; Method Triangulation: two or more research methods are used in a single study; Theoretical Triangulation: the application of different philosophical view points to the phenomenon (Thurmond, 2001). In this case triangulation was achieved by sampling diverse specialty groups interviewed on separate occasions, and, additionally, using more than two researchers during the development of the framework.

External validity refers to the concept of whether the author's conclusions can legitimately be claimed from the collected data. In order to enhance external validity the data collected must be adequate. An adequate quantity of data in qualitative research is analogous to ensuring sufficient statistical power in quantitative studies. A calculation of statistical power would not be considered appropriate in qualitative data analysis. The data set was considered adequate when previously collected data was confirmed and no new concepts or themes were emerging, in other words saturation. It is the author's assertion that seven interviews created sufficient diversity of opinion and views, but that by the seventh interview there were no new emerging themes and therefore saturation had been reached. External validity was also enhanced by the involvement of two other researchers viewing and coding examples of the

data independently of each other as part of framework development thus providing additional external audit of the coding framework. This is also addressed in the discussion chapter.

Having described in detail the research question, theoretical assumptions, participants and sampling, data collection and handling, the following chapter will share the personal reflections of the author, in order to enhance transparency by allowing the reader an insight into the lens through which the results have interpreted. This will set the scene for the subsequent chapter which will present the results of the research.

4. PERSONAL REFLECTIONS

4.1. Introduction

Qualitative research, by its very nature will be influenced by the researcher themselves, who cannot be an entirely objective bystander, but plays a central role in collection, selection and the interpretation of the data. Rather than attempting to eradicate this influence with the aim of objectivity the influence of the researcher in this central role can be embraced and seen as an opportunity (Finlay, 2002b). Reflection involving reflexivity, then, becomes an essential component of the research process. It has also been argued that the action of examining how the researcher and intersubjective elements impinge on, and even transform, research, is an important part of qualitative research (Finlay, 2002a). Reflection can be defined as 'an in-depth consideration of events or situations, the people involved and how they felt about it' (Bolton, 2015). Reflexivity, then, is critical questioning which is initiated and supported by reflective processes (Bolton, 2015). Finlay (2002a) argues that in order to increase the integrity and trustworthiness of qualitative research, researchers need to evaluate how intersubjective elements influence data collection and analysis. Reflexivity, where researchers engage in explicit, self-aware analysis of their own role, offers one tool for such evaluation. Reflection and reflexivity could be considered ends of a spectrum. Reflexivity on the part of the researcher is considered an important part of legitimizing the findings of qualitative research (Pillow, 2003). Reflexivity can be a valuable tool to examine the impact of the position, perspective and presence of the researcher, to promote rich insight through examining personal responses and interpersonal dynamics, and to enable public scrutiny of the integrity of the research (Finlay, 1998). Qualitative researchers who are aware of their own role and can make this explicit can enhance the trustworthiness and transparency of their research. Therefore this section will describe a personal learning journey as a researcher and author through the course of designing, data collection and interpretation of the data and writing and dissemination of the findings. It will also discuss the influence on the research.

Although personal reflection is often added as a *post script* to a thesis, the author argues that the value of reflexivity in enhancing transparency and allowing the reader insights into the lens through which the data are interpreted is an essential component of the research, and the body of the thesis and forms a bridge between the methodology and the presentation of the results. Therefore the personal reflections are presented at this point. As it is written from a personal and subjective perspective it will have a different tone and voice to both the content and style of writing to the other components of the thesis. (Creswell and Plano-Clark, 2011)

4.2. Personal Biography

This account begins by sharing my professional biography by way of context. At the beginning of my thesis journey I was deeply immersed in the world of clinical medicine. During the course of my career I have worked as a clinician in a wide range of medical specialties: medical, surgical, anaesthetics, emergency medicine, and medicine for the elderly. In keeping with tradition, all of my clinical career involved supervision and teaching of students and junior doctors in the context of both the clinical workplace and on specialist courses. Many of the courses I was involved with, as either learner or teacher, involved elements of simulation. Having been both a learner in the traditional medical apprenticeship culture, the so called 'See one, do one, teach one' tradition and also as a learner and teacher in the new and emerging simulation culture I share many of the lived experiences described by the research participants, and would have difficulty in disentangling my own subjective experiences adequately to claim genuine objectivity. I found that I could identify with many of the participants' narratives of simulation and could easily project my personal feelings into my recollections of being both learner and teacher. At that time, in my early (research) career, I was unaware of how deeply rooted in a tradition of positivism and the natural sciences my experiences and influences were (Wilson, 2000). Much of my simulation teaching was implicitly based on behaviourist principles and deliberate practice. Many authors have summarized and described this worldview which predominates in natural sciences, but insight into this positivism and its impact is poorly recognized or appreciated in the realm of clinical medicine, and its influence pervades medicine and medical education.

I subsequently moved from full time clinical practice to almost full time education in a University, student centred context. I began to encounter new concepts such as communities of practice and the importance of understanding the socio-cultural influences in medicine and in medical education (Lave and Wegner, 1991). As I began to read and understand more of education traditions and expose myself to the philosophical positions of social sciences and how they might approach a problem I began to feel challenged by a new set of beliefs, understanding and practice.

In the early stages of designing my doctoral research a key challenge to my positivist thinking came in the form of critical appraisal of the underlying influences of my previously published work. This shifting worldview can be seen most easily in comparison of my previous peer reviewed publication, which are implicitly positivist in their approach, to the extent that alignment is not even discussed, and there is a paucity of underlying theory. Specifically, the paper discussing the complex intervention to deliver a urology learning package (Owen et al., 2008) uses a two-group comparison methodology.

Influential writers such as Silverman (2013) were clear that ontology, epistemology and methodology were related in a hierarchical manner and that alignment was synonymous with rigour. This led me into somewhat of an epistemological wilderness as I was influenced heavily by the social sciences and the qualitative traditions but did not wish to totally discard my positivist tendencies which had influenced for so long. I wanted to *understand* how and why learners might engage with simulation based medical education, but I also had a lingering urge to somehow quantify and 'fix' the perceived problem with an underlying self-doubt about whether my research would be taken seriously in the medical world without a control group or a p value.

Although my initial aim was not to contribute to theory, however I did find as I began to form my conclusions that the existing theoretical models of motivation were inadequate to explain the importance of realism in simulation. What is realism, what do learners understand by realism and what is its role in motivation for simulation? I felt trapped in a situation where I needed to use qualitative methods to explore and understand motivation, but aligning solely with the interpretivist tradition felt too dangerous to achieve a product, result or outcome which would be acceptable to the medical community and their implicit traditions. As a consequence of this period of self-doubt and epistemological wandering in the wilderness, I experienced near paralysis in terms of making forward progress. Some interviews had been done, but then much searching of the literature needed to follow in order to navigate a way through. Some particularly helpful resources offered guidance on the use of Atlas-Ti (Freise, 2012) as a tool for qualitative data analysis and research offered a simple 'notice, collect, think' (NCT) way of approaching the data without the slavish squeezing into a hierarchy. Similarly during the progression of the professional doctorate a reader could see that my research paradigm and worldview has transitioned towards a pragmatic world view and settled into a mixed methods, 'horses for courses' approach which aims to embrace a variety of traditions from cross disciplinary knowledge and thinking. Once I had discovered mixed methods epistemological ecumenism, I felt sufficiently confident in my approach to begin to make progress once again.

4.3. Development of epistemology and Identity

During this epistemological development another very important process was occurring in my own thinking, in fact in my own identity. I felt that I was having to make a choice as to whether I identified my academic and research persona with my medical roots and positivist traditions, or whether I had now become an interpretivist social scientist (Lieff et al., 2012). One cross disciplinary researcher summed up well, the identity crisis often experienced in cross disciplinary research and described the phenomenon in terms of academic danger (Corr,

2015). I finally reached a place where I could not wholly align myself with either of these identities, but needed to steer a course between the two. Liberation came with a number of publications supporting mixed methods research, as being superior to alignment entirely within a single tradition. My misunderstanding in the early days of the research that I had to be wholeheartedly committed to a single research tradition, with epistemological alignment in order to be robust was replaced by a confidence in that bringing traditions together can achieve more. My identity has become that of a medical doctor/teacher and practising clinician/learner, with an interest in, and expertise in qualitative and interpretive methodology. Primarily, I want to provoke the medical simulation community to think more deeply about their assumptions, habits, perceptions and beliefs about simulation and learners and might seek to gain deeper understanding of the learners' perceptions, motivations, expectations and barriers.

Another important landmark in my own scholarly identity came in spring 2015, when I presented an essay to the 6[th] International clinical skills conference. As part of my reading and thinking about the nature of reality and realism, I was exploring how the entertainment industry conceptualize reality. I discovered an essay by the notable author J.R.R. Tolkien (1964), where he outlined his own ideas, as a highly successful author of fiction, on what made fantasy believable. I found this essay compelling and felt that there were such significant parallels to what simulation is trying to achieve, so brought my own application of these principles to the simulation community by way of an oral presentation 'From Fairies to Simman: Lessons from Tolkien'. The presentation had a surprisingly warm response. This provided reassurance that my scholarly identity could bridge the gap between disciplines, to bring knowledge from one domain to apply into another totally unrelated domain. One researcher vividly describes the sense of academic danger in crossing disciplinary boundaries and described it in this way 'What was I trying to be? Where do I fit in? Whose rules do I abide by and what happens if I break them?' She advises 'Exploit the disciplines you are dipping into and exploring; acknowledge, but ignore, the boundaries that constrict your research unnecessarily'(Corr, 2015).

Inger Mewburn, writing as 'The Thesis Whisperer', also highlights a major source of anxiety in cross disciplinary work which is the worry of displaying 'shallow knowledge' of another discipline. She even goes on to describe cross disciplinary theses as 'monsters' relating this to the concept that monsters in entertainment are most often analogous with adolescence and the sense of 'otherness' - no longer a child and not quite an adult yet. She does however go on to say that the creativity involved may even result in single disciplines questioning their own assumptions and create much richer product as a result. (Thesis Whisperer, 2013)

4.4. Relationship to the participants.

My professional relationship to the participants can be considered reflexively as well. My existing professional relationship to the undergraduate group is that students would recognize me as a member of faculty, in my usual work clothes, wearing a staff ID badge and conducting interviews in my normal teaching work space. My role also involves important assessment decisions for the students. This may have potential to represent a power imbalance in this relationship. Students would therefore be likely to relate to me in terms of representing the university institution. My personal hope was that the students might feel free to share confidentially, their views of simulation teaching in the institution, but it is likely that students could view the interaction as a mechanism to initiate feedback and change in the elements of their learning which they disliked, or felt should change. This is also discussed in section 3.1.3 Ethical Considerations. This relationship contrasted with interviews with the GPs or anesthetists, most of whom were unknown to me, I did not hold any apparent position of authority and did not represent any agency or institution. I felt more like a peer enquiring informally about personal experiences in a way I could entirely identify with. I experienced an enhanced sense of rapport.

Some elements of the dialogue created a significant emotional response in me, as interviewer, and as a teacher frequently using simulation techniques and technologies in my own practice. In particular episodes of personal incident narrative, where participants describe negative emotional experiences and responses such as feeling silly, stupid or tricked during simulation, created an emotional response in me. This response in me was firstly a negative reaction: I felt disappointed as I related to the unnamed simulation teachers or trainers, I wanted to reassure learners that 'no we want you to feel safe from embarrassment or humiliation in front of your peers, we don't want you to feel or look like an idiot'. However in my own effort to avoid constraining the important dialogue, the very views I had set out to elicit, I felt a need to draw on self-control to listen deeply in an attempt to understand the participants better and to elicit more of their thoughts, perceptions and feelings. It is also worth noting that some of the interviews with GP groups occurred in individual group members' homes, prior to a practice based small group learning event. The location of such interviews influenced me as feeling like a guest, so therefore contrasting with the possible power imbalance of undergraduate and foundation doctor groups.

4.5. Impact of the research on my own practice.

I have no doubt that because of listening to participant narratives and subsequently immersing myself in the data, my own teaching practice has changed in many ways. I have been aware

of changes in my approach, including a much greater awareness that participants need to feel safe in their learning, particularly when role play is involved. I am now much more explicit about the format of any feedback, emphasizing that I consider the learning experience as a shared journey, rather than a test. I have a much deeper awareness of the contextualization of reality. I now spend more time in briefing and debriefing to ensure that participants know what the limitations of the reality are. In the design stage of simulation based teaching I now place more emphasis on ensuring semantic realism, rather than physical realism. I have also been deeply influenced by Tolkien's writing and am prepared to take greater risks in simulation design, where I attend to the detail of internal consistency within the secondary reality that is the simulation, rather than attempting to create the physical reality within the secondary reality.

4.6. Impact of my own beliefs on the thesis.

In conclusion then, it would be naive to believe that I have been fully objective in my interpretation of the data. The reader having had some insight into my own biography and context may be able to identify where I have seen the data through a particular lens. That simulation is a useful, fun and positive tool with enormous potential to enhance clinical learning when used wisely is perhaps the main underlining assumption creating my own lens. I have also assumed that creating awareness of learners' perceptions, motivations and barriers to engagement with simulation can lead to improvements in the design and process of simulation learning. My hope is that this work can enhance simulation based medical education for the benefit of learners and the patients and their families for whom we ultimately care.

5. RESULTS

5.1. Introduction

This chapter presents the results of the research. It will provide an overview of the nature of the data. The main purpose of this chapter is to reveal the themes which emerged from the data and lead to demonstrating how these themes answer the research questions. A quantitative overview of the data is presented first, followed by a description of the process by which the themes emerged, and a description of the emerging themes and sub-themes. Although many different themes emerged the emphasis will be on those themes which relate to the research questions. The chapter concludes with a summary of the results.

5.2. Overview of the data

A total of seven interviews was carried out. The interviews were all conducted as group interviews as described in Chapter 3: Methodology. Table 5-1 Details of participants, summarising the participant characteristics in each of the seven group interviews is shown below.

Interview number	Duration Mins:secs	Participant Description	Specialty	Number of participants	Career stage	Gender Male/Female
Interview 1	25:26	Senior medical students	general	3	undergraduate	1M/2F
Interview 2	15:17	Foundation doctors	general	2	early graduate	1M/1F
Interview 3	21:11	Anaesthetic senior trainees	anaesthetics	5	mid-career	5M
Interview 4	16:06	Anaesthetic senior trainees	anaesthetics	2	mid-career	2 F
Interview 5	21:43	General Practitioners	Primary care	5	senior	3M, 2F
Interview 6	21:42	General Practitioners	Primary care	7	senior	7F
Interview 7	20:29	General Practitioners	Primary care	4	senior	4F

Table 5-1 Details of participants

A total of 28 subjects (10 male, 18 female) participated in group interviews which had a range of 2 to 7 participants per interview. It can be seen that some of the interviews had all male participants, some all-female participants and some had a mixture of male and female participants. This can be understood with reference to the recruitment method, where participants were recruited and interviewed in naturally occurring learning groups. This sample is representative, in so far as continuing medical education learning groups may be single sex, or mixed sex groups. Within medical practice the proportion of men to women in hospital specialty practice is 67% men, 33% women, and in general practice is 49% men, and 51% women (General Medical Council, 2015), but the gender mix of licenced doctors who regularly participate in formal continuing medical education events is not known. The interviews lasted between 16:06 minutes and 25:26 minutes with the total recorded interview time of 141 minutes, 54 seconds, and a mean interview time of 20 minutes, 16 seconds. The total data set which was analysed was the transcribed text from these seven group interviews.

5.3. Qualitative Overview of the data

5.3.1. How did the themes emerge?

As described in Chapter 3: Methodology, two other researchers independently listened to the audio recordings of two interviews whilst reading the transcribed text and made notes alongside the text on their interpretation of the text and audio. After negotiation between the three, an initial framework was agreed. This initial framework was used to create a selection of initial codes. In the early stages of coding the process involved description of initial observations of the data, but as the coding framework was applied to the entire data set common characteristics in the data and codes allowed categories to be developed by pulling together more detailed observations. In the first instance as the researcher read the transcript and simultaneously listened to the audio recording, each data segment which seemed interesting was marked as a quotation and a code from the initial framework was applied. If an interesting segment of data was identified which could not be coded using the initial framework it was marked as a quotation and assigned either a new code, or assigned as a quotation for further analysis later. A quotation was defined as a segment of data, and was indexed using interview number and line number. In some cases the code was an *in-vivo* code, in other words used the actual words that appeared in the quotation. An example would be the code 'don't want to look like an idiot'. Another type of code was a researcher generated description which attempted to characterize the particular quotation. An example of this would be 'CPR'; a code created to identify quotations where participants discussed any courses or programmes where they learnt resuscitation skills, but did not necessarily use the expression

'CPR'. Another type of code which was generated was an evaluative code, where the researcher began to make abstract sense of a segment of data and applied a code based on the co-researcher developed framework. An example of this type of code would be 'anxiety'. The alphabetical list of codes created was then applied to the entire data set in the first round of coding, but as new, interesting data was identified it was given a new code if an existing code was not applicable. This process generated a list of codes, which at this point in the analysis was arranged as an alphabetical list and represented a mixture of inductive and deductive codes. Alongside the coding process the researcher also began to create definitions of each code used, this could be considered the beginning of the analytical process. As interesting data segments were encountered which seemed similar, but not identical to an existing code it became helpful to explicate exactly what was, and was not meant by the code title. The creation of exact code definitions was an important analytical process for this step. This process allowed some codes which had originally been separate codes to be merged into a single code when homogeneity was found in the description and definition creation. Additionally this process of explicating and defining the code descriptions allowed some codes to be refined, by sub diving into two distinct codes. This was often useful if a single code had a lot of quotations, with some degree of heterogeneity, hence more detail was required. This process although described here in a linear sense, in fact, progressed recursively and bi-directionally, where noticing, collecting and thinking, defining and redefining happened simultaneously. This is represented in Figure 5-1 NCT Model of Analysis below.
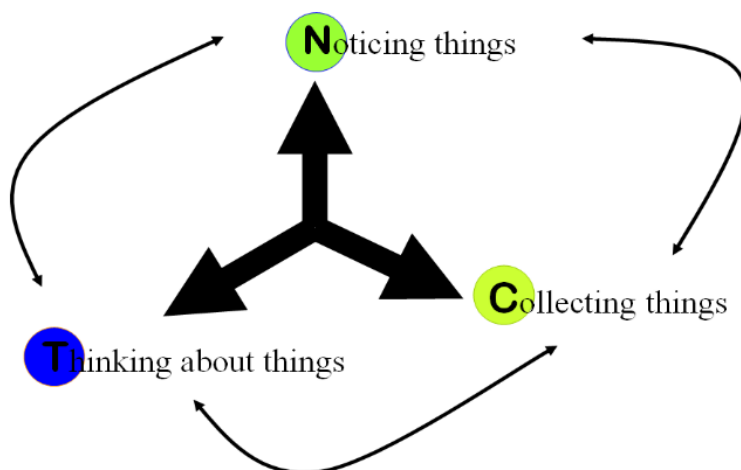
Figure 5-1 NCT Model of Analysis (Freise, 2012)

The initial alphabetical list created was both unwieldy, being difficult to search and navigate, in a practical sense, and also generating lots of codes which were only descriptive in a superficial sense and lacked conceptualisation. The codes were then examined in the alphabetical list with their associated quotations and similar codes were then grouped into

code families. The code families were given names which were then attached to the lower level codes using colour and capital letters to make the code list begin to have both practical and analytical structure. Themes began to emerge. Themes are defined as ideas or concepts where individual codes with their descriptions could be considered as sufficiently similar to be grouped together. The process of refining the coding framework progressed as both a bottom-up and top-down process. The bottom up process sought out commonalities across several codes and created families as basis for themes, and the top down approach examined groups of quotations to see where there was similarity but insufficient homogeneity, and so sub - categories were created and quotations re-coded into the new subcategories. Although some quotations were very interesting, in their own right, if the idea was only expressed by a single participant on a single occasion it was marked as a quotation, but not considered a theme. A tool in Atlas-Ti ® which was particularly helpful with this process was the groundedness measure. The groundedness measure (GM) is a tally recording how many times a particular code has been linked to quotations in the data. Therefore any code with a high GM number had a high occurrence rate within the data. This helped support the researcher's impressions of frequency and importance of concepts and ideas with quantitative evidence.

5.3.2. Themes

This section will discuss four main themes which emerged from the process described above. The four initial themes which emerged will be organized and described here in chronological order as they occurred within the interview. The four major themes which will be discussed are shown in Figure 5-2 Major Themes

Learner experience
Realism
Relevance
Motivation
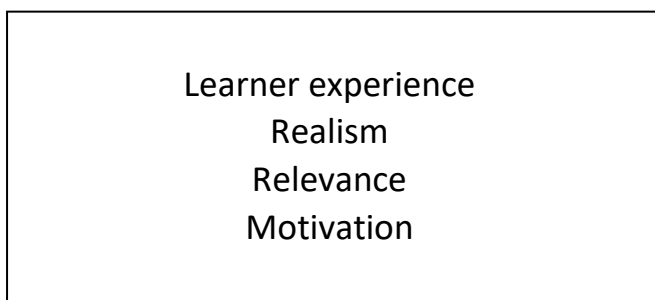
Figure 5-2 Major Themes

For each of these themes the researcher will discuss how each one was defined as a major theme, how it emerged and whether the emergence of the main theme changed and evolved with progression of the analysis. From the interview schedule (appendix 5) it can be seen that the opening question was based on participants describing their prior experience of simulation. The section on learner experience, firstly, will set the context for the type of simulation which learners had experienced. This is described as learner experience – context. This is followed by participants' evaluations of their experiences in positive terms, and in negative terms, and finally a discussion around the concept of ambivalent or qualified value perceptions. As one of the themes discussed by participants as an important influence on their value perceptions was realism, it is discussed subsequently. Realism will be discussed in terms of sub - themes around physical realism, also semantic realism and phenomenological realism. The section on relevance follows on naturally from the preceding section as the content and skills offered in simulation based courses is compared to clinical practice needs, training expectations and opportunities for the various specialty subgroups. The section which follows, entitled motivation, focusses on some of the features of simulation based courses that may make them accessible or feasible in a practical sense, including, for example, cost, location and so on. This section discusses these features and uses the term pragmatic moderators to distinguish them from the aspects of perceived relevance and aspects of realism which are also discussed in the chapter. All direct quotations in this chapter can be identified as indented text, entitled by a unique speaker identifier, and using the transcribing convention as detailed in Table 3-4 Transcribing convention, where comma or question mark are added for reading clarity, full stop indicates a short drop of voice, and underline indicates an emphasized word or phrase.

5.3.2.1. Learner Experience - Context

A significant theme which emerged early in each interview was learner experience. It was clear this was a theme because of the large number (GM 99) of quotations about learner experience. This was entirely expected because the introductory interview question was 'Tell me about your experience of simulation'. Learners described their experience as contextual descriptions. Participants were very willing to describe their experiences of simulation, typically they began by talking about the simulation in which they had already participated. There were four sub-themes of descriptions used by participants to describe the context of their experience:

- Course title or description
- Type of simulator used
- Type of skill emphasized
- Role of the participant

It can be seen from the examples shown here that these descriptions began with typical phrases such as 'I've done ….', 'I did….', 'I went on….', or 'I've used ….'. A selection of typical responses giving an overview of the range of experiences is shown here.

FY1F 1: I did a course as part of the undergraduate which was actually at the hospital in [place] where we did a one day simulated course on a variety of practical procedures for foundation doctors on venepuncture and so on and at post graduate level things like ILS [Immediate Life Support] day course here.

ANF1: We've had it in medical school [we] went to the [place] simulator we've also had an obstetric emergency simulator session thingy and similar kind of thing down in [place] then just like you say various airway things, mostly simulations of emergencies and the sort of ALS [Advanced Life Support] type training stuff

ANM2: it's a requirement that everyone must do ALS advanced life support for a couple of days which is all simulation as [ANM1] said and then the rest I suppose subsequently done a combination of ATLS [Advanced Trauma Life Support], APLS [Advanced paediatric Life Support] and then in [place] the simulator in [place] gone to courses there as well so for anaesthesia specific ones

GPF1: I suppose I've used things that I can think of were in CPR, and you know the sort of yearly ILS training and there's a joint injection course that you can go on which also gives you what would you call it artificial joints with lights to practice on. And it was good.

GPM1: Yeah, did quite a lot of joint injection stuff

GPF2: the only thing I've done's the ALS and the resuscitation things (.) did a minor surgery course at one point I think we did chop artificial things or was it bits of meat?

GPM2: Yeah just regular CPR using a mannequin I did a minor surgery course years ago which was using bits of plastic which weren't particularly good to be honest, I've <u>assessed</u> on was it the GP recruitment thing? For people using simulated patients.

GPF4: I've used the dummies for cardiac massage and putting cannulas in and [implantable contraceptive device]

Participants initially described their experiences in terms of either which courses they had done, or in terms of the type of simulator which had been used. Participants tended to describe the course by course name or by describing the course content. Those courses described in terms of the title of the course were taken as understood by the other group members and sometimes elaborated on for the benefit of the interviewer. For a reader unfamiliar with the content or purpose of particular courses or their associated abbreviations these can be seen in the table below: Table 5-2 Course description

CODE FOR COURSE CONTENT	NUMBER OF QUOTATIONS	DESCRIPTION
COURSE_CONTENT_ALS	8	Advanced Life Support (ALS). A course designed for team leaders likely to be involved in initiation and ongoing care of patients in cardiorespiratory arrest, resuscitation, and post resuscitation care, usually according to European or internationally agreed guidelines and standard protocols. A compulsory course for some groups of clinicians who are expected to perform more complex therapies and make more complex decisions than compared with CPR or ILS
COURSE_CONTENT_CPR	13	Cardiopulmonary resuscitation (CPR). A course where the primary skills emphasized is cardiopulmonary resuscitation i.e. an attempt through medical treatment to restart breathing and heart circulation if they have ceased because of illness or injury. This includes adults and children and is usually according to national, European or internationally agreed standard protocols and basic CPR training is mandatory for most medical clinicians. This includes ILS - immediate life support, but not Advanced Life support which is coded separately
COURSE_CONTENT_Communication	4	A course or component where emphasis is on doctors' communication skills: particularly doctor - patient communication. Does not include communication within healthcare teams, which is coded as 'teamwork'
COURSE_CONTENT_Drills NOS	5	Drills: Not otherwise specified. Emergency or urgent medical response sequences that usually follow agreed protocols or pathways, may include for example Airway emergency drills, and excludes courses or skills which are described by other codes

CODE FOR COURSE CONTENT	NUMBER OF QUOTATIONS	DESCRIPTION
COURSE_CONTENT_Medical Emergency	11	Medical emergency, training for response to urgent or life-threatening illness or injury. Code includes obstetric emergency, also code used when the exact type of medical is unspecified
COURSE_CONTENT_Team work	5	Course or programme where the emphasis is on teamwork and non-technical skills, including team communication, leadership, followership. This contrasts with courses with an emphasis on technical skills.

Table 5-2 Course description

As well as describing the title of courses participants also described the type of skill or knowledge outcome which was associated with particular courses or programmes. Some examples are ALS, APLS, skills and drills, airway course, implantable contraceptives, intra articular joint injection. The reader may note that ALS: Advanced Life Support occurs both as a course title and as content description. This is because it is used in both of these contexts. For example a participant might *go on* an ALS course, that is a course developed and delivered by the resuscitation council of the UK entitled 'ALS provider course' but known as ALS (course), or they might learn or apply advanced life support skills, that is the skills applied to care for and treat a patient in cardiorespiratory arrest, i.e. one might *give* ALS. On other occasions the course was described in terms of what *type* of simulation was involved: process based descriptions of courses or curricula, e.g. using part task trainers, using Resusci Anne®, using Simman®, using SPs or actors. Table 5-3 below lists all the courses or types of courses the participants described.

COURSE	NUMBER OF PARTICIPANTS
CPR Cardio Pulmonary Resuscitation/ILS	13
ALS Advanced Life Support	8
Joint injection	5
APLS Advanced Paediatric Life Support	4
Anaesthesia specific course - Airway skills (included in medical emergency)	3
Minor surgery	5
GP recruitment	2
Procedures, venepuncture, central line insertion	4
Implants Implantable contraceptives or hormonal therapy	3
Simulated patients/Actors/role play - consultation skills	15

COURSE	NUMBER OF PARTICIPANTS
BASICS British Association of Immediate Care Scotland - Roadside trauma care	1
PROMPT PRactical Obstetric Multi-Professional Training -Obstetric emergency course	3
Ward simulation exercise	3

Table 5-3 Types of courses

A further type of description used by participants in illustrating the context of their experiences was the course outcomes: whether the primary expected outcomes were technical, psychomotor and procedural skills, or non-technical skills. A technical skill is one where the emphasis is on doing the right thing, in the correct order and applies to a procedure such as injecting drugs into a particular anatomical location, or correctly instigating cardio-pulmonary resuscitation. A non-technical skill, in contrast, is a combination of human, social, and metacognitive skills and includes items such as communication, team working, leadership, situational awareness and risk assessment. The contrast between courses emphasising technical versus non-technical skills was only discussed in groups who had participated in courses or programmes with an emphasis on non-technical skills. Interestingly only anaesthetic trainees mentioned courses where non-technical skills were emphasized. Participants in courses with emphases on technical, procedural and psychomotor skills did not explicate this aspect of the course by using terminology of technical skills although this was implicit in the skills and outcomes described. Some examples of descriptions of course where technical skills are emphasized are shown here:

GPF4: I've used the dummies for cardiac massage and putting cannulas in and Implanon [injectable contraceptive device]

GPF1: there's a joint injection course that you can go on which also gives you what would you call it artificial joints with lights to practice on

FY1F 1: I did a course as part of the undergraduate which was actually at the hospital in [place] where we did a one day simulated course on a variety of practical procedures for foundation doctors on venepuncture and so on and at post graduate level things like ILS day course here.

Some examples of descriptions of simulation based learning with emphasis on non-technical skills are shown here:

ANF1: [You] learn a lot in a short amount of time (...) and you remember it because it's a scary high stress situation especially if you've got like multidisciplinary teams, you know like the PROMPT course you've got the midwives and

you've got a load of obstetricians and you've anaesthetic nurses and you all
do it together and the actual team that you're really going to be doing it with

ANM4: We had two compulsory courses on emergency simulated anaesthesia that
we had to go on which [were] looking more at team work aspects

ANM4: I know a lot of the simulations I've been in have been technical simulations
but really what they've been looking at is your team work and your
communication skills within the team and you know whatever the outcome of
the simulation is its more how did you react together

In describing the context of participants' prior simulation experience in terms of the name of
the course they also described their experiences in terms of the physical nature of the
simulator. This can be linked back to the discussions in the literature review about simulator
classification. The descriptors used by participants closely corresponded to Maran & Glavin's
classification (2003). Participants used a range of descriptions of courses with reference to
the physical characteristics of the simulator or type of simulator used. This is illustrated in
Table 5-4 below.

TYPE OF SIMULATOR	NUMBER OF QUOTATIONS	DESCRIPTION
COURSE_TYPE_Animal tissue	4	Course using permitted non-human animal tissue for teaching or assessing surgical procedures such as excision, suturing insertion of lines or devices, includes sheep, chicken or pig material. Could be considered a sub-group of part-task trainers.
COURSE_TYPE_Joint injection	5	Course or programme which includes at least one anatomical replica of an articulated joint designed to teach or assess correct needle placement for injection of drugs into articular space, which includes a feedback mechanism such as a buzzer or light. Could be considered a sub-group of part-task trainer
COURSE_TYPE_Limb implant	3	An artificial arm designed to teach or assess the delivery of an implantable device under the skin for long term delivery of a drug e.g. Implanon, Nexplanon contraceptive implants or hormone drug implants for prostate cancer. Could be considered a sub-group of part-task trainer
COURSE_TYPE_Mannequins	13	participant refers to whole body mechanical simulator, includes mannequins, 'dummy' and branded products 'Anni' Resusci Anni' 'Simman' 'Harvey'' Meti Man'

TYPE OF SIMULATOR	NUMBER OF QUOTATIONS	DESCRIPTION
COURSE_TYPE_Part task trainer	4	device or model which represents a specific body part for the purpose of teaching or assessment e.g. rectal examination, vaginal examination, birthing trainer, an artificial arm or neck designed to teach or assess procedures involving access to veins or arteries to take blood or administer drugs or fluids
COURSE_TYPE_Simulated patients	16	A person who is portraying signs or symptoms of illness or emotional state which they are not actually experiencing, for the purpose of education or assessment. Includes 'actors' 'SP's' 'standardized patients' 'simulated patients'. They may be paid or volunteers

Table 5-4 Type of simulator

As well as identification of the context of their experiences of simulation in terms of the name or description of the course participants also described their roles. The majority of discussion assumed participants to be in the role of learner taking part in course, but some participants described their experiences of simulation as teachers and as assessors.

GPM2: I've <u>assessed</u> on was it the GP recruitment thing? For people using simulated patients.

GPF8: I've used actors - used I don't mean used I have experience with actors [GPF5 laughs] with training the trainers point of view and assessment as a learner and also as an assessor

In summary, participants described the context of their previous experiences of simulation in terms of courses attended, type of skill emphasized, type of simulator used and their role as learner, teacher of assessor.

5.3.2.2. Learner Experience - Evaluative

Having described the context and range of simulation experiences described by participants, this section will discuss participants' evaluations of those experiences. This section will describe positive value experiences, negative value experiences and will then discuss value experiences which were qualified, or ambivalent views of experiences. There was limited response to the overall value of the experience at first, it was mainly descriptive at the level of courses attended and nature of those courses. After most participants had contributed to this introductory conversation setting the context, some groups moved on to then describing

subjectively their experiences and perceptions spontaneously. For example both of these participants went immediately onto evaluative statements whilst describing their previous experience in terms of context.

> GPF1: Emm I suppose I've used the things that I can think of were in CPR emm and you know the sort of yearly ILS training, and there's a joint injection course that you can go on which also gives you emm what would you call it artificial joints if you like to practice on. and it was good.

> GPM2: Yeah just regular CPR using a mannequin I did a minor surgery course years ago which was using bits of plastic which weren't particularly good to be honest, emm I've <u>assessed</u> on was it the GP recruitment thing? For people using simulated patients. But I've never actually been assessed myself doing that. but I think in my opinion it's a good, good thing

Positive Value Experiences

 If participants had not moved on to their perceptions and evaluations of the simulation based course a question from the interview schedule was then used to solicit those views. The interview then progressed towards identifying how participants evaluated their previous experiences of simulation by asking them if these experiences had been positive or negative.

> ANM3: When I went to the anaesthetic challenge course in [place] I was transformed

Some of the positive value perceptions of simulation were general descriptions of good or helpful without further specific explanation.

> ANF1: I think it's really valuable

> ANF2: yes it is quite valuable, yes; yes I mean I would rate it as a valuable learning experience, yes

> GPF1: I think it's a very, very good way of learning techniques on models and <u>practising</u> you know situations like CPR and it's an extremely good way of practising them and learning them

In total, the groundedness measure for positive comments was [GM67]. As well as general statements of positive perceptions of simulation experiences, (positive value perception - Not Otherwise Specified) many participants then elaborated on what it was, in particular, that they identified as a positive experience. There were a number of factors identified by participants that contributed to the positive experience, a summary of these is shown below, followed by example quotes. This included simulation as good or helpful for providing a rehearsal opportunity for learning skills and drills, for gaining knowledge, better than lectures or reading

books, offering an opportunity to experience rare and unusual events, particularly in emergency situations. Other positive value perceptions included simulation providing a concrete experience for reflection and self-evaluation, and learning from experts in the topic. A summary of the positive value perceptions is also shown in Table 5-5 Positive value perceptions.

POSITIVE VALUE PERCEPTION	NUMBER OF QUOTATIONS	EXAMPLE QUOTATIONS
Rehearsal opportunity: learning skills by rehearsal, gaining knowledge	22	FY1M1: At least practicing it gives you a little bit of experience in how to manage it GPF6: yeah it's the practice then almost as well you're doing it several times hopefully then you know when you're in that real situation hopefully you'll remember some of what you've done GPF4: but it puts you through the motions of how to vary the introducer GPF12: it's reinforcement by repetition as well isn't it GPF9: yes, it's the practice element as well isn't it, of doing it several times ANF2: it gives you an opportunity to practice many things that you haven't faced really emm GPF1: I think it's a very, very good way of learning techniques on models and practicing you know situations like CPR and it's an extremely good way of practicing them and learning them
Patient safety and reduction of harm	14	GPF4: you can do what you like to these things but you can't really do that to a human GPF4: when we were sort of medical students we did blood gases and all sorts of dreadful things on patients [because] there were no simulators ANM5: which is obviously better to do in a safe environment for you and for the patient rather than doing it first hand in real life GPF1: much better to do [joint injection] in an artificial model that a real patient UGF2: I think they're important for learning the techniques obviously a lot of the ones you mention there, some of them can be quite invasive so if you were learning that for the first time you're not going to be doing it on a real you wouldn't want to emm put patients at risk or potentially at risk

POSITIVE VALUE PERCEPTION	NUMBER OF QUOTATIONS	EXAMPLE QUOTATIONS
Opportunity for experiencing rare situations	9	ANM1: you get scenarios where you don't normally encounter or get all the time during real working life so (.) ANM4: can run through the real emergencies that you need to be prepared for but you will very rarely see and it's likely that the first time you may see it could be when you're a consultant and don't have a senior backing you up at that stage. so it's quite useful in those aspects ANM3: I think also it gives also a familiarity to unfamiliar situations you might not have seen it in real life GPF2: it is very helpful, it's a good way to learn without doing any <u>harm</u> and practicing in our settings the sort of emergency situations that obviously you're <u>never</u> going to be able to <u>do</u> <u>without</u> that facility in terms of a dry run at it. GPF13: I think it's crucial for situations where, emm for procedures that are rare that you won't often have to do them and that there's a chance that you'll have to do them quickly, so you know things like emm tracheostomy you don't want to be looking up a book trying to work out how to do that and it's pretty rare so there's a good chance there might not be a doctor in the room who knows how do it when it needs done, and I think for that sort of thing it's invaluable really .
Simulation experiences leading to feedback and reflection	7	GPF8: you can learn a lot about yourself in terms of interactions and reactions if you know if you put yourself in a simulated scenario face to face with another <u>person</u> GPF2: I suppose because how maybe to assess your practice you know to know what you're doing and reflect on your practice and you don't know what you don't know FY1M1: It was very it was a nice way to see the mistakes that you make or emm how <u>slow</u> you actually are ANM5: if you've either gone to the course with an idea and you come away and think, Yes I've been right that's how I am approaching things, or what was I thinking there? [laughs] I really have to revise how I 'm approaching this

POSITIVE VALUE PERCEPTION	NUMBER OF QUOTATIONS	EXAMPLE QUOTATIONS
Opportunity for team-working	3	ANF2: it gave me more of an appreciation of what they [other speciality] found what's an emergency to an obstetrician emm compared to what's an emergency to an anaesthetist, the things that I'm worried about, the things that they're worried about, the things the midwives are worried about are two or three different things and so. I mean I don't think it, I hope it didn't change the way I interact as a human being with these other people, but to have that baseline of knowing oh that's why he's terrified about that, it's not, it maybe, maybe kind of smooths things a bit. ANM2: The good side of that is that people who go to the courses and if you turn up at an arrest with someone who's F2, ST1 [inexperienced doctor] whatever will. you'll like to think will have been through that process will know a standardized how to work, and so everyone's singing off the same hymn-sheet for the start of the process
Positive value of simulation as compared to other methods or styles of learning. Simulation was compared by participants to other types and styles of learning such as books and lectures. Also simulation was compared and contrasted with the traditional model of learning on patients.		ANM5: I think I learnt more in the three days that I did in the rest of the five weeks just from seeing things I hadn't experienced before being played out, as opposed to waiting for things to come through the door in A&E, or reading the books which seemed disengaging non - interesting at times GPF8: See one, do one teach one was [hospital]'s method yeah ANF1: learn a lot in a short amount of time GPF2: Are you glad your exam wasn't simulation at the time? GPM2: No I'd far rather [GPF2: Would you prefer to have done] GPM2: I'd have far rather done the CSA [clinical skills assessment using simulation] than the videos I hated the videos GPF2: would have been much better to have just gone and done/ GPF1: uh huh GPM2: would have been far easier
Simulation learning as fun	8	GPF5: yeah we'd all have a laugh] ANF1: Some of them were compulsory, and emm some were, make my CV look a lot better, emm, and then also they're quite fun actually. FY1M1: Most recently I've. I did the ALS course in [place] recently I thought it was really good fun and I suppose that uses a lot of simulated. FY1M1: I've quite enjoyed the simulated training

Table 5-5 Positive value perceptions

In summary, there was a significant number of quotations expressing positive value perceptions of simulation across all participant groups. In particular there was a positive perception of the opportunity for rehearsal, the avoidance of causing harm to patients and the chance to experience rare situations. Having identified the positive value perceptions the next section will present the negative value perceptions.

Negative Value Perceptions

The other important and contrasting aspect of learner experience was negative value perceptions. These were also coded and studied as a group of quotations. The groundedness measure for negative value perceptions was [GM32]. Negative value perceptions included negative emotional experiences of anxiety, embarrassment as well as issues around realism. The emotional themes are described first, followed by negative value perceptions around realism, which are discussed in the following section. An important observation is that simulation based education is a much more emotional experience that other styles of learning such as books or lectures. This can be seen from the quotations where the use of emotional talk or emotional descriptions was seen in personal incident narratives or reports of previous experiences of simulation. In particular the theme of anxiety was important.

Anxiety

Anxiety, which can be defined as 'distress or uneasiness of mind caused by fear of danger or misfortune, apprehension' is an emotion which involves imagining and negatively anticipating a future event, based on previous experiences of one's self or others. Anxiety is an emotional experience described by participants in contrast to the educational value described in positive value experiences as described in the previous section. A large number of participants described anxiety [GM 14]. All groups discussed anxiety without direct questioning, whilst discussing their experiences. Language included in descriptions coded as anxiety include 'nerves', 'anxiety' and 'stress'. Examples are shown in Table 5-6 Negative value perceptions.

NEGATIVE VALUE PERCEPTION	NUMBER OF QUOTATIONS	EXAMPLE QUOTATIONS
Anxiety	14	UGM1: I think for a lot of people it's purely overcoming nerves it's in the session themselves like it. one thing that I think it all stems from is the fact that you sit quite often and it's you in front of your <u>entire</u> group and you do the entire session kind of thing and you take this history and everyone is watching you and they are asked to critique you and it's I think it's just nerve racking for a lot of people so a lot of people may, can just underperform based on that although actually they comment saying if they had to go onto a ward and take a history they're actually fine but suddenly in front of those people it becomes quite nerve racking and very rarely, in fact if ever, they go on the ward and take a history with somebody else watching so (.) FY1F1: because when there's a real person there you're obviously quite anxious to do it well but it's an environment where you can. identify the potential pitfalls and <u>actually</u> sometimes almost deliberately make mistakes to see why it is a mistake GPF4: you feel people are sort of judging you type of thing you're thinking God what have I missed and oh my goodness I've made a mess of that

NEGATIVE VALUE PERCEPTION	NUMBER OF QUOTATIONS	EXAMPLE QUOTATIONS
		ANM4: I think from the sort of the realism point if you don't get sort of caught up in the fact that 'Oh your patient's gonna die' you at least get caught up in the fact that there's an element of competition there [soft laughter from other interviewees] and so you want to do well so you know you, you the stress is still there from the aspect of your wanting to do well [ANM2: yeah when you're sitting next door you are thinking I'm glad I didn't get that one, [laughter]] ANM3: and it's so funny when you're watching what your colleague's doing and [thinking] I'm not going to do that [laughter]

Table 5-6 Negative value perceptions

It is important then to identify what it is about simulation which causes anxiety. Careful scrutiny of the data segments enabled a sub-classification of anxiety in 4 sub-themes to identify what it is about simulation which causes anxiety. Anxiety can be identified from the narrative for four closely associated, but subtly different reasons. These sub-themes are

- Self-consciousness about role play
- Peer scrutiny of skills and practice
- Making mistakes
- Being 'tricked'

Each of these sources of anxiety will be discussed, and how they relate to each other. Firstly self-consciousness about role play or pretending as a source of anxiety can be seen in this section of quotes. The code 'embarrassment' was used. Embarrassment is an emotional construct, different from anxiety, in that it is defined as 'A feeling of self-consciousness, shame, or awkwardness' (Oxford Dictionaries, 2016) and will be understood in the context of self-consciousness about role-play or pretending. It is subtly different from fear of failure, making a mistake or being scrutinized by others although may co-exist with these other emotions. There appears to be an inherent anxiety about role play itself, when simply engaging with a simulation, without reference to being judged for making a fool of oneself by getting things wrong or performing badly. Even participation alone appeared to cause embarrassment for some groups (female GPs).

GPF9: I've been role playing as well with an actor patient and then also observing an actor and someone else and commenting and things, I think they are useful they are quite intimidating sometimes until you start actually getting

involved and then it's it doesn't seem to be as bad as you think it's going to be

GPF8: I think embarrassment I think what [GPF5] brought up before if it's not a necessity and there was an option not to do it then I'd opt out

GPF4: I don't think I'd opt out of the sort of mannequin type scenario though would you?

GPF8: In public? [Laughter]

GPF13: I think if a simulated, you know teaching in a simulator. simulated setting is not emm if it's not set up well, you can feel really embarrassed at the sort of role playing side of it, and the trying to pretend that this lump of plastic's a patient, and emm I think it needs to be dealt with really, really sensitively and if it's done really, really well you can be completely absorbed in the thing talking to a dummy as if it's a patient and then it's really, really good but you know if it's not well handled, it can be quite embarrassing, it can be quite difficult and certainly I can sort of suspend disbelief and get on with it, but I've seen other people who are completely unable to

GPF5: it's the sort of OTT [Over -The -Top] stuff they make you do like that you have to check all around

As well as self-consciousness about role play, another source of anxiety which emerged is concern about peer scrutiny, being watched and evaluated or judged by other course participants, either during group teaching or via video in real time or after the simulation, this was a powerful theme. The sense of scrutiny was related to personal performance - getting the correct treatment, or appropriate management outcome, with a high degree of anxiety about how one would appear to professional colleagues. This was coded as 'peer-scrutiny' and examples are shown below.

UGM1: I think for a lot of people it's purely overcoming nerves it's in the session themselves like it. one thing that I think it all stems from is the fact that you sit quite often and it's you in front of your entire group and you do the entire session kind of thing and you take this history and everyone is watching you and they are asked to critique you and it's I think it's just nerve racking for a lot of people so a lot of people may, can just under-perform based on that although actually they comment saying if they had to go onto a ward and take a history they're actually fine but suddenly in front of those people it becomes quite nerve racking

GPF4: you feel people are sort of judging you type of thing you're thinking God what have I missed and oh my goodness I've made a mess of that

ANM4: I think from the sort of the realism point if you don't get sort of caught up in the fact that 'Oh your patient's gonna die' you at least get caught up in the fact that there's an element of competition there [soft laughter from other interviewees] and so you want to do well so you know you, you the stress is still there from the aspect of your wanting to do well [

UGF2: I think a lot of people do get quite nervous when their whole group is sitting watching you, obviously that can be quite nerve racking

The anxiety of peer scrutiny was particularly apparent when anticipating getting something wrong or performing poorly. So there was anxiety about making a mistake. This anxiety was described as an emotion in its own right, but also as a powerful emotion when combined with the self-conscious anxiety of role play. Typical quotes include language such as 'not wanting to look like an idiot' this was also expressed as 'making a ninny of myself'. This concept was consistent across all the participant groups. Examples of this are shown here.

GPF8: Like you said if there was a whole load of folk you didn't know if it was an unsafe environment or you perceived it to be an unsafe environment in terms of security and embarrassment and things then emm and if it wasn't compulsory <u>yeah</u> I wouldn't want to make a ninny of myself so I'd opt out

AMN4: and wanting to not look like an idiot in front of your colleagues

ANM4: there's an element of competition there [soft laughter from other interviewees] and so you want to do well so you know you, you the stress is still there from the aspect of your wanting to do well

Some of the data revealed a perception that simulated learning can be set up to deliberately trick learners into making mistakes or performing poorly, and this possibility of making mistakes in the context of peer scrutiny was exacerbated.

GPF9: it's like you were saying at [meeting] when [name] had said you know they <u>deliberately</u> put the medical students sometimes with the actors they put them in an embarrassing situation and just wait and see how they dig themselves out of the <u>hole</u> with the rest of their classmates watching and I think as a doctor I would find that very intimidating

UGM1: The sims shouldn't be out to get you I think like some of the things

UGF2: Well that one was

UGM1: Yeah I actually genuinely felt, we're both in the same group so with that session we were all just sitting there just like, she's genuinely tearing at her, like the woman who was doing the sim was just trying to like, trying to provoke you into making mistakes I was like, <u>come on</u> I mean you probably do get people like in the real world that try and trip you up and are a bit

UGF2: She had to go and catch a plane to America [laughs]

UGM1: There was no way to <u>win</u> that consultation like, I think that was part of the point of what it was

It was also observed in these segments that there is a lot of emotional talk present as well as a number of instances of the use of humour. In the area of discourse analysis it is suggested that the use of humour indicates anxiety in the speaker and/or their listeners and is used as a conversational strategy to protect the speaker or listener from psychological harm. Other discourse strategies which were noted in the data were use of metaphor and anthropomorphism. As this research did not intend to perform analysis at the discourse level this will only be briefly mentioned here.

In contrast to the negative perceptions described above, for some participants anxiety was not described in purely negative terms, but was discussed in positive terms and compared with the anxiety experienced in real life emergencies. Anxiety was described in both positive and negative terms by participants, and in some cases with ambivalence. Anxiety as a positive value perception contradicts anxiety as a negative value perception but was perceived as even contributing to the positive features of simulation i.e. the benefits.

ANM4: It's a different kind of stress but it at least simulates it in some way emm (.) so I think although yeah a lot of people say 'well I'm never going to believe that that's really a patient' I'm not sure how much that truly matters.

GPF4: I never think it's never like the real thing you can practice all you like but it's <u>never </u>like the <u>real thing</u>, I'm talking about like emergency   scenarios and things I think, you just don't get that adrenaline kick you might get the embarrassment kick and that's akin to it but you don't get the adrenaline kick type of thing,

ANF1: because it's a scary high stress situation, especially if you've got like multidisciplinary teams, you know like the PROMPT course[

ANM4: I think from the sort of the realism point if you don't get sort of caught up in the fact that 'Oh your patient's gonna die' you at least get caught up in the fact that there's an element of competition there [soft laughter from other interviewees] and so you want to do well so you know you, you the stress is still there from the aspect of your wanting to do well

Ambivalence and qualified value perceptions.

In the previous paragraph it can be seen that anxiety was considered both in positive and negative terms. This is one example of an emotional or phenomenological experience described as positive, negative or ambivalent experiences. As well as anxiety, other emotional experiences were portrayed in this way and included peer scrutiny, embarrassment, looking foolish, and competitiveness against peers - both in cooperative sense as well as an oppositional sense. In terms of anxiety there was some ambivalence and contradiction in the discourse around anxiety.   Participants acknowledged that performance anxiety and competitiveness may be a very close phenomenological substitute for workplace anxiety in the immediate life threatening emergency situation, there was therefore an acknowledgement that performance and scrutiny anxiety can add to the experience in terms of realism. There was uncertainty in discussion amongst participants whether the anxiety of simulation was greater or less than real life with a perception that they were very closely related, although different, and that this anxiety although an unpleasant emotional experience could be considered helpful for rehearsing and learning for the real world. Anxiety codes co-occurred with positive value perceptions, negative value perception, comparison, competitiveness, 'don't want to look like an idiot', embarrassment, use of humour and phenomenological realism. Some participants whilst acknowledging embarrassment explained that this was a hurdle which had to be overcome in order to gain the expected benefits of the learning. 'Just got to get over it'. Whilst other participants also identified the anxiety as a barrier which could not or would not be overcome. 'Well if I didn't have to do it I just wouldn't'. Positive value perceptions and negative value perceptions were used initially in the coding process, but as the analysis of the data progressed it seemed that the categories of positive and negative were too black and white to capture what participants really experienced. Interestingly, in some cases positive elements were closely juxtaposed to negative elements, so some of the data didn't support a purely positive or purely negative experience, so a further code was added to the coding framework: 'qualified value'. Whenever a quotation appeared to be positive, but qualified, typically some variation of 'simulation is good *but…*' then it was coded as 'positive value perception' *and* 'qualified'. Similarly some negative value perceptions were also qualified, typically expressed as 'simulation has limitations *but…*' This addition to the coding allowed exploration of the apparent tension between the positive value perceptions

and negative value perceptions. Much of the tension between positive and negative value perceptions was focussed around issues of realism and this is discussed in the following section.

5.3.2.3. Theme 2: Realism

A second main theme was realism. Realism is defined as the extent to which the simulation or simulator appears, feels and/or behaves the same as the real-life system. Although similar definitions are used of fidelity, this term is avoided because it tends to be associated with simulations which involve technology and where low fidelity can imply lower realism or authenticity, when, as was seen in the literature review, this is not necessarily the case. Use of the term artificialness will be used as the opposite of reality, in other words, the degree to which the look, feel, or behaviour of a simulation deviated from that of the real-life system, process or object. Although the initial interview schedule did not include questions designed for the exploration of realism it became clear during the earliest interviews that it was an important consideration, and many individuals even returned to this theme to repeat, or expand their ideas. When the initial coding framework was developed realism was included as a code. Once a number of quotations had been identified for realism they were examined for heterogeneity. This allowed the coding to evolve to identify the different domains of realism which have been described in Chapter 2: Literature Review. This resulted in codes for physical, semantic and phenomenological realism being applied.

In discussions about realism there was more subjective discussion than there had been at the course description level at the start of the interviews. The construct of reality, how reality is pursued, the impact it has on learning and some of the contested assertions about the importance of reality to the learning experience have been discussed in the literature review. There was contrast and contradiction in descriptions and narratives around realism. Realism was sometimes considered a barrier or hindrance, and at other times a benefit to simulation. Artificialness or lack of realism were described as negative features. Some examples are shown here of negative perceptions of lack physical realism.

> GPF4: I remember when you know the arms for putting in venflons [intravenous cannulation device] and things came out and the injections, shoulder injections and things like that that were never <u>exactly,</u> like you can have a play with that but you can stick a needle where you like in that, you know what I mean it's not like you can do it in a real person you know what I mean, so there is you know limitations, it doesn't feel the same

GPF14: As real as possible but that's the difficulty that's the challenge where people set these courses because I think the thing with the nexplanon [implantable contraceptive device] was it really, it <u>looked</u> nothing like an arm, it <u>felt</u> nothing like an arm, so it wasn't that great

GPM1: Yeah did quite a lot of joint injection stuff which emm it was good it was very useful though there was a lot of kind of prodding till the green light went on hitting the spot that's getting increasingly worn emm (laughs)

Other quotations show that the lack of semantic realism was a negative feature for participants, interestingly GP participants discussed the limitations of physical reality, whereas anaesthetists emphasized lack of semantic realism as a negative feature.

ANF1: you get the fidelity of it sometimes gets in the way of the learning so say the, you know the blood pressure, the thing that's showing you the blood pressure is playing up or something and that can mess it up, it's emm you know things that get in the way, like that kind of ruins it a bit you know if it it, you know if you just have to pretend, like they go 'right right this is the real patient and this is the blood pressure' and things except for 'if you're cannulating you get this arm out'. <u>what?</u> You know you just , I realize that there are practical limitations and they're getting better and everything but little hitches like that or even the fact that when you pick up the phone and then you're told whenever you pick up the phone and you're dialling 2222 you say 2222 but you really dial 8911 or whatever, I mean I know that one's a particular one you <u>cannot</u> have them really dialling 2222 I understand that, but these little things that are in the fidelity kind of emm can be a problem, like yeah

ANM1: It's just quite <u>artificial</u> sometimes, you don't act the way you think you normally would act

ANF1: you've really got the real kit that might use in real life, you're not pretending to put a cannula in even that sort of stuff, the time based stuff that that, eh often in the stuff when we can't really afford it, and we are just <u>pretending</u> in front in a room and it's not really a proper simulation, and you've just got a resus mannequin and then they say 'right you've put a cannula in' and they, you just say it and then it happens really quickly, so something that slows it down because in real life you actually get a lot of time to <u>think</u> in some ways, and then sometimes on simulator courses you don't because you don't have

that time, you're putting the cannula in and that time that you're pre-oxygenating, they pretend you've pre oxygenated in 20 seconds whereas in <u>real life</u> you do it for 3 minutes and you time it and you do it <u>properly</u>. That kind of stuff. It's kind of important

ANM3: I think you perform better at work because at simulation centre emm or when you're in a simulation situation you have to do a set of things but in real situation if you have an experience or if you know what's going on you will do them automatically (.)

ANM2: I think one of the limitations with the high fidelity though is you're working within an environment of with people who you may have just met that morning, who are <u>not.</u> you're taking on roles that not necessarily reflective on your normal day to day, for example you could have someone else who's the same stage as you doctor in anaesthetics who's taking on the role as your nurse or whatever who then without meaning to will <u>assist</u> you in ways that wouldn't be forthcoming if that event actually arose

UGF2: but I mean there's been a few scenarios when maybe emm, they haven't quite been realistic, like well <u>no</u> that actually wouldn't happen, emm in kind of the real in the real world

However the artificiality of the situation was sometimes acknowledged as a specific positive value, this was coded as hyper-realism: the concept that a simulation can be slowed down or speeded up in a way that can enhance learning, and also that in simulation, precisely *because* it is artificial, participants can deliberately choose to make mistakes, to deliberately do things incorrectly in order to explore the limits of a skill or procedure or to understand the consequences of mistake-making and to create boundaries of where correct techniques becomes error.

GPF5: you could also practice doing it <u>badly</u> you know putting it in the wrong, putting it in too <u>deeply</u> and stuff which is not what you want to do

GPF5: so you can pull the skin back and look and see where it ends up [laughs] It's quite clever

FY1F1: I think it's a good opportunity to. be able to go be go through the technique very slowly and thoroughly and fully explore what indications and contraindications would be

FY1F1: because when there's a real person there [real clinical situation] you're obviously quite anxious to do it well but it's [simulation] an environment where you can. identify the potential pitfalls and <u>actually</u> sometimes almost deliberately make mistakes to see why it is a mistake

When considering artificiality or lack of realism there was some tension and contradiction, in some circumstances the lack of realism was tolerated but in other circumstances lack of realism was not tolerated by participants. Those quotes demonstrating tolerance of artificiality had the view that although one 'knows' the simulation isn't 'real' they considered that this didn't actually matter as the educational outcomes or goals were still similarly achievable, other perceptions had a 'yes, but' attitude to tolerance of inadequate realism perceptions.

GPF4: Well I don't think you can do CPR on anything <u>other </u>than a mannequin

GPF14: of course it doesn't feel anything like a real body and it doesn't have the same flexibility but it's a good idea for just giving you training more the closest thing you're going to get

ANM3: I think you have to accept the artificialness

ANM4: although yeah a lot of people say 'well I'm never going to believe that that's really a patient' I'm not sure how much that truly matters.

UGF2: you just kind of have to emm go with it because it's not the real world is it, it's a simulation.

UGM1: the models that are used for PR exams that sort of thing emm are obviously not quite as realistic but practically you aren't ever going to be able to practice these things on real patients all the time so, it is an effective model but it's because it's the most effective model we've got sort of thing

There was a negative value perception around realism but an acknowledgement of a lack of accessible, sustainable educational alternatives to gain the same skills or experience, such as above on experiencing rare and unusual emergency circumstances.

GPF6: I think it's particularly unrealistic that particular plastic arm

GPF4: but it puts you through the motions of how to vary the introducer

There were various levels or domains or realism described. Although participants did not use a scholarly typology in their talk about realism, the types of realism described did align with the levels of realism as discussed by Dieckmann (Dieckmann et al., 2007). The realism

described was in terms of physical realism, whether the model or mannequin looked, felt or was empirically a close replication of the real thing, but by and large limitations of physical realism were accepted and tolerated as necessary or unavoidable. When participants went on to talk about semantic realism this was different. Semantic realism refers to whether something would really 'happen' like that in the real world and variously meant team behaviours, timing of events or physiological changes or contextual reality. It seems that semantic realism lapses are significantly less tolerable to participants than physical reality breakdowns as they were described in more negative terms of tolerance of artificialness. Following on from the analysis of emotional talk the area of phenomenological realism was interesting in that here was once again a tolerance of lack of realism, but a comparison of causes of stress, the experiences of stress, competition and scrutiny in simulation when contrasted with stress of real clinical practice in particular in the emergency situation.

GPF4:   you just don't get that adrenaline kick, you might get the embarrassment kick and that's akin to it but you don't get the adrenaline kick type of thing,

ANM4:   I think from the sort of the realism point if you don't get sort of caught up in the fact that 'Oh your patient's gonna die' you at least get caught up in the fact that there's an element of competition there [soft laughter from other interviewees] and so you want to do well so you know you, you the stress is still there from the aspect of your wanting to do well [

ANM4:   It's a different kind of stress but it at least simulates it in some way

5.3.2.4. Theme 3: Relevance

The third major theme to emerge was relevance. Relevance is the degree to which something is related or useful to what is happening or being talked about.   Although a number of participants directly discussed the relevance of simulation to their own specialty career choice or aspiration this theme was much more dominant in interviews with GPs. For example interview 3 with GPs created 7 coded sections in relation to relevance, interview 5 with GPs created 5 segments of text coded for relevance theme.

GPM2:   But we're doing this every day 30 or 40 patients every day why do we need to do that with a simulated patient?

GPF2:   I suppose if there was something that fitted into your learning plan that was relevant you know personally I would be thinking the joint injection course

GPF14: to be able to become a trained nexplanon inserter so you need to go through the course so it's a means to an end in a way, but also it is useful I suppose

it's the same for the joint injections it's because you want to improve your skills but it has to be relevant

[laughter]

The interview with male anaesthetists did not have any quotations coded for relevance, and with female anaesthetists only one segment of text explored the concept of relevance.

ANF1: the reasons I've been on courses before is if it's gonna make my CV look better and if it's gonna give me a chance to do something real in real life like that pre-hospital medicine thing then that's good. If it's high fidelity, if it's cheap, if it's nearby, if it's recognized somehow

It seems that the relevance of current simulation based courses appears very much part of the normal expectations of training in anaesthetics and seems highly relevant, but less so for GP participants. A particularly interesting dialogue occurs in relation to the theme of perceived relevance to specialty practice. An experienced GP partner expresses his reservations about the relevance of simulation based training to his personal practice, a female colleague brings a challenge and suggest some potential benefits in terms of triggering reflecting on one's own practice. This interesting dialogue is shown below.

GPM2: I think it would have to be relevant to what we think we need to do in our career if it's totally irrelevant like any adult education it's a turn off. then if it's in a simulated way it wouldn't put me off in itself so long as it's relevant.

GPM2: but I think the main barrier for me for that would be do we need to do it?

GPM2: But we're doing this every day 30 or 40 patients every day why do we need to do that with a simulated patient?

GPF2: I suppose because how maybe to assess your practice you know, to know what you're doing and reflect on your practice and you don't know what you don't know and.

GPM2: yeah

GPF2: I don't know but that would be in the world where you'd plenty of time really to slot that in to just perfect the.

INT: Would you be suggesting then that perhaps this would something that would be for novices rather than for people who are well established in their expertise?

GPM2: I'd need to see a reason I'd need to see a reason why. I would have no problem going to do it, I've no hang ups on doing that if, if for some reason someone said that all GP's should be assessed by a simulated surgery like the trainees are I'd be fine I'd just go and do it wouldn't put me up nor down but there'd have to be a reason. is this for revalidation? Fine if that's what's decided I'll do it, but just for [

GPF2: For your CPD?]

GPM2: For my CPD? (..) I don't know I mean cos if it's a voluntary thing you're going to get the maybe the 5% of motivated people going to do it which I'd probably be one of them but is that relevant to you know if I emm correlate with these other five per cent what does that really tell us what the rest of general practice is doing I wouldn't be averse to doing it in that method but I'd need to see that there was a good reason for it.

The perceived relevance of simulation to different career stages and carer intentions and specialties emerged as a theme. The expectations of what one would achieve was closely linked to whether a course was mandated by the employer or by a Specialty College, such as The Royal College of Anaesthetists. This was called 'mandatoriness.' Closely associated with the question of relevance was the anticipated outcome of the learning activity. The outcome expected was described mainly by anaesthetists who had participated in the most simulation based activity, although other groups did explain their anticipated outcomes. Outcomes expected could be categorized into outcomes as pre-determined consequences of a course or as learner's post hoc observations of what they learned on a course. The learning outcomes varied from getting a certificate, adding something to the CV, doing a course which is mandated by either the employer or a Medical Royal College.

ANM1: Some of them [simulation courses] are mandatory   [laughter]

ANM2: You also get a certificate for your CV which bulks it out a bit [soft laughter] which is a requirement

ANM4: increases the thickness of the portfolio [

ANM5: yeah that's mandatory

ANM3: now you see any big trust they've got Simman I think it's very useful if it's locally available (...)

ANM4:   I was a [MEDICAL SCHOOL] trainee before this and we had two compulsory courses on emergency simulated anaesthesia that we had to go on, which looking more at team work aspects, emm obviously there's a lot of preparation for the exams because the exams use Simman so there's a Simman station in every OSCE emm so did a lot of preparation using the Simman for that

For general practitioners established in their professional specialty simulation is not seen as a normal part of the training experience.

GPF8:   but our generation has not emm grown up with simulation as a method of learning has it I mean we are of the see one do one teach one regime [

GPF5:   absolutely

GPF8:   where everything was tried out on a patient and it's those that are considerably younger than us that emm I know that's most of us in the room [laughs] sorry if I'm ageing everybody here but you know that's not what we've grown up with it is alien to us and it does feel awkward and we didn't do it at medical school and we didn't do it in junior jobs

When asked about what participants thought they would gain from a course many also discussed the types of skills they expected to learn. The expected skills expressed included increased knowledge, enhanced or new technical skills - resuscitation communication skills, intubation, insertion of implants, putting in chest drains or devices etc. Enhanced non-technical skills were also highlighted as perceived outcomes from simulation participation, such as working with teams, to enhance patient care, creating better understanding of roles, responsibilities and different ways of thinking across different disciplinary groups in health care. This theme was related to descriptions around personal experience, where rehearsal of skills and drills was both a positive feature and expected outcome. Some participants also described deep learning during and following simulation based learning. This was expressed both as a positive value perception and an expected outcome. An increase in self-awareness was an expected outcome described in both GP an anaesthetics groups. Although the anxiety of scrutiny and performance in front of one's peer group was considered a negative value perception as discussed above, the opportunity to compare oneself with one's peers in terms of performance under pressure was valued and an expected outcome of simulation in a way that is not available in lecture or other traditional based teaching.

Other factors were identified under the theme of relevance which influenced motivation - such as career development and enhancing one's CV. Anaesthetic participants reported that

simulation based courses and education were perceived to enhance their CV. Enhancing one's educational profile or CV was not however described as a motivation for, or benefit of simulation in other participant interviews. The expected outcomes which expressed here also relate to another motivating factor: the reputation of any particular course or centre. This sub-theme is linked to both the skills outcomes expected as well as the enhancement of one's CV or portfolio. Some example quotations are shown.

ANF1:   the reasons I've been on courses before [..] if it's recognized somehow

ANF1:   some are recognized and some are less recognized and some are famous and some are rubbish, officially rubbish yeah. What other people think of the course, people who're in the job

ANM4:   you sort of hear around about where the good courses are and you know once they've had a few years running you tend to think well I'll go on that one rather than this one, cos I 've heard its better and fair/ and it tends to be fairly localized to your area but you know you're still getting a choice of sort of three or four courses in your local area and think well that's got the reputation of being better, so (...)

GPM3:   as you say it's the quality of these courses isn't it. Of course the CSA is very professional they use professional actors actually down in [Place] [

GPM3:   whereas you wouldn't want to go to a course where it's poorly set up. you know poorly trained/

Although other factors which influence motivation were discussed during participant personal incident narratives and discussion about their views of simulation they rarely mentioned these other factors in response to the direct question 'what would motivate you to participate in simulation?'

The expected outcome of a particular course or programme was related to relevance and identified in the interview data. These quotations were coded as 'expected outcome' and a summary of the expected outcomes is shown below

- Enhanced technical skills

- Preparation for assessment

- Better non-technical skills such as understanding of other professional groups

- Improved patient care as a result of practice

- Enhanced CV or portfolio

- Financial reward

- Focussed learning

5.3.2.5. **Theme 4 Motivation**

This theme will be discussed as follows. Firstly the orientation of motivation described in the data will be presented. This will be followed by other motivating factors identified in the data. When searching for different orientations of motivation the following codes, derived from SDT (Ryan and Deci, 2000a) were used. It may be helpful for the reader to refer to Figure 2-11 Taxonomy of human motivation. For each orientation of motivation coded segments were collected and compared. Table 5-7 Orientation of motivation summarising the number of occurrences (groundedness measure) for each orientation of motivation with examples is shown.

ORIENTATION OF MOTIVATION	NUMBER OF OCCURRENCES	SPECIALTY OF RESPONDENT WITH NUMBER OF QUOTES	EXAMPLE QUOTATIONS
Amotivation	2	GP 2	GPM5: if for some reason someone said that all GP's should be assessed by a simulated surgery like the trainees are I'd be fine I'd just go and do it GPM2: I'd need to see a reason I'd need to see a reason why. I would have no problem going to do it, I've no hang ups on doing that if if for some reason someone said that all GP's should be assessed by a simulated surgery like the trainees are I'd be fine I'd just go and do it wouldn't put me up nor down but there'd have to be a reason. is this for revalidation. Fine if that's what's decided I'll do it, but just for[
External	23	GP 17 AN 6 FY 0 UG 0	GPF5: well you have to do like ILS [immediate life support] we have to ANF1: Some [courses] were compulsory ANM4: we had two compulsory courses …. that we had to go on GPF14: well as a teacher and assessor the money. I mean I'm not being flippant that's why you do these things
Introjected	6	GP 2 AN 4 FY 0 UG 0	GPF4: you feel people are sort of judging you type of thing you're thinking God what have I missed and oh my goodness I've made a mess of that ANF1: when we apply for jobs we get points systems …when you're applying for a job, nowadays perhaps that's maybe

ORIENTATION OF MOTIVATION	NUMBER OF OCCURRENCES	SPECIALTY OF RESPONDENT WITH NUMBER OF QUOTES	EXAMPLE QUOTATIONS
			less of a problem for me cos at the moment I've got a [training number] and you get points mean prizes ANM4: I think from the sort of the realism point if you don't get sort of caught up in the fact that 'Oh your patient's gonna die' you at least get caught up in the fact that there's an element of competition there [soft laughter from other interviewees] and so you want to do well so you know you, you the stress is still there from the aspect of your wanting to do well[AMN4: and wanting to not look like an idiot in front of your colleagues ANM2: Yeah if you're being videoed and people watching next door GPF2: And appraisal as well is I suppose altered maybe what we do for CPD …I think you kind of work out what your learning needs are and try and have a bit more <u>directed</u> learning now so I suppose if there was something that fitted into your <u>learning</u> plan that was relevant
Identified	23	GP 7 AN 11 UG 5	GPF9: yes, it's the practice element as well isn't it, of doing it several times GPF6: then you know when you're in that real situation hopefully you'll remember some of what you've done (...) ANF2: it did help a lot like in the airway, arrest scenarios, well, it did provide an idea and a practice I think ANM5: there's the opportunity to explore things you know you don't know emm. ANM2: Yeah it focuses your learning GPM1: did quite a lot of joint injection stuff which emm it was good it was very useful UGF1: We've had a lot of simulation for communication skills emm which I definitely found to be you know beneficial emm in terms of you know emm talking to patients learning how to take their histories and things UGF2: you're wanting to build up your confidence UGF2: I think if you don't get a chance to <u>practice</u> then …. you're not going to know what to ask you're not going to be able to. your communication skills aren't going to be you know up to scratch

ORIENTATION OF MOTIVATION	NUMBER OF OCCURRENCES	SPECIALTY OF RESPONDENT WITH NUMBER OF QUOTES	EXAMPLE QUOTATIONS
Integrated	12	GP 2 AN 7 FY 3 UG 0	ANF1: I think it's <u>really</u> valuable……compared to the amount of time, …learn a lot in a short amount of time (...) and you remember it because it's a scary high stress situation ANF2: something happens in real life you 're more, you think about it and so yes it <u>has</u> improved patient care ANM3: When I went to the the anaesthetic challenge course in [place] I was transformed ANM2: cos you can explore why you did stuff. ANM5: if you've either gone to the course with an idea and you come away and think, yes I've been right that's how I am approaching things, or what was I thinking there? [laughs] I really have to revise how I 'm approaching this GPF2: I suppose because how maybe to assess your practice you know to know what you're doing and reflect on your practice and you don't know what you don't know FY1M1: it was a nice way to see the mistakes that you make or emm how <u>slow</u> you actually are FY1M1: So it's quite interesting to see how you cope in those kinds of circumstances.
Intrinsic	6	GP 1 AN 2 FY 3	ANF1: Some of them were <u>compulsory</u>, and emm some were, make my CV look a lot better, emm, and then also they're quite fun actually. FY1M1: Most recently I've. I did the ALS course in [place] recently I thought it was really good fun and I suppose that uses a lot of simulated.

Table 5-7 Orientation of motivation

It can be seen that there was a range of orientations of motivation expressed by the research participants. Further discussion can be found in Chapter 6. Having described motivation in terms of SDT additional motivating factors are now presented. It is clear that previous experiences have a significant effect on future motivation, and the positive and negative value perceptions of simulation make an important contribution to motivation. These positive and negative value perceptions have already been shown. Perceived relevance is also an important variable which influences future motivation and has also been discussed already above. This section will deal with additional factors which have not yet been addressed. All groups discussed a number of factors which they described as influencing their motivation to

participate in simulation. Firstly the expected outcomes of participation, which were shown and discussed in the previous paragraph, play an important role in motivation, as well as the expectation that simulation based learning is considered a normal part of training by some specialists' groups, if less so by other groups. Having already considered these important influences on participation in simulation there were additional factors which were likely to influence motivation. These factors have been grouped together as they all related to practical issues around ability to attend specific courses or programmes. These included time to be released from usual clinical responsibilities and duties, the cost of courses, the location of courses, and also the known reputation of a particular course or venue. These practical matters were not particularly surprising and were grouped together as 'pragmatic moderators' and shown in Table 5-8 Pragmatic moderator.

PRAGMATIC MODERATOR	NUMBER OF QUOTATIONS	EXAMPLE QUOTATIONS
Time	8	GPF2: I don't know but that would be in the world where you'd plenty of time really to slot that in to just perfect the. GPM2: Emm cost. time. when is it? FY1F1: Unless. it's very rare to be given time so unless you use your annual leave to go on courses FY1M1: I think I'm quite lucky in the job I am just now that I got time off to go to my ALS course. GPF11: take time off out of work or whether it's an evening thing if you're free and all these sorts of things
Cost	12	ANF1: Sometimes they cost a lot of money, ANF1: it's variable, the last one that I went to, this ATTAC course thing and I thought I would be funding it myself, so I was paying £675 and then taaa daa six months later they said 'oh we've got some money' and they paid me back, but I couldn't have guaranteed it so it's like a gamble INT: Are there other factors that would influence your decision to go on a course or to not to go on a course? ANM1: Cost ANM1: Some of them are quite expensive GPM1: I think the cost of things as well (.) I did the communication skills course fairly recently and emm it was enormously expensive when you add up travel the cost of the course itself FY1M1: Finances as well particularly I mean we are all expected to do ALS so I did mine or you could get funding for that

PRAGMATIC MODERATOR	NUMBER OF QUOTATIONS	EXAMPLE QUOTATIONS
		GPF11: Cost always plays a part in it and whether it's evenings or afternoons and you have to take time off out of work
Location/ Accessibility	5	INT: Are there other factors that would influence your decision to go on a course or to not go on a course? ANM2: Location ANM3: I think it's very useful if its locally available GPF2: accessibility GPM2: yeah accessibility where is it

Table 5-8 Pragmatic moderators

Those factors described here as pragmatic moderators, such as time, cost, money, as well as the other factors identified under the themes of positive and negative value perceptions, perceived relevance, expected outcomes will be seen in the following chapter to map against motivational theory. The concept of realism, however, was challenging to try to map against existing motivation theory. This will be explored further in Chapter 6: Discussion.

5.4. Summary

In summary, this chapter demonstrates that participants had a wide range of experiences, with some having had a great deal of exposure to simulation based learning and other groups having experienced relatively little. There was a wide range of courses or programmes described, which were described both in terms of the expected learning outcomes of the course or programme or described in terms of the type of simulator used in achieving those learning outcomes. This participant group represented the full range of types of course described in the literature using simulation in terms of part task trainers, mannequins, simulated patients and full immersive simulations.

Participants expressed a range of perceptions on the value of their experiences. There were many positive value perceptions of simulation experiences, which corresponded to the published literature, describing the benefits of simulation. These included the opportunity for repeated practice in a circumstance which has no risk of harm to patients, provision of an opportunity to experience otherwise rare situations or conditions, the provision of effective feedback leading to reflection, opportunity to work with and learn from a team, and simulation learning as fun. There were also negative perceptions expressed by participants. The negative experiences were more in relation to the emotional domains of learning. A key negative feature was the anxiety created in participants actual or anticipated simulation

experiences. There was anxiety expressed about self-consciousness in role play, anxiety about the fear of having one's knowledge, skills or practice under scrutiny, and this was contributed to further by the concern that simulation may attempt to deliberately provoke or trick a participant into making a mistake.

The positive and negative perceptions expressed did not correspond neatly into polar opposite views but rather fell within a range of value perceptions which were often ambivalent, and co-existed. Many positive value perceptions were qualified with additional negative aspects, and many negative value perceptions were qualified with positive value concepts. Typically positive value perceptions emphasized the benefits as described above, juxtaposed with a qualification about the degree of realism which can be achieved. The negative value of anxiety of role play and peer scrutiny combined as 'not wanting to look like an idiot' was typically qualified with acknowledgement that effective alternative educational opportunities to learn many of the skills encountered are sparse apart from simulation.

This chapter has also identified that participants' views around the realism/artificialness tension were important. Whilst GPs found the physical limitations of realism in simulation a barrier to their engagement they were prepared to tolerate this limitation because of a lack of any realistic alternative to gaining the particular skills involved. Anaesthetists, in contrast, did not find physical artificialness a barrier, but rather a breakdown in semantic realism was considered a negative factor. Anaesthetists also consider simulation very much a normal part of their continuing education and appear to have wider acceptance of the role it plays in the development of both technical and non-technical skills. The GP participants did not consider simulation as a normal part of their continuing education and did not consider simulation based experiences as a relevant contribution to their knowledge or skill development.

This chapter has identified a range of orientations of the motivation expressed by participants from examples of amotivation and externally regulated motivation, through increasing levels of autonomy and perceived control to integrated and internalized forms of motivation and some intrinsic motivation for simulation activity. The chapter also identified other factors, of a practical nature, which played a role in doctor's motivation to engage with simulation based activities. These included cost, time away from clinical responsibilities and location.

Having identified the themes and sub-themes which emerged from the data analysis the following chapter will discuss how these results help answer the research questions and may inform future educational design and practice.

6. DISCUSSION

6.1. Introduction to the Discussion

The previous chapter described the results in terms of the themes which emerged from the data. This chapter discusses the analysis of the transcribed interviews in terms of the content and themes which emerged, and the relevance of these to answering each of the research questions. It will also identify how this research makes an original contribution to the current scholarship of simulation based medical education. The chapter will refer to Chapter 2: Literature Review and show how this research answers some of the unanswered questions identified there, and relate the findings to current theory. The strengths and limitations of the research will also be discussed, including the methods used for data collection and analysis, and technical and epistemological considerations. Finally the educational implications of the research for practice and policy will be discussed, as well as the areas for potential future research building on the thesis presented here.

6.2. The Emergent Themes

The themes and sub-themes which emerged from the data were fully described in the previous chapter and are summarized in Table 6-1 Summary of identified themes.

THEMES	SUB-THEMES	
Range of Learner experiences	Name or type of course	
	Type of simulator	
	Range of skills emphasized	
Positive Value Perceptions	Rehearsal opportunity	
	Learning skills	
	Patient safety and reduction of harm	
	Opportunity to experience rare situations	
	Simulation leading to feedback and reflection	
	Opportunity for team-working	
	Positive value of simulation as compared to other learning	
	Learning using simulation as fun	
Negative Value Perceptions	Anxiety	Self-consciousness about role play
		Peer scrutiny of skills and practice
		Making mistakes, being 'tricked'

THEMES	SUB-THEMES	
Realism	Physical	
	Semantic	
	Phenomenological	
Relevance	Type of skills learnt:	Enhanced technical skills
		Preparation for assessment
	Expected Outcome:	Non-technical skills e.g. teamwork
		Improved patient care as a result of rehearsal
		Enhanced CV or portfolio
		Financial reward
		Focusses learning
		Mandatory training
		Part of normal career progression
Pragmatic Moderators	Time	
	Cost	
	Location/Accessibility	

Table 6-1 Summary of identified themes

6.3. How the Emergent Themes Address the Research Questions

The following section discusses how the emergence of the themes helps to address the research questions. It is structured under each research question as a heading. Some of the identified themes such as type of course experienced will not be discussed in further detail as they allow an understanding of context, but do not add new knowledge in terms of answering the research question. The themes most relevant to the research questions are emphasized in this chapter.

6.3.1. Research Question 1: What motivating and demotivating factors in simulation based medical education do doctors and medical students describe?

This section will address the positive value perceptions and anxiety as a sub-theme of negative value perceptions, as well as the pragmatic moderators which influence motivation.

The other factor which enhance or undermine motivation, realism and relevance are discussed in detail in the section addressing the second research question. In Table 6-1 Summary of identified themes, it can be seen that anything which a participant considers a positive value experience can enhance motivation to engage with future simulation opportunities. The positive value perceptions expressed by participants were shown. This demonstrated consistency with the benefits and advantages of simulation which were identified in the literature review and summarized in Table 2-4 Advantages of simulation . This qualitative research therefore supports the existing literature arguing that simulation offers an opportunity for deliberate practice of skills, an opportunity to learn from mistakes, to rehearse with teams, in the context of no risk of patient harm. A tension which can be seen and will be discussed further is between positive value perceptions and negative value perceptions. Whilst the positive value perceptions were consistent with the educational benefits as suggested in the literature the negative value perceptions related to emotional experiences. Although the opportunity to experience the rare situations through simulation, plus the elements of deliberate practice, were considered as positive value perceptions there were a number of occasions when the positive value perception was accompanied by a 'yes, but' in particular as expressed by those with less experience of simulation. As the identification of these positive value perceptions is consistent with the existing literature, and does not offer any new insights, it will not be discussed in further detail here.

In addition, motivating factors for engagement with simulation which were identified from the data, and which can be seen in the table above also include appropriate realism, and perceived relevance which are discussed, and the other expected outcomes such as certification. Finally the group of motivating factors relating to practical issues, named pragmatic moderators contribute to motivation. The influence of the pragmatic moderators can be understood with reference to Hertzberg's theory of motivation (Gawel, 1997). Hertzberg did his empirical research on motivation for work in the manufacturing industry. He described certain motivating factors which were intrinsic to a job or tasks such as appropriate level of challenge, responsibility, and recognition for one's work. However, he also identified de-motivating factors which, although when present, did not enhance motivation, if absent had a demotivating effect. In his research, he identified factors such as job security, salary and time off behaved in this way. Because dissatisfaction resulted if these were absent he named them 'hygiene factors'. It appears from this research that the group of factors named 'pragmatic moderators' have this effect. When these favourable moderators were present they were not discussed as positive motivating factors, but their absence did cause barriers to engagement with simulation.

This finding was also consistent with the research work of Savoldelli (2005) as described in Chapter 2. The research done by Savoldelli was done in a contextually relevant setting of medical doctors in the specialty of anaesthesia. He explored barriers to engagement with simulation amongst anaesthetists and identified that 'time' and 'financial issues' were indicated to be barriers for a significant proportion of anaesthetists. Although the research did explore positive motivating factors, there was a greater emphasis on negative influences and barriers to simulation. As well as the pragmatic moderators described, Savoldelli also identified that issues relating to the emotional experience of simulation were also barriers. A significant number of respondents indicated that they found the 'Stressful/intimidating environment' and the 'Fear of educator's/peers' judgments' to be de-motivating factors. This thesis adds to existing knowledge by supporting this survey finding, and adds to the body of knowledge by using a qualitative methodology to explore more deeply what it is about simulation that causes this anxiety and the complex relationship with de-motivation.

6.3.1.1. Anxiety

This research identified that anxiety was a very important theme in the data. Anxiety was discussed by all groups of participants, across all career stages and range of medical specialties. Anxiety was mostly considered a negative feature of learning using simulation, and so could result in demotivation. On some occasions anxiety was described in positive terms and could act as a motivating factor for engagement with simulation. This section firstly discusses anxiety as a negative perception, secondly as a positive perception and then as ambivalent. Anxiety is an emotional construct, and therefore complex to understand and for participants to express. The language used by participants to describe their emotional experiences of simulation included 'stress', 'anxiety' and 'nerves'. Anxiety was defined in the previous chapter as 'distress or uneasiness of mind caused by fear of danger or misfortune, apprehension.' The reasons for anxiety are important to discuss, to help understand how this emotional experience can influence motivation, and to address this in educational practice.

There appear to be several levels of anxiety, which, although closely related, are subtly different. One source of anxiety is the self-consciousness of role play. Some participants described this in terms of embarrassment of acting, pretending or doing something which isn't real. Being observed by peers was an important contributor to this negative emotion. In addition to the self-consciousness of role play there was a related source of anxiety which was peer-scrutiny. This term is used to describe the idea that others are not simply detached observers, but are critically evaluating a performance of a task or skill. Anxiety is caused by the fear that the peer scrutiny might result in a negative judgement being made about the participant's skills or abilities. This fear is a profound human emotion which can impact on the

sense of professional esteem, and indeed the sense of self-efficacy, which was seen in the literature review to be an important influence on motivation. It has been theorized that motivation is enhanced by feelings of self-worth, having success and feeling adequate, and that this leads to gaining approval of one's peers or others. (Ausubel et al., 1968). Bandura (2001) built on this further emphasising the importance of groups and community on the individual in creating the powerful motivation of believing one has the power to succeed. Ryan and Deci's Self-determination theory of motivation (Ryan and Deci, 2000a), as discussed in Chapter 2, identified this as an important contributor to motivation and referred to this as competence: the belief that one has the capacity to achieve. SDT emphasizes the importance of competence in the enhancement and development of more autonomous forms of motivation. These powerful emotions were present in all participant groups in relation to the specific context of simulation.

Two sources of anxiety, self-consciousness and peer-scrutiny overlap. An individual can be self-conscious about role play as an isolated phenomenon, or the self-consciousness can be exacerbated if combined with the sense of peer scrutiny and fear of judgement. Another additional layer to this complex emotion is the fear of making a mistake. Of course, one of the often quoted benefits of learning and rehearsing in simulation, is that it offers a 'safe' place for learners to make mistakes without patients suffering any harm, and simulation is often promoted as a 'safe' place for learners to practise and make mistakes without the negative consequences of the real clinical context such as harming a patient, having to deal with complaints, sanctions or litigation (Ziv et al., 2006). In this sense, curriculum and course designers promote learner safety by acknowledging this anxiety and by using a wide variety of feedback and debriefing models and tools which seek to reinforce the positive elements of performance, whilst correcting errors in a supportive way. This was interestingly illustrated in this section of text from anaesthetic registrars. This short section shows that whilst facilitators are trying to avoid the negative emotions associated with failure and mistake-making, this can be seen as a negative feature if it lacks authenticity, if the extrinsic feedback contradicts the self-evaluation of performance. The expectation is that feedback is mostly positive, but positive feedback becomes problematic if it contradicts a learner's self-evaluation of a poor performance.

ANM3:   Most of the feedback is usually positive feedback

ANM2:   uh huh

ANM3:   you don't really get negative feedback who cares if the patient survives
         and if you are rude or bad [laughs]

Also this quote

ANM5: Sort of highlights one of the downsides you can imagine a situation where you come up with the wrong diagnosis give them the wrong treatment done things badly and then you might get comments like 'but you've interacted well with the team and your non-verbal communication was good and your situation task management was good' and you are like well if it was that situation I wouldn't particularly care like I've ruined the patient

Interestingly, an early publication in the development of simulation (Kurrek and Fish, 1996) identified anxiety amongst anaesthetists about using simulators . The anxiety was attributed to peer scrutiny and having deficiencies identified. The hypothesis that this anxiety would be reduced if courses attend to positive feedback, and if the simulation experience is not used for performance assessment or certification is not supported by this contemporary research. In fact this research indicates that the perception that sometimes positive feedback can be contradictory to one's own evaluation of performance can be de-motivating. This research reinforces the importance of self-efficacy and competence as contributing to autonomy and hence are powerful motivating factors.

Another perception of simulation which can diminish motivation is the concept that when a learner is already anxious about their performance under peer scrutiny, that this is exacerbated by the anxiety that the simulation may be designed or delivered in such a way as to deliberately 'trick' a learner into making a mistake. Course or programme designers and teachers would not consider this deliberate trickery, rather they might consider the simulation as a safe place to experience challenging clinical scenarios (Ziv et al., 2005). With higher degrees of challenge comes the increased chance of errors. The underlying assumption is that it is better to make mistakes in the simulator when no patients will be harmed, and learning occurs, rather than make the same mistake in the real clinical encounter. This concept was not noted in anaesthetic trainees' interviews, but was seen in both interviews with GPs and senior medical students.

The sections of text where participants discussed the idea of being 'tricked' into making mistakes were sections of transcribed text which were also rich with emotional talk and use of metaphor, suggesting this to be a particularly strong emotional reaction (Schmitt, 2005). It has been argued that the use of metaphor can reveal deeper insight into narrative accounts than analysis for theme alone (Schmitt, 2005). According to discourse analysis, metaphor use is a conversational strategy where an abstract construct is described using something more concrete to enable listeners to understand complex ideas, especially emotional ones (Rees et al., 2009). An important metaphor seen in the selection of quotations discussing the idea that

simulation may deliberately trick a participant into making a mistake is the metaphor of simulation learning as COMPETITION or as WAR. This is discussed in more detail elsewhere (Owen, 2015b). Another discourse strategy which can be seen is anthropomorphism: a literary process of ascribing human values or characteristics to an inanimate object - in this case the simulation 'The sim shouldn't be out to get you'. Caporael and Heyes' (1997) social theory of anthropomorphism claims that anthropomorphism is not neutral but is, in fact value laden and defines our interaction with the environment. From this perspective, attributing human characteristics to inanimate objects is a way of changing the values placed on them and how one can behave towards them and possesses the potential for social consequence. In this instance the speaker ascribes oppositional human characteristics to the simulation, which allows them to conceptually take an oppositional position and pass judgement about what a simulation ought to do, or ought not to do. By attribution of these characteristics to the learning scenario, it avoids the learner having to express their opposition to the person of the teacher-facilitator. This aligns with the interesting description of simulation experiences as following a narrative plot device similar to an investigative detective story (Pelletier and Kneebone, 2015): seeking out clues, evaluating the evidence, the player-hero finds the guilty party i.e. the diagnosis and all ends well. It was pointed out that this can be at odds with the trainee's expectation of the purpose of the simulation to practice skills and drills and protocol adherence. This is demotivating as it both undermines the self-efficacy and competence of the learner, but it also has a negative effect on the relatedness of the learner. There is also the possibility that it can undermine protocol adherence. It appears to make the learner feel like they are in opposition or conflict rather than being part of a community of practice. This is demotivating when seen through the lens of Lave and Wegners' theory (1991). In Chapter 2 it was argued that the socio-cultural setting is key to learning. Within a whole community the learning occurs through collaboration, social interaction and connectivity with the practice community. Therefore when the community seem divided by perceived opposition or conflict, learning is undermined. Similarly this supports the assertion by Kaufman and Mann (Swanwick, 2014 pp25-26) that learning is not an isolated or individual pursuit, but rather a collective experience.

The results suggest that anxiety, however, was not seen as a purely negative factor in simulation. It was acknowledged that anxiety can be useful in rehearsing one's professional skills and practice, particularly for the emergency situation. It was acknowledged by all groups that medical emergencies cause anxiety, and therefore to experience anxiety in simulated practice can, in fact enhance the reality of the simulation, even though it was acknowledged that the cause or source of the anxiety is different, as illustrated here.

GPF4:   it's <u>never</u> like the <u>real thing</u>, I'm talking about like emergency scenarios and things I think, you just don't get that adrenaline kick you might get the embarrassment kick and that's akin to it but you don't get the adrenaline kick type of thing

In healthcare, as well as other performance science, there is a relationship between anxiety and performance. Commonly this is known as the anxiety –performance curve, and is often attributed to Yerkes-Dodson, although there have been many developments of the concept (Winton, 1987). The theory of the anxiety performance curve is that increasing levels of arousal will initially increase individual performance under stress, when measured by a variety of different metrics. However there is a threshold at which further increases in anxiety leads to diminished task performance. However, the level at which this threshold is reached is difficult to quantify, has huge variation between individuals and varies over time, and with multiple other contextual factors. There is some suggestion from this research data that the degree of anxiety or arousal experienced in simulation is considered helpful in some circumstances and for some individuals, yet is unhelpful for others. Anxiety can therefore be considered as both a motivating and as a de-motivating factor for simulation, but the fear of deliberate trickery is strongly negative. How this concept relates to the existing theoretical understanding of motivation is further discussed in the following section.

6.3.2. Research Question 2: What is the relationship between motivating and demotivating factors, perceived relevance and realism in decisions to participate in simulation based medical education?

In considering the process model of simulation, as outlined in chapter 2 one could consider the factors identified from the research in terms of these categories. Factors existing *before* a simulation experience will include individual characteristics of the learner such as age, experience, gender, and ethnicity. Learner motivation pre-exists, and contributes to pre - simulation decisions and intention. Once a course or curriculum is underway the research identified a number of process related factors which are either, positive, negative or sometimes ambivalent. These factors have a very important feedback effect on the learner, on their motivation and hence future input factors. Many of the positive value perceptions relate to prior experiences of simulation process, and many relate to the expected outcomes of the simulation. There is an important feedback mechanism whereby positive experiences lead to increased motivation for future engagement. After the course or programme the output factors identified included the value of enhanced skills, improved knowledge, certification or CV enhancement, or completion of mandatory training or a qualification with high perceived relevance. Once again the output factors identified have an important positive or negative

feedback effect on the learner's future motivation. This relationship is illustrated in Figure 6 1: Process model of simulation
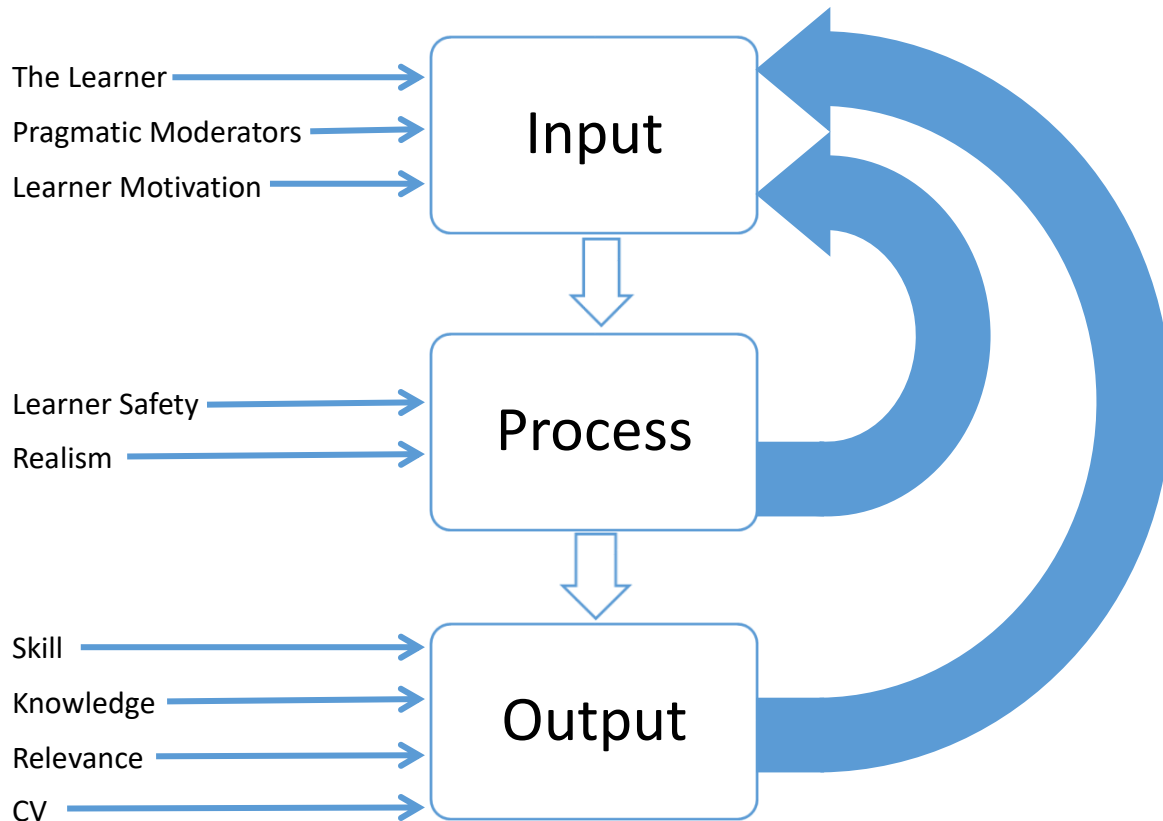
Figure 6-1: Process model of simulation

6.3.2.1. Input Factors

This section discusses the input factors: the learner, pragmatic moderators and learner motivation as shown in Figure 6.1 Process Model of Simulation. Learner motivation will be discussed with reference to the theoretical lens of SDT.

6.3.2.1.1. The Learner

Learner characteristics will clearly influence motivation to learn, and motivation to engage with leaning using simulation. The learner characteristics which are associated with motivation for learning in general have been researched and discussed in Chapter 2. The researcher is not aware of any previous studies which relate the learner characteristics to motivation *for simulation* as a particular type of learning. The results would suggest that there are differing orientations of motivation to engage with simulation in different groups. The original aim of the research was to identify the widest possible range of perceptions for simulation motivation, and so the recruitment and sampling was broad. Therefore, although the data collection was not designed to enable a statistical comparison of demographic groups, nonetheless there

would appear to be different emergent themes between the different professional groups. Anaesthetists, who had experienced significantly more simulation, described less anxiety and fewer barriers to engagement than GP participants.

6.3.2.1.2. Pragmatic Moderators

Pragmatic moderators: time, cost, and accessibility influence motivation at the stage of input, or before participation in the simulation learning. It is not surprising than within a busy healthcare profession, the ability to have time off to attend courses for skills development can be challenging. Some participants describe the pragmatic challenges of giving appropriate notice to get the time off needed for engaging with simulation courses. Of course simulation is not any different from other forms of continuing professional development which also require time commitment. Lecture based educational activities, for example, also require time away from clinical responsibility. Interestingly GPs in interview 9, identified a course for continuing professional development for primary care, that is lecture based update designed to give GPs a very rapid update of recent evidence and changes that directly impact practice. Most GP participants report the strong positive perception of this course due to the rapid delivery of carefully selected and robust information for general practice decision making. This brings to light important issues in relation to GP busyness and the perceived need to get information delivered very rapidly. The typical simulation based course is in contrast to this because moulage, the use of make up to replicate injury or illness, and complex replications of the workplace or teams for scenarios are very time consuming, often engagement is on an individual basis and all group members take turns at performing or observing. GPS may perceive this lacks the desired speed or efficiency of information delivery.

6.3.2.1.3. Learner motivation: Intrinsic and Extrinsic

Table 5-7 demonstrating orientation of motivation was shown in chapter 5: Results and is now discussed. Firstly, amotivation is defined as the absence of drive to engage, irrespective of external contingencies. Only two segments of data were coded as amotivation.

> GPM2: I'd need to see a reason I'd need to see a reason why. I would have no problem going to do it, I've no hang ups on doing that if if for some reason someone said that all GP's should be assessed by a simulated surgery like the trainees are I'd be fine I'd just go and do it wouldn't put me up nor down but there'd have to be a <u>reason</u>. Is this for <u>revalidation</u>? Fine if that's what's decided I'll do it, but just for [

> GPM2: I wouldn't be averse to doing it in that method but I'd need to see that there was a good reason for it.

From these two quotations it can be seen that this participant does not currently describe any extrinsic or any intrinsic motivation, but anticipates that in the future only if an external contingency were there, then it would provide a motivating force for participation.

The least autonomous form of motivations is external motivation which is defined as a task or activity done because of an external reward such as financial, or to avoid punishment. It is associated with low levels of control, and low sense of causality. Examples of quotations can be seen here and in Table 5-7 Orientation of motivation. It can be seen from the table that of 23 occurrences, seventeen were attributed to GP's, suggestive that GPs may describe less autonomous orientations of their motivation to engage with simulation.

GPF5:   well you have to do like ILS [immediate life support] we have to

GPF4:   there's no other way I can ever do this [insert device]

GPF5:   well you have to it before insertion you have to have done the training
          course therefore you have to go [contd]

GPF8:   it's a necessity [contd]

GPF8:   [regarding CPR training] if it wasn't compulsory yeah I wouldn't want to
          make a ninny of myself so I'd opt out

From these examples it can be seen that the compulsory or mandatory element is the main motivating feature for many course for anaesthetic trainees and GPs to do CPR and implant insertion. Introjected motivation is defined as taking in a regulation, but not fully embracing it as one's own. This orientation of motivation demonstrates a feeling of not being entirely in control, but with some embracing of the activity as maintaining an appropriate professional persona. It can be seen that this type of motivation was numerically more distributed across the various professional groups and range of career stages. Identified motivation is described as representing a conscious valuing of the goal, so that the action becomes accepted as one's own even though driven by some external regulation. It is similar to integrated and some authors have merged these two themes together as they can be difficult to differentiate. This code was used when participants described their motivation in terms of the personal learning

which has occurred or is expected to occur. There is a balanced distribution of this orientation across the different groups of participants. Some examples are shown.

GPF9:   yes, it's the practice element as well isn't it, of doing it several times

GPF6:   then you know when you're in that real situation hopefully you'll remember some of what you've done (...)

Integrated motivation is defined as more autonomous than introjected or identified, though not intrinsic motivation i.e. done purely for the enjoyment of task. The values of the externally regulated task are fully assimilated to the self, and congruent with values and needs. Examples of integrated motivation demonstrate perceptions of simulation leading to personal and deep reflection on learning and there is a greater number of quotations from anaesthetic participants than other groups.

Finally the most internalized orientation of motivation, is considered intrinsic motivation, when a participant engages in an activity out of unregulated choice and purely of the pleasure and enjoyment of the activity and for no external reward. This type of motivation is considered a more powerful driver of action than the more controlled, or less autonomous orientations. It has been acknowledged that it would be unrealistic to expect all life activity can be motivated in this way, as many educational or occupational activities are driven by a range of external demands. There was a small number of quotations coded as demonstrating intrinsic motivation for simulation, across the range of professional groups, all of which used a description of 'fun'. This research demonstrates that there is a wide range of learner orientations of motivation to engage with simulation and a wide range of external regulation and contingency, as well as introjected, identified and integrated motivation. Having identified different learner orientations of motivation simulation other factors influencing motivations are discussed.

6.3.2.2. Process Factors

The process factors influencing motivation which are discussed in this section are learner safety and realism.

6.3.2.2.1. Learner safety

Learner safety is part of experience of the process of simulation based learning. Learner safety is considered as a collection of values, behaviours and processes which create a culture of supported learning in the absence of anxiety of unjustified criticism, humiliation or emotional harm. The concept of learner safety is readily understood and identified in motivation theory as self-efficacy, autonomy, and concepts of well-being. Motivation cannot become more

autonomous, when fear of unjustified criticism is present as this would result in integrated or identified motivation shifting towards introjected motivation. As a feature of process, perceptions of learner safety result in feedback to input features. Positive perceptions of learner safety result in enhanced internalisation of motivation for future engagement, whereas negative perceptions and experiences result in negative feedback and a shift to less internalized or reduced motivation for future simulation engagement.

6.3.2.2.2. Realism

Like learner safety, realism is part of process. Realism was sometimes considered a barrier or hindrance to participants, and at other times a benefit of simulation. Realism is interesting, in that, the initial interview schedule did not include any specific questions about realism. However as the issue of realism was raised in every interview it is important. Realism is the characteristics of the simulation which match how close the replication or model is to the real thing. It became clear that this is an important issue to learners in simulation, and therefore can impact on motivation. There were different emphases between different professional groups on what aspects of realism were important or were not important, and what type of realism mattered. Some types of artificialness were tolerated, whilst others were not. Realism in simulation could also be considered as the context in which learning takes place. The role of context has been discussed in the literature (Koens et al., 2005b) where it has been argued that a learning context which is high in meaning can enhance learning, recall and transfer of knowledge and skills. The authors discuss the work of Smith (Koens et al., 2005b) which demonstrated that there was a same - context advantage for memory recall for simple tasks. In other words recall of learned material was better when the test occurred in the same setting as the original material-to-be-learned was presented. There has been no research to demonstrate the phenomenon for more complex skills and the deep learning necessary for medical training. There has been research which demonstrates that students attribute high meaning to clinical teaching compared with classroom teaching, even though there are some challenges involved in the move from classroom to bedside (Urquhart, 2014) .

The changing venue for medical education over time was discussed in detail in Chapter 2. It can be argued that simulation offers a bridge between classroom teaching and the clinical environment, in the sense that it is most often delivered in dedicated educational facilities, but may be a close replication of a clinical environment. It is noted that there is an emerging body of literature exploring the role of *in-situ* simulation, where a simulation is created within the real clinical environment either for the purpose of team or individual learning, or alternatively as a means of testing systems and processes within complex healthcare settings. This research did not explore in-situ simulation or simulation involving whole institutions, as the focus was on the individual experience. Koens (2005a) goes on to argue that considering

context as simply the physical environment in which to-be-learned material is presented is over simplistic and that a more complex physical environment may not be semantically rich. For example while a busy clinical environment may have greater contextual relevance, but because the primary goal of the clinical area is not educational, the learning is much less controlled, hence may not be able to offer same-context advantage for learning. It is fascinating to note that their proposed model of context has physical, semantic or cognitive and commitment and emotional dimensions. This has very much in common with Dieckmann's domains of realism which is discussed in detail below.

This research identified that the perception of appropriate realism also influences learner participation in a positive or a negative feedback way. Realism was a surprising theme to emerge, whereas the demotivating factors such as time, cost and location, and the issues around anxiety and scrutiny could be readily explained both by existing theories and from the previous literature. In the few previous research publications discussing motivation and barriers to engagement with simulation realism was not discussed (Savoldelli et al., 2005, Kurrek and Fish, 1996). There has, however, been some research exploring the effect of realism on immersion into a simulation scenario, once a learner has undertaken a course or programme (Dieckmann et al., 2012, Dieckmann et al., 2007). In this research, participants' conversations and narratives around realism were frequent and created a large quantity of text quotations within the interviews. Participants often returned to discussions about reality when conversation had moved forward. This indicates the important role that reality and perceptions of reality play in motivation for simulation learning. As described in Chapter 3: Methodology, FA is a bi-directional methodology allowing the researcher an opportunity to adapt the coding framework to take account of emerging concepts even when they have not been considered previously, or have an existing theory.

When considering theory of realism, the author has drawn on work from two very different domains. Firstly, from academic writing on simulation, and secondly from the world of fiction and fantasy writing. The theoretical work of Dieckmann was discussed in chapter 2: Literature review, and presents three domains of realism in simulation: the physical domain, the semantic domain and the phenomenological domain. Physical reality being the characteristics of the simulation which can be seen, heard, touched or measured, the semantic features are those which happen as they would in the real situation and the phenomenological domain being that of the learner's lived experience: experience which is emotional. The results of this research would suggest that the three domains of reality vary in their importance to learners' motivation. For example, it can be seen that shortcomings and limitations in the domain of physical reality were discussed by GPs, in particular, as limitations, and therefore contribute to a negative value perception, yet these negative value perceptions of short comings in the sense of

physical reality limitations were very often qualified negative value perceptions. Typically with statements which could be paraphrased as 'of course it is never really exactly like the real thing, but it is the best available' and hence tolerated. Physical limitations are even embraced as a positive value in terms of hyper-realism, where one can have the opportunity to deliberately make a mistake, as a part of the learning process. Physical limitations of reality were not mentioned by anaesthetic trainees. This was an interesting contrast. For anaesthetic trainees the short comings of semantic realism were much more significant in their perception of the simulation experiences as being positive or negative. There were no quotations from any of the anaesthetic participants about the physical limitations of simulation, however there were discussions about the semantic progress of simulations deviating from the experiences in reality.

A second theoretical perspective which can help deepen understanding of realism and the role it plays in creating positive or negative value perceptions around simulation can be taken from the writing of J.R.R. Tolkien (1964). Tolkien's concept of the primary and secondary realities of created or fantasy worlds was discussed in chapter 2. Tolkien identified the primary reality as being the world one lives and functions in, where the secondary reality is the created world. In the area of simulation the created world or secondary reality is the simulation. By considering the results of this research through the lens of primary and secondary realities it can be seen that some of the demotivating factors described by participants, were in the primary reality, whilst others were in the secondary reality. If we combine these two perspectives of primary reality versus secondary reality with the physical, semantic and phenomenological classification it helps to provide a structure to understand which aspects of reality are important to participants. This combination of perspectives is illustrated in Figure 6-2 Domains of Realism Combined, where there are primary and secondary realities in each of the physical, semantic and phenomenological domains. Each cell of the matrix will be discussed below.

DIECKMANN'S DOMAINS / TOLKIEN'S DOMAINS	Physical look /feel /sound	Semantic happen	Phenomenological feeling
Primary reality	No quotations	Competition Game-playing	Peer scrutiny Embarrassment Have fun together
Secondary reality	Part task trainers CPR mannequins Mostly tolerated	Team roles Sequencing Timing	Anxiety as ambivalent War, trickery

Figure 6-2 Domains of realism combined

None of the participants talked about the physical elements of the primary reality, suggesting that the physical aspects of the primary reality do not play a significant role in learner experience or motivation. This is not surprising as one would expect any well-resourced educational experience offered to medical healthcare professionals would have the most appropriate primary reality, physical setting appropriately arranged to enhance learning. This could be compared to physiological needs as described by Maslow. There was however discussion around the physical limitations of the secondary reality in 'the simulator/simulation.' In particular with reference to part task trainers such as limbs for rehearsing insertion of implantable devices, or CPR using a mannequin. These limitations of realism were mentioned, in particular by GPs, but interestingly were tolerated. In the coding scheme this was identified as 'negative value – qualified', or even considered a positive because of the opportunity to deliberately make a mistake then analyse the mistake by, for example, pulling 'skin' back to see where the implant has gone. This benefit associated with physical qualities in the secondary reality has been called hyper - realism. The table represents examples of the overlap between the primary reality and semantic realism. This includes the use of video, the interface between learning as the participant in role in the simulation versus learning as

an observer of the simulation. Participants describe this in terms of friendly competition, which would not occur in individualized learning endeavours.

Within the secondary reality there were negative perceptions around semantic issues i.e. 'it wouldn't happen like that in the real world', typical examples included sequencing, timing of physiological changes, availability of help, other people in team roles - these were not well tolerated, and had the potential to create a negative feedback influence on learner motivation. It could also be inferred that when there were breakdowns in the semantic realism and issues of inconsistency in the secondary reality that this also contributed to learner anxiety. This supports the work of Decarlo (2008) which was discussed in Chapter 2 and identified 'it isn't real' as a barrier for nurses in simulation, although that work did not relate the findings to any theoretical concepts of motivation or of reality. In summary some reality limitations are tolerated, but others are less tolerated, but the concept that an appropriate level of, especially semantic realism appears to contribute to enhancing motivation. This has not previously been described in a theoretical or empirical sense.

In terms of phenomenological experiences of simulation there were significant issues around anxiety. Considering anxiety in the primary reality, the researcher has classified on three levels. Firstly, self-consciousness about role play. Secondly, fear of making a mistake, whilst having one's professional practice scrutinized by colleagues or one's peers. Thirdly, the fear of making a mistake is exacerbated if there is a perception that simulation involves deliberate trickery to force a mistake. These three escalating levels of anxiety are succinctly expressed as 'I don't want to look like an idiot.' In the secondary reality, in contrast, anxiety is tolerated, or even seen as a positive part of the learning, as it is recognized as substitute for anxiety in emergency situations, and hence enhances the secondary realism.

6.3.2.3. Output Factors

Having discussed input and process factors which influence motivation, this section addresses output factors. Relevance and expected outcome are discussed.

6.3.2.3.1. Relevance

Participants also talked about relevance to their individual circumstances. As seen in Chapter 5: Results, there was variation in how relevant participants saw simulation to their own professional specialty and career stage. Anaesthetic trainees viewed simulation as very relevant both to their daily work, as well as relevant to their professional career development. They had experienced a lot of simulation and expected this to continue. There was a high degree of perceived relevance for opportunities to experience rare situations such as advanced airway management, which cannot be learned in a controlled way in real time, in

the real clinical setting. There was also a positive perception of relevance for courses emphasising non-technical skills such as team work, with positive responses about improved understanding of the different priorities of others in a team and the resulting enhanced team work in emergency situations. This finding was consistent with the literature supporting the effective use of simulation at team and system level, rather than courses where the individual practitioner is the target unit to be trained. For example Siassakos (2009) and Smith (Smith et al., 2013) as discussed previously, presented evidence for effective interventions improving neonatal outcomes after training in obstetric emergencies, when the training involved whole teams at institutional level. Many of the courses, described by anaesthetists, which were mandatory for their progress were simulation based courses. They expected successful completion of simulation course to enhance their CV or portfolio, and also identified that some forms of assessment required for successful career progression involved simulation.

This was in contrast to GPs where the perceived relevance to career stage and specialty was less. There was little or no mandatory training or development required apart from annual CPR training. Courses using part-task trainers such as musculo-skeletal joint injection, or implantable device insertion were not a mandatory part of professional training or accreditation. Rather, they were courses selected by GPs because they wished to expand their skills repertoire. If, however a GP wishes to be accredited to use implantable products, the simulation based component of the course is mandatory. Although, superficially, it would appear then, that the GP group have more autonomy, more control over their own CPD and learning this was restricted in some cases where simulation based learning was the only option to allow the provision of an important patient service i.e. implantable contraceptives. This driver represents an extrinsic orientation to motivation. GPs rated traditional lecture based CPD activities very highly and expressed a preference for these over simulation based activities as they were perceived as highly relevant, and particularly useful and efficient for keeping up to date with 'hot topics'. This group of activities represented motivation best described as identified motivation - where there is a conscious valuing of the activity and self-endorsement of the goals.

The role of simulation in training for communication and consultation skills is well established in undergraduate and foundation doctors' discussions, but less well established or seen as less relevant in post graduate learning. The anaesthetic specialty see simulation as a very normal part of learning and training. There is an existing curriculum inclusive of simulation based learning, and assessments which are essential to career progression in post graduate examinations. In anaesthetic practice relevance is implicit, and discussions around relevance are focussed, not on simulation itself, but on specific elements of particular courses. The relevance of life support and resuscitation skills is accepted as relevant and necessary across

all groups, co-occurring with a tolerance of there being no well-established, or reproducible way to learn life support skills other than in simulation settings. Life support courses have used mannequins for many decades, and this form of simulated learning is widely accepted within the healthcare professions as well as among members of the general public and as such is seen as relevant. Perceptions of relevance, then are closely associated with whether a practice is seen as normal.

There were both issues about relevance, as well as time constraints revealed in the data, when comparing the different learning modalities amongst GPs. Another area where there was a perception amongst GPs of less relevance was in the area of communication and consultation skills. More experienced GPs suggested that as they consult with dozens of patients every day they did not see any relevance in engaging with a course which delivered training in this area. This represented a state of amotivation in the context of non-relevance and non-intentionality with the only anticipated future motivation being external regulation. Existing motivation theory shows that increased autonomy enhances motivation. The implication then, from the theoretical perspectives might be that GPs, having greater autonomy will have higher levels of motivation than those for whom the training is mandatory, but this was not the case. Perhaps the function of true autonomy would only be present if the same learning outcome could be achieved using a choice of means to achieve the desired outcome.

SDT argues that extrinsic motivation, particularly less autonomous forms, is less powerfully motivating compared to intrinsic and more autonomous forms of motivation. The negative features of extrinsic motivation are described as influences such as threats, deadlines and excessive competition pressures. However if extrinsically motivated actions become self-determined, they become internalized, then this becomes more powerfully motivating and enhances belongingness and connections and relatedness. This is seen in the anaesthetist's views. The sequential motivation is that simulation is mandatory, the participant engages with it, and their engagement is internalized and because participation in simulation is seen as normal practice for the group, the extrinsic motivating force becomes internalized and there is a sense of belonging in the community of practice. Sobral (2004) also proposed that autonomy was highly motivating, and particularly so when the task was associated with meaningfulness as a high value educational experience. Anaesthetists expressed more views suggesting they placed high value and meaning to simulation based experiences than GPs placed on their simulation experiences or opportunities.

6.4. Relating results to existing theory

In Chapter 2: Literature review, a number of important theories of motivation were discussed including Maslow's hierarchy of needs (1970), Ausubel's (1968) and Bandura's (2001) theories of self-worth and self-efficacy as well as self-determination theory of motivation (SDT) (Ryan and Deci, 2000a). The themes which emerged in this data can been considered in relation to these theories.

Figure 6-3 Maslow's needs hierarchy

The concept of safety was an important consideration for simulation participants. If participants had concerns about their psychological safety this was demotivating. The emergent themes also were consistent with Maslow's hierarchy shown in Figure 6-3 Maslow's needs hierarchy above, in terms of esteem: the importance of having one's success recognized, and conversely not having one's failures publicly scrutinized. A positive value of simulation was also identified in which the intrinsic satisfaction of solving a problem through deliberate practice in a safe environment of simulation was satisfying and a positive value experience for participants.

In viewing the results through the lens of Ausubel's theoretical position the data supports the theory that motivation is not simply an isolated or individualized construct, but that there is an important role of group, society and community on the values and aspirations of the individual, which are powerful influencers of motivation. Much of the expressed anxiety, which can be demotivating in simulation can be readily understood in terms the importance of gaining approval of one's peers. This was a powerful theme in the data. Once again, the data clearly revealed that the potential of anticipated future failure, in particular, in the context of public or peer scrutiny would result in demotivation for the learner considering future simulation

opportunities. This appeared to be particularly amongst GPs well established in their own professional practice and professional identity. Similarly, SDT (Ryan and Deci, 2000a) argued that

> '*Interpersonal events and structures (e.g., rewards, communications, and feedback) that conduce toward feelings of competence during action can enhance intrinsic motivation for that action because they allow satisfaction of the basic psychological need for competence. Accordingly, for example, optimal challenges, effectance promoting feedback, and freedom from demeaning evaluations are all predicted to facilitate intrinsic motivation'.*

When the results are considered through self-determination theory, it can be seen that many the themes can be categorized into areas of autonomy, competence and relatedness. For example in terms of intrinsic and extrinsic orientations it can be seen that the opportunity for personal rehearsal, and the opportunity for self-reflection are self-determined activities for a learner in simulation, as well as the positive value perceptions of the learning such as team-working in a safe environment and fun, enhance motivation. There are also extrinsic rewards as motivating factors identified in the data in the theme of expected outcome which includes enhanced CV or the mandatory nature of a course or programme, or preparation for assessment. SDT offered a more complex understanding of these factors by demonstrating that intrinsic and extrinsic motivations are not dichotomous, but rather are context dependent, variable over time and complexly related to each other. As described above extrinsic motivations can become internalized resulting in increased self-determination.

In the domain of competence, there are a number of themes to be considered. This area is closely related to the concept of self-efficacy as described previously. If a learner feels that they may have, or appear to have inadequate skills, this is demotivating. It is considered that the particular feature of simulation, which is role play in front of faculty, peers, or video, that the risk of exposure creates a high level of anxiety in learners. This reflects SDTs assertion that belief and confidence in one's own ability, that is 'competence', is a highly motivating force. Of course one could also consider that the simulation learning experience itself, by provision of a guided opportunity for rehearsal, allows the learner to gain more knowledge, technical skills and non-technical skills, thus enhancing future competence. Anaesthetic participants tended to emphasize this view of competence, whereas GP participants tended to emphasize the former view. When simulation and stress have been discussed in the literature, it has been identified that stress is acceptable to learners and does not undermine confidence (Macdougall et al., 2013).

Within the domain of relatedness a number of the emergent themes can be considered. There were several factors which emerged as motivating or demotivating which can be considered as features in the domain of relatedness. These include team-working and fun learning with peers. Both anaesthetists and GPs used descriptions indicating the fun aspect of learning in simulation. This is in keeping with relatedness (SDT), as well as Lave and Wegner's community of practice (1991), where the emphasis on effective motivation and learning is on socio-cultural as well as individual characteristics. As well as some of the negative factors, where there is an anxiety of the simulation undermining, rather than enhancing relatedness. This was discussed previously. In summary, this section has related the findings of this empirical research to contemporary theory of motivation.

6.5. Original Contribution

In Chapter 2: Literature Review, it was seen that although there is an ever-increasing body of literature bringing deeper understanding to the processes and outcomes of simulation, the literature has been criticized as lacking high quality, robust, and theoretically underpinned research. There is a need for research which helps the academic community and practitioners in simulation to identify robust evidence for effectiveness of simulation. A detailed understanding of what it is about certain courses or programmes which makes them effective is needed. In other words, in the highly complex and variable world of medical education what in simulation 'works' and what is the 'magic ingredient'. The research consensus statement (Issenberg et al., 2011) identified a clear need for deeper understanding of learner characteristics, perceptions and influences that impact on engagement with, and effective learning from simulation. The literature, as described in Chapter 2, identified some research revealing barriers to engagement with simulation, but did not address contemporary theories of motivation in the context of simulation. This research offers an original contribution by presenting empirical research in motivation for simulation which is theoretically underpinned. The theoretical underpinning crosses academic disciplinary boundaries. This research is original in that it crosses disciplinary boundaries of medicine, medical education, education, and psychology, particularly in the area of motivation. In addition this research makes a further contribution to knowledge by identifying a clear relationship between motivation for simulation and realism. The author is not aware of any other presentations or publications drawing a link between motivation for simulation and the realism of the simulation. Another original contribution of this work is the inclusion of the scholarship of J.R.R. Tolkien, the famous fiction writer. Tolkien's writing can deepen understanding of the simulation if it is considered as a type of fantasy world. If simulation is then considered as a fantasy world, motivation and engagement require, not just an individual's ability or intent to suspend disbelief, but a design

that takes account of the internal consistency of the simulation. This thesis offers an original contribution and also a challenge to simulation designers to attend to the internal consistency of the simulation, rather than focussing continued efforts on creating closer (physical) approximations to the real world.

6.6. Strengths and Limitations of the Results

An important strength is that this thesis is based on empirical research, done in naturally occurring learning groups of medical students and doctors across a broad range of career stages and differing medical specialties. Appropriate sampling, setting and analysis have been used and are dealt with in the paragraphs below. A further strength of the thesis is the theoretical underpinning of the work. This work also drew on existing knowledge and theory from more than one single scholarly discipline. Although the challenges of academic work across different disciplines can bring great challenge, as discussed in Chapter 4: Personal reflections of the author, cross-disciplinary research can reveal deep and original insights which would not have been revealed by confinement to a single academic discipline.

Other methodologies which were considered included individual interviews with a wide range of healthcare professionals, analysed using principles and using the interpretivist method of grounded theory. This would have offered the advantage of generating great depth of analysis and an opportunity to challenge or even generate new theory. The disadvantages, however, included the increased time and resource requirement for both interviewing, transcribing and data analysis with uncertainty when beginning, about how many interviews and different specialists would be required in order to achieve saturation. Another methodology considered was the use of surveys. This would have offered the advantage of potentially reaching a larger number of participants across a wide range of specialties. Both quantitative and free text response data could have been collected and analysed. This could have built on the previous survey research done by Savoldelli and colleagues. A disadvantage, however would have been the limited depth of response which can be achieved with survey based instruments.

The choice of methodology was influenced by the cross-disciplinary nature of the work, and justified in section 3.1.2. Some of the challenges of working in a cross-disciplinary way are discussed in greater depth in the author's reflections in chapter 4. One the one hand, a methodology associated with social sciences, heavily influenced by interpretivist paradigms would have allowed a deeper understanding of a complex human endeavour, with the associated emotional responses, and may have allowed for very deep insight in a qualitative way, and the development of new theory. However, on the other hand a methodology rooted in the positivist tradition of medicine and the natural sciences, could have allowed gathering

of data from a larger number of sources, statistical analysis and interpretation, and may have had wider acceptability to a medical audience. The author considered that the research work should be accessible to a range of professionals and sought a methodology which could be considered sufficiently robust and accessible to a wide range of academics across the spectrum of methodological paradigms, whilst acknowledging the limitations of doing so.

6.6.1. Sampling

Sample size and gender balance are discussed here; career stage and specialty representation were previously addressed in Chapter 3: Methodology. The sample was based on principles of purposive sampling as described there, and so the sample size was relatively small. Purposive sampling rather than random sampling can allow for a smaller sample size. Barbour (2001) acknowledges that purposive sampling can often contain elements of random or convenience sampling, yet still retain rigor. As the aim of the research was to identify specific views about phenomena, rather than to hypothesize on how widespread these phenomena were, it could be considered that the bias due to sampling is likely to have little impact on the conclusions drawn. Sample size can be difficult to determine in advance of qualitative studies (Malterud et al., 2015). Much qualitative research uses the concept of saturation, derived from grounded theory, and can be considered the point at which, a researcher has 'heard it all before'. In this research study the primary purpose was not development of theory, in fact, framework analysis is not designed to build theory, although many of the principles of grounded theory are used, therefore the concept of saturation is not the most appropriate way to determine adequacy of the sample (Ritchie and Spencer, 2002a). It should be noted that the main ambition of this research is not to cover the whole range of phenomena, but to present selected patterns. Malterud (2015) helpfully discusses 'information power' and suggests the adequacy of the sample size be continuously evaluated during the analytical process by considering (a) study aim (b) sample specificity (c) use of established theory (d) quality of dialogue (e) analysis strategy. Each of these factors is listed with a statement of application of this work.

a) The study aim. This study was relatively narrow.
b) Sample specificity. The target group for this research had characteristics highly relevant to the study, enhancing information power.
c) Use of established theory. Use of existing theory means a narrow sample is acceptable.
d) Quality of the dialogue. Information power was enhanced by clear, articulate interviews.
e) Analysis strategy. This research used an established methodology.

Another consideration in sampling is gender balance. The strategy described above for purposive sampling resulted in the recruitment of a total of 28 subjects. Of these subjects 10 were men (36%), and 18 were women (64%). Within the whole medical profession the proportion of men to women in hospital specialty practice is 67% men, 33% women, and in general practice is 49% men, and 51% women (General Medical Council, 2015), but the gender mix of licenced doctors who regularly participate in formal continuing medical education events is not known. It was also seen that some of the interviews had all male participants, some all-female participants and some had a mixture of male and female participants. This was due to the fact that interviewees were recruited and interviewed in naturally occurring learning groups. This sample can be considered suitable, in so far as continuing medical education learning groups may be single sex, or mixed sex groups. This could be potential source of sampling bias, as there is an established relationship between motivation and gender, and this sample has more women participants than men. The research does not, however make any claims or assertions based on gender attributes or different motivating or de-motivating factors for simulation, but rather was seeking a broad range of possible factors to consider. Sampling was discussed in section 3.1.4, where the author outlined the process for recruiting a wide range of medical practitioners at different carer stages and from a range of different medical specialties. Some of the groups had experienced a lot of simulation based medical education, and others relatively little. One limitation to this work is the limited number of different medical specialties included in the research. Ideally participants from additional specialties could have been recruited for further depth to the work. For example a number of specialties who have much exposure to simulation, and therefore whose views and attitudes to simulation are of importance include for example interventional specialties such as radiology or cardiology. Also much if the literature discussed in chapter 2 related to surgeons and the expanding filed of laparoscopic work, where simulation plays a prominent role. Section 3.1.4 presented a case for making a pragmatic decision on included groups on the basis of manageability for a single researcher working with no research budget, whilst accepting that this causes some limitation to the generalizability of the conclusions.

6.6.2. Setting

Although the research was conducted in the context of medical simulation based education it offers applicability to other healthcare educators who use simulation. This research was conducted in the setting of a United Kingdom university teaching hospital and associated community primary care, so the transferability to other settings, such as internationally, is not guaranteed. The structure and funding of medical undergraduate, and continuing medical education vary in different health care systems internationally. The educational climate and culture may demonstrate significant variations, and additionally there may be wide variations

internationally, in the degree of previous exposure to simulation various practitioners have been involved with, in terms of access, resources and so on. In order to suggest transferability to other contexts with different educational cultures and resources, further research would be required. The participants were also recruited in the context of either a hospital or primary care setting of a small Scottish city, with access to a local simulation centre with a strong international reputation, and also access to a national centre of excellence within 1.5 hours travelling. This is also a limitation to the transferability of the findings to other settings, such as remote or rural, or those where there are other resource issues around distribution and access to training. In order to confirm transferability of the results to other such settings, more research would be desirable.

6.6.3. Analysis

The method used for analysis was Framework Analysis as described by Spencer and Ritchie (2002a). The steps which were taken to enhance reliability and validity were described in Chapter 3: Methodology, these steps included a transparent and auditable path from audio data to written transcripts guided by an explicit transcribing convention. A further step to enhance reliability was the use of three researchers independently listening to, and reading a sample of transcribed data independently in development of the coding framework, and in order to achieve triangulation in that process. The strengths of framework include providing a highly structured way of handling largely unstructured qualitative data, allowing both deductive analysis based on prior understanding of theory, yet also allowing for new ideas to emerge inductively (Barnett-Page and Thomas, 2009).

Potential weaknesses in use of this particular method of analysis are discussed here. One weakness is that the method is not designed to enable the development or testing of new or existing theory. Another potential weakness of the method is that the framework is developed *a priori*, so has the potential to be restricted to knowledge or concepts that are already understood, or well described in the literature. This potential disadvantage is overcome, by the iterative nature of the method which allows interesting or new ideas to emerge, even if they were not initially part of the framework. In this case the first coding framework had relatively little emphasis on realism as a motivating factor for simulation, because this has not previously been described in the literature. Although this has emerged as a concept and identifies an important gap in existing motivation theory when applied to the specific circumstance of simulation, the method does not support the development of a new contribution to theory. Discussions, therefore, on the gaps in existing theory and potential for development of theory can only be done in a hypothetical way.

Other methods which were considered for the research were grounded theory and thematic analysis. If grounded theory had been used there may have been the possibility of proposing or developing a theory of motivation for simulation, where the gap in theory has been identified. Grounded theory however may have required a larger body of data in order to guarantee reaching saturation and was considered a less pragmatic option (Barnett and Ceci, 2002). Thematic analysis would also have been a suitable methodology which could have allowed for the development of theory, but the literature revealed wide variation in the descriptions of the exact steps to be taken when using this methodology (Bryman, 2008). Also at the start of the research process it had not been anticipated that the existing theoretical models would be inadequate for explaining some of the emergent themes, so it was not anticipated that a methodology suitable for developing theory would be required. There was little literature using thematic analysis to answer specific policy and process research questions. There were however a number of thorough descriptions of the uses of FA which were helpful in outlining the exact steps to be taken. The researcher, therefore considered FA the methodology offering the greatest transparency in process to effectively answer the research questions.

Atlas-Ti® was used as both a repository for the data set, as well as a tool to assist with organisation and visualisation of the data. Although the use of customized software is not required in order to conduct robust analysis, its use enhances transparency (Silver and Lewins, 2014). The software allowed continuous linking of the data in text form to the original audio files, thus enhancing transparency. The design of the software to make quotations the heart of the workflow allows representation of the relationship between concepts as well as further enhancing transparency (Silver and Lewins, 2014).

6.6.4. Bias

In the context of qualitative research bias is the action of reporting a skewed or slanted presentation of results which leads to reduced validity or reliability. It could be said that some degree of bias in qualitative research reporting is inevitable, but steps can be taken to reduce this. Bias can be considered in these areas, researcher bias, biased questions, biased samples and biased reporting. Sampling has already been addressed above and the other areas will now be discussed in turn.

Firstly researcher bias: it is understood that a researcher cannot be entirely objective. The potential for bias due to the underlying attitudes and assumptions of the researcher is inevitable. One way of enhancing the credibility of the results is for the researcher to be transparent in their own assumptions and biases (Mays and Pope, 2000). This has been addressed reflexively in Chapter 4: Author's reflections. It should be noted that the chapter

on the author's reflections is positioned *before* the results chapter of the thesis, in order that the reader can appreciate the lens through which the data was analysed.

Secondly bias could arise due to the use of biased questions: This potential source of bias was reduced by the predominant use of open questions. The initial interview schedule can be seen (appendix 5), to enhance transparency. Open questions such as 'Tell me about your experience of simulation' could be considered a question with reduced potential for bias. Similarly 'Would you describe your experience as positive or negative?' is an open question.

A further potential source of bias is in the reporting process, would be if only some sections of results were reported but others omitted. Although the entire body of transcribed data could be included, this was however, considered too cumbersome. With the richness of qualitative data not all themes could be described due to practical limitations, but rather only those themes which helped contribute to answering the specific research questions which were articulated *a priori*. The density measure available in Atlas-Ti allows a reader to identify how many times each code was used, giving a quantitative evaluation of the frequency of the themes or sub-themes arising. Other areas where steps were taken to reduce bias have been described above. Having identified the original contribution offered by this research, and discussed the strengths and limitations the following section will identify and discuss the implications for policy and practice.

6.6.5. Summary

In summary the strengths of this work are that it is original, empirical, interdisciplinary research done in an appropriate context using an appropriate sampling process and a robust methodology. It also has a strong theoretical underpinning and the qualitative nature of the data offers greater depth than previous survey based research. Although the limitations include a relatively small sample size, in a single institution and the use of a methodology which does not produce new theory, nonetheless, this work helps answer key questions in simulation and allows recommendations for course designers, policy and practice.

6.7. Implications for Practice and Policy

It can be seen from the discussion above that motivation is not uniform in all medical personnel who participate, or consider participation in simulation based medical education activities and that there are many factors and perceptions which will influence engagement. It would be helpful for all educators, irrespective of the teaching and learning tools they use, including simulation, to have an understanding of contemporary theories of motivation, and in particular, those factors influencing motivation which can be manipulated by the educator (Williams and

Deci, 1998). In particular, in the setting of simulation there are opportunities for enhancing autonomy, and enhancing self-efficacy. (Patrick and Williams, 2009). It is therefore essential that in order to plan simulation activities and courses where participants derive the maximum educational value that course and programme designers are cognoscente of these factors and consider how they might enhance or hinder engagement. Even when a course is a mandatory part of training, there are still opportunities to enhance the internalisation of motivation which may have originated in response to an external goal. Course designers should be aware of the importance of signalling the relevance of a course or programme to the target participants, particularly when an activity is mandated by a body, rather than a deliberate or personal choice on behalf of the participant. In other words explicitly linking relevance to current or future practice, as these activities help learners to introject, integrate and internalize the drives for learning, beyond external regulation or contingencies.

Another important recommendation is to increase awareness, amongst course designers and teaching faculty of the high levels of anxiety prevalent in simulation learning activities. Teachers should be aware that there are different sources of anxiety, firstly self-consciousness about role play, secondly fear of peer scrutiny, and thirdly fear of being ushered into making a mistake.

The author would recommend incorporating training on understanding, identifying and managing anxiety in learners, as a part of on-going simulation faculty development programmes. This may be achieved in a practical sense by the development of new faulty development courses or inclusion of the material in existing faculty development. As with any research, the dissemination of new concepts through publication in appropriate texts, journals and social media, as well as conference proceedings, is an essential part of the research process. This allows for both dissemination of the findings and their implications as well as peer review leading to further development and refinement.

For example, during the later stages of the research the author was invited to host a workshop at a national conference for healthcare clinical skills educators. The workshop presented the research findings and invited experienced clinical educators, the majority of whom had significant experience of learning and teaching using simulation. The purpose was to discuss and suggest ways in which anxiety can be identified, and managed. One of the strategies discussed in terms of helping to reduce learner anxiety about making mistakes, is to ensure that small mistakes made early in the proceedings are celebrated as key opportunities for all to learn and serve as a reminder that the purpose of simulation is to allow mistakes without harm. Faculty should have clear agreement on the avoidance of deliberate trickery to precipitate mistakes. The briefing of learners plays a key role in this area. Learners must feel

secure that they will not be deliberately tricked into making mistakes or looking foolish in front of peers. The anxiety around reality and establishing what is real and what is not real in simulation can also contribute to anxiety or breakdown in suspension of disbelief. It is becoming increasing accepted that the briefing and de-briefing are important in the learner experience (Owen and Follows, 2006) (Stafford, 2005, Rudolph et al., 2008). Also the content and manner in which feedback is given contribute positively or negatively to the learner experience in simulation (Raemer et al., 2011). Although terminology varies, briefing can be helpfully used to describe the process by which the learner is introduced to the simulation context - how it works, what the mannequin can or cannot do, any limitations or contingencies to the realism and how they will be handled. This can then be followed by the introduction 'in-role' for the task to be achieved or the skill set to be demonstrated.

6.8. Future research

It was seen above that although the use of FA was an appropriate methodology to answer the research questions, and to identify motivating and demotivating factors for participation in simulation, it does not allow development of new theory. The research identified a gap in the existing literature: a theory of motivation which could account for the important role that realism plays in participants' motivation. Because the method used did not allow for the development or testing of a new theory, future research will consider strategies and methodology to develop and test new theory of motivation for simulation, which addresses the important issue of realism. In terms of realism, although this research does not claim to offer a new theory of motivation, it does demonstrate that the issues around realism do play an important role in motivation for simulation. This thesis suggests that there is a need for further research to develop and test a theory which relates realism to other motivating factors. This thesis, by identifying which realism issues were most significant to participants, offers a structure which education designers may find helpful in carefully considering which domains of realism deserve the most attention and resources. It is hoped that this research will empower educators to avoid the temptation to restrict their effort to enhancing physical realism at the expense of semantic or phenomenological realism. This research also suggests that attending to the internal consistency of the simulation as a secondary reality may enable better engagement and reduce the risk of breakdown in suspension of disbelief.

This research has identified that anxiety plays an important role in learners' experiences and intentions to participate in simulation. Future research will explore this emotional construct further, with a view to creating a taxonomy of anxiety in simulation.

7. CONCLUSION

The subject of this research is learner attitudes and motivation for simulation based medical education. This is an important area because simulation is being used increasingly in medical undergraduate and post graduate education. It has significant potential to provide an additional medium for learning the complex skills needed for the delivery of safe, patient centred healthcare which 'does no harm' (Ziv et al., 2006). Although the benefits have been widely stated, like any educational intervention, it is complex to evaluate in terms of effectiveness particularly in considering the impact on patient outcomes. The work is situated in the scholarly traditions of medicine and education and is underpinned by contemporary theoretical perspectives on motivation for learning. The work relates to other contributions to the field of simulation research as there is a quest to identify what works, for whom and in what circumstances (Dieckmann et al., 2011). It contributes to the body of literature by arguing that in order to generate robust evidence to answer these questions, the attitudes and motivation of learners must be understood and taken account of. This work explores the attitudes of medical learners from a range of medical specialties and career stages. Previous positive and negative experiences, and positive and negative value perceptions which influence decisions on participation in simulation have been explored. Factors which enhance or undermine the motivation for simulation have been demonstrated. Factors enhancing motivation include perceived relevance, opportunities for practice, effective feedback and appropriate realism. Factors undermining motivation include perceived irrelevance, anxiety about role-play, peer-scrutiny of practice, and fear of 'looking like an idiot'. These results highlight the importance of recognising anxiety in simulation, ensuring appropriate realism and creating a safe learning environment. Attention has been given to addressing the strengths and limitations of the work, and recommendations for practice have been made. The opportunities for further research have also been outlined. In conclusion this thesis answers the questions 'What motivating and demotivating factors in simulation based medical education do doctors and medical students describe?' and 'What is the relationship between motivating and demotivating factors, perceived relevance and realism in decisions to participate in simulation based medical education?' and so has contributed to greater understanding of motivation for simulation.

8. REFERENCES

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APPENDICES

ORIGINAL ARTICLE

From fairies to SimMan: Tolkien and realism in simulation

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Abstract

Background: There is a paucity of empirical and theoretical literature on reality and realism in simulation-based learning. **Methods**: This article makes an original contribution to the body of literature by using the theoretical conceptualizations of reality described by Dieckmann et al. in simulation and by the fantasy author and scholar J.R.R. Tolkien to challenge and develop our understanding of reality in simulation. This article reports a qualitative research study that reveals the perceptions of realism in simulation-based medical education. **Results**: A significant finding was the importance participants placed on realism in their motivation to participate in simulation. Participants' descriptions of realism were consistent with the domains of physical, semantic and phenomenological realism and played an important role in their intention to participate in simulation-based learning. The data also revealed that while lapses in physical realism were tolerated, lapses in semantic realism were very poorly tolerated. In addition, when there was inconsistency within the secondary reality as described by Tolkien, this resulted in a breakdown of suspension of disbelief. **Conclusions**: A deeper understanding of these factors will inform course designers as they consider the processes of simulation-based learning and as they seek robust evidence for its effectiveness. Developing understanding of realism for medical simulation can help course designers and teachers make best use of resources by focussing on the domains of realism that have most impact on learners.

Keywords: *simulation; theory; reality*

Introduction

There has been a dramatic increase in the use of simulation-based education (SBE) in medical and surgical training over the past three decades. In parallel with this, there has also been an increase in the published literature relating to SBE. Much of the literature has, however, been criticized for being too descriptive, lacking in methodological robustness or lacking theoretical underpinning. This is particularly true when considering realism. Much of the research and literature focusses on describing ways to enhance realism, despite the argument that that more (physical) realism does not necessarily lead to better learning.[1] Although several authors have classified simulators and simulations in terms of fidelity,[2,3] there is a paucity of literature exploring the construct of realism in SBE in a way that enhances understanding of the phenomenon. There is even less research in the field that develops, tests or challenges the underpinning theory of realism,[4,5] However, Dieckmann et al.[6] have made an important contribution in this area in their work on developing a theory of immersion and engagement with simulation-based learning, both at the level of the individual practitioner and as a learning community. They explore what reality means in the context of a fully immersive simulation experience. The nature of reality is a profound question of ontology and is beyond the scope of this article.[7] It is, however, clearly an important issue to address in any role play or simulation as the degree of engagement, or immersion into the created world of simulation, will have a profound impact on the nature and quality of learning. Dieckmann et al.'s theoretical framework, based on empirical research using interviews and video analysis of high-fidelity immersive simulation behaviour, is outlined and discussed and compared with other conceptual frameworks from entertainment and fiction, and used as a launch pad for analysis of the author's own qualitative research exploring SBE.

Dieckmann et al.[6] proposed that immersive simulation is essentially a social activity and a social learning experience

and have compared it with immersive experiences in entertainment. Their conceptual framework for reality is based on three domains of physical, semantic and phenomenological realism. Physical reality refers to the properties of the simulation that can be sensed or are measurable, through sight, sound or feel; for example, a blood pressure recording, a lab result, heart sounds on auscultation. The physical realism domain considers the question "Does this look, sound or feel like the real thing?" Semantic realism addresses the question "Would it happen like this in the real world?" This refers to issues of sequencing, timing, changes in physiological parameters, availability of help when required, or the roles played within teams and the degrees of expertise exhibited. The third domain of realism is phenomenological. This refers to how the participant feels and experiences the simulation. It addresses the question "Does this feel the same as the real situation?"

Dieckmann et al.'s work suggests that semantic realism is more important to participants than physical realism. These three domains of realism are summarised in Table 1.

Another helpful insight can be gained from a different context that can be considered analogous to simulation; that is, the entertainment industry. This is helpful both in terms of a language of realism and also conceptualization. The terminology of "suspension of disbelief" is very helpful. An audience deliberately choose to suspend their disbelief for the purposes of entertainment. It is suggested that there is a conceptual contract between consumer and director in relation to suspension of disbelief. The audience choose to believe that the fiction created is "real" even when they "know" it is a fictional representation. Curiously, there are occasions when suspension of disbelief breaks down: a consumer may go to a cinema with friends to watch a historical fiction movie in which the audience choose to suspend disbelief for the purpose of enjoyment. If, however, the audience then see a piece of modern technology, for example, an electricity pylon, which is inconsistent with the historical period, it can cause a temporary break in the suspension of disbelief. In

an essay "On Fairy Stories",[8] the famous author of fantasy J.R.R. Tolkien discusses the creation of fantasy kingdoms in relation to reality; he introduces the idea of primary and secondary realities. The primary reality is sitting in a comfortable seat, alone or with friends, reading a book or watching a movie for entertainment, escape or relaxation; the secondary reality is the other world or kingdom created as a fictional entity entirely by the author or director. The physical reality of a cinema, the furnishings, etc. have less impact on the overall value of the experience compared with the fictional content of the book or movie. Tolkien asserts that the characteristics of the secondary reality can be as creative, even as fanciful, as the author wishes, but stresses that the internal consistency of the secondary world is essential to the suspension of disbelief. This concept of primary and secondary realities provides a helpful framework for considering immersive simulation. As Tolkien's conceptualization suggests, provided the created world, that is, the simulation, is internally consistent, then it can be as imaginative as the designer wishes and one can fully engage in the secondary reality. This article describes empirical, qualitative research that contributes to the literature by deepening understanding of reality in simulation as well as testing, challenging and developing existing theory even further.

Materials and methods

Semi-structured group interviews were carried out with a range of medical students and doctors at different stages of their careers and from different professional groups including anaesthetists, general practitioners (primary care physicians) and foundation doctors. Participants described their experiences of simulation and what would motivate them to participate in SBE or what factors would be demotivating. All interviews were transcribed and coded for themes and subthemes using framework analysis.

Results

The data revealed a range of simulation experiences including cardiopulmonary resuscitation (CPR) training, procedural training using part task trainers, use of simulated patients and complex immersive simulations. Several themes were identified, such as range of experiences, positive value perceptions, negative value perceptions, realism, relevance and pragmatic moderators to simulation. This article discusses one of these themes: realism. It was clear that reality was an important consideration in all groups. Realism is defined as the extent to which the simulation or simulator appears, feels and/or behaves the same as the real-life system. Although similar definitions are used of fidelity, this term is avoided first because of the variation in the

Table 1 Dieckmann et al.'s three domains of realism

Realism Domain	Description
Physical	Can be measured, sensed; e.g. auscultatory heart sounds, vital signs on a chart
Semantic	Sequencing, timing, changes, roles and responsibilities consistent
Phenomenological	If the learner experience feels as it would in the real situation, stress, emotions, responses

numerous different definitions of use of the term,[9] and second, because it tends to be associated with simulations that involve technology and where low fidelity can imply lower realism or authenticity, when this is not necessarily the case. The term artificialness is used as the opposite of reality, in other words, the degree to which the look, feel, or behaviour of a simulation deviates from that of the real-life system, process or object.

The data revealed a great deal of subjective discussion about realism. There was contrast and contradiction in descriptions and narratives around realism. Artificialness or lack of realism was described in negative terms, in positive terms or in terms of tolerance of realism limitations. In order to give the reader insight into the qualitative data, a number of direct quotations are shown. For readers less familiar with qualitative methodology, the transcribing convention is shown in Table 2.

First, quotations are shown for negative value perceptions around physical realism. There were relatively few quotations about negative perceptions of physical realism, and most related to the use of part task trainers. There were no instances in the data where anaesthetic trainees mentioned physical realism as a negative perception.

> GPF14: It [part task trainer] *looked* nothing like an arm, it *felt* nothing like an arm, so it wasn't that great

> GPM2: I did a minor surgery course years ago which was using bits of plastic which weren't particularly good to be honest

> FY1F1: I suppose there's a limit to how realistic models can be

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Table 2 Transcribing convention

Standard English grammar and punctuation for clarity of reading

Comma or question mark used to enhance readability

Short drop of voice, full stop

Pause in brackets, 1 s [.], 3 s [. .]

Emphasized words are in italic type

Notes and comments to add explanation or clarity in brackets []

Direct participant quotations indicated by indented text

GP, general practitioner; AN, anaesthetist; FY1, first year foundation doctor; UG, undergraduate

Gender M/F

Second, quotations showing the lack of semantic realism as a negative feature for participants, are shown. For this theme, most of the quotations were from anaesthetic trainees and undergraduates, and related to complex immersive simulation experiences.

> ANF1: You get, the fidelity of it sometimes gets in the way of the learning [..] the blood pressure, the thing that's showing you the blood pressure is playing up or something and that can mess it up, [..] things that get in the way, like that kind of ruins it a bit you know if [..] you just have to pretend, like they go "right, right this is the real patient and this is the blood pressure" and things except for "if you're cannulating you get this arm out". *What*? You know you just, I realise that there are practical limitations and they're getting better and everything but little hitches like that or even the fact that when you pick up the phone and then you're told whenever you pick up the phone and you're dialling 2222 you say "2222" but you really dial 8911 or whatever, I mean I know that one's a particular one, you *cannot* have them really dialling 2222 I understand that, but these little things that are in the fidelity kind of emm can be a problem.

> ANM1: It's just quite *artificial* sometimes, you don't act the way you think you normally would act.

> ANF1: You've really got the real kit that [you] might use in real life, you're not pretending to put a cannula in, even that sort of stuff, the time-based stuff that that, eh often in the stuff when we can't really afford it, and we are just *pretending* [..] and it's not really a proper simulation, and you've just got a resus mannequin and then they say "right you've put a cannula in" and [..] you just say it and then it happens really quickly, so something that slows it down because in real life you actually get a lot of time to *think* in some ways, and then sometimes on simulator courses you don't because you don't have that time, you're putting the cannula in and that time that you're pre-oxygenating, they pretend you've pre-oxygenated in 20 seconds, whereas in *real life* you do it for 3 minutes and you time it and you do it *properly*. That kind of stuff. It's kind of important.

> ANM2: I think one of the limitations with the high fidelity though is you're working within an environment [with] people who you may have just met that morning [..] You're taking on roles that [are] not necessarily reflective on your normal day to day, for example, you could have someone else who's the same stage as you [a] doctor in anaesthetics who's taking on the role as your nurse or whatever, who then without meaning to will *assist* you in

ways that wouldn't be forthcoming if that event actually arose.

UGF2: But I mean there's been a few scenarios when maybe emm, they haven't quite been realistic, like well no that actually wouldn't happen, emm in kind of the real in the real world.

Third, phenomenological realism was interesting in that there was tolerance of artificialness, and a comparison of stress, competition and scrutiny in simulation with the stress of real clinical practice particularly in the emergency situation.

GPF4: You just don't get that adrenaline kick, you might get the embarrassment kick and that's akin to it but you don't get the adrenaline kick type of thing.

ANM4: I think from the sort of the realism point if you don't get sort of caught up in the fact that "Oh your patient's gonna die" you at least get caught up in the fact that there's an element of competition there [soft laughter from other interviewees] and so you want to do well so you know you, you the stress is still there from the aspect of your wanting to do well.

ANM4: It's a different kind of stress but it at least simulates it in some way.

Fourth, the lack of reality or artificialness of the situation was acknowledged as a specific positive value perception: hyper-realism. This is the concept that a simulation can be slowed down or speeded up in a way that can enhance learning, and also that in simulation, precisely because it is artificial, participants can deliberately choose to make mistakes, choose to do things incorrectly in order to explore the limits of a skill or procedure or to understand the consequences of mistake making and to create boundaries of where correct techniques becomes error. Examples are shown below.

GPF4: You can do what you *like* to these things but you can't really do that to a human.

GPF5: You could also practice doing it *badly*, you know putting it in the wrong, putting it in too *deeply* and stuff, which is not what you want to do.

GPF5: So you can pull the skin back and look and see where it ends up [laughs]. It's quite clever.

FY1F1: I think it's a good opportunity to [be able to go] through the technique very slowly and thoroughly and fully explore what indications and contraindications would be.

FY1F1: Because when there's a real person there [real clinical situation] you're obviously quite anxious to do it well but it's [simulation] an environment where you can identify the potential pitfalls and *actually* sometimes almost deliberately make mistakes to see why it is.

Finally, quotations are shown demonstrating tolerance of artificialness; the view that although one knows the simulation is not real, this did not actually matter as the educational outcomes or goals were achievable.

GPF4: Well I don't think you can do CPR on anything *other* than a mannequin

GPF14: Of course it doesn't feel anything like a real body and it doesn't have the same flexibility but it's a good idea for just giving you training; more the closest thing you're going to get.

ANM3: I think you have to accept the artificialness.

ANM4: Although yeah a lot of people say "well I'm never going to believe that that's really a patient" I'm not sure how much that truly matters.

UGF2: You just kind of have to emm go with it because it's not the real world is it, it's a simulation.

UGM1: The models that are used for PR exams, that sort of thing emm are obviously not quite as realistic, but practically you aren't ever going to be able to practice these things on real patients all the time so, it is an effective model but it's because it's the most effective model we've got sort of thing.

Discussion

From the quotations shown above, it can be seen that various levels or domains of realism are described. Although participants did not use a scholarly typology in their talk about realism, the types of realism described did align with the types of realism as discussed by Dieckmann et al.[6] The realism described was in terms of physical realism, whether the model or mannequin looked, felt or was empirically a close replication of the real thing. It can also be seen that the limitations of physical realism were accepted and tolerated as necessary, unavoidable, or even beneficial. It can also be inferred that as none of the anaesthetic participants mentioned limitations of physical realism that this feature is not important to this group. When participants went on to talk about semantic realism, this was different. It seems that semantic realism lapses are significantly less tolerated than physical reality breakdowns, and they were described in more negative terms.

It can be seen from the quotations above that general practitioners tended to emphasize the limitations of physical reality, whereas anaesthetists emphasized lack of semantic realism.

When considering artificiality or lack of realism, there was some tension and contradiction; in some circumstances the lack of realism was tolerated but in other circumstances, lack of realism was not tolerated by participants.

There was a negative value perception around realism as described above, but an acknowledgement of the lack of accessible, sustainable educational alternatives to gain the same skills or experience, particularly in rare and unusual emergency circumstances.

Using Tolkien's concepts of primary and secondary reality, it can be seen that the physical aspect of the primary reality was not important, but the physical limitations of the secondary reality were significant, in particular with reference to part task trainers. By and large, these limitations of realism were tolerated. In fact, sometimes artificiality in the secondary reality, hyper-reality, was considered beneficial. The results support the idea that internal consistency may be more important than greater degrees of realism.

Within the secondary reality, that is, the simulation, semantic realism issues were problematic for participants in immersive simulations. Typically issues around sequencing, timing of physiological changes, availability of help, and other people in team roles were not well tolerated.

Conclusions

This article argues that a theory of realism in SBE derived from the work of Dieckmann et al. and Tolkien can deepen our understanding of the complex issues in engaging with simulation as well as encouraging simulation designers and teachers to consider the semantical reality and the internal consistency of simulation as well as the physical constructs. Understanding of and attention to detail in creating internal consistency within the secondary reality and semantical realism may lead to more effective engagement and consequently better learning, as well as more cost-effective use of resources in simulation-based learning.

Acknowledgements

Conflict of interest

The author has no financial or personal conflict of interest.

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Appendix 2: Ethical Approval

School of Psychology

University of Dundee Research Ethics Committee

Lysa Owen,
Clinical Skills Centre,
Ninewells Hospital & Medical School,
Dundee,
DD1 9SY.

23 September 2011

Dear Dr Owen,

Application Number: UREC 11068

Title: Motivation and barriers to engagement with simulation based learning.

Your application has been reviewed by the University Research Ethics Committee, and there are no ethical concerns with the proposed research. I am pleased to confirm that the above application has now been approved.

You submitted the following documents:

1. Ethics Applcn form	2. consent
3. interview questionsF	4. participant InfoF
5. Proposal ethics	6. consen2t
7. participant Info2	8. Proposal ethics2

Yours sincerely,

Dr Peter Willatts
Chair, University of Dundee Research Ethics Committee

Appendix 3: Participant Information Sheet

PARTICIPANT INFORMATION SHEET

MOTIVATION AND BARRIERS TO ENGAGEMENT WITH SIMULATION BASED LEARNING

INVITATION TO TAKE PART IN A RESEARCH STUDY
You are invited to take part in a research study, which will be exploring the motivation and barriers to engagement with simulation based learning in medical education. This is a study to identify some of these features. The study is part of a professional doctorate within the Institute of health skills education and the School of Education and Social work.

PURPOSE OF THE RESEARCH STUDY
This study will identify motivating factors and perceived barriers to learner engagement with simulation based medical education.
Participation in this research would benefit simulation education as it will inform strategies for optimum engagement, and effective use of educational resources.

TIME COMMITMENT
If you agree to participate the study will require you to participate in a group interview which will last no longer than 30 minutes. Interviews will be audio recorded using a digital audio recording device. Participants who do not wish to be audiorecorded may participate in the study without audiorecording.

TERMINATION OF PARTICIPATION
Your participation in this study is entirely voluntary. You may decide to stop being a part of the research study at any time without explanation. You may decline any question or discussion point you do not wish to answer.

RISKS
There are no known risks to you in this study

CONFIDENTIALITY/ANONYMITY
The data we collect will not contain any personal information about you. Participants will be anonymised in all data, for example Participant number 1 etc. The interview data will use participant codes. The interview data will be kept as digital files or transcribed documents on a password protected computer, in a locked room at all times. Any associated written data will be stored in a locked filing cabinet. Only researchers directly involved in the study will have access to the data. Raw data may be made available for monitoring in relation to the professional doctorate degree only. Anonymised data may be used in quotations in the thesis or for peer reviewed journal publication.   The data will be destroyed 10 years after participation in the project.

FOR FURTHER INFORMATION ABOUT THIS RESEARCH STUDY
Lysa Owen will be glad to answer your questions about this study at any time.

You may contact her at l.e.owen@dundee.ac.uk   Phone: 01382 660111 ext 33937

Dr Lysa E.Owen

Clinical Skills Centre

Institute of Health Skills education

University of Dundee.Approval this research study has been granted by The Non-Clinical Research Ethics Committee of the University of Dundee.

Appendix 4: Consent Form

Motivation and barriers to engagement with simulation based learning
CONSENT FORM

NB   *This form must be completed and signed by the research subject in the presence of someone with knowledge of the research. This will be a member of the research team who will countersign the form as witness to the subject's signature.*

Please tick (✓) appropriate box

	Yes	No
Have you read and understood the subject information sheet?	☐	☐
Have you been given an opportunity to ask questions and further discuss this study?	☐	☐
Have you received satisfactory answers to all of your questions?	☐	☐
Have you now received enough information about this study	☐	☐

Who have you spoken to?   Dr/Mr/Mrs/Miss…………………………………....

	Yes	No
Do you understand that your participation is entirely voluntary?	☐	☐

Do you understand that you are free to withdraw from this study:

At any time?	☐	☐
Without having to give a reason for withdrawing?	☐	☐

Do you agree that your records in this research be made available for inspection by monitors from

the University of Dundee?	☐	☐
Do you agree to take part in this study?	☐	☐
Do you agree to audio recording of the interview?	☐	☐

 Signature………………………………………………   Date…………………….

Name in block letters…………………………………

Signature of person obtaining consent…………………
Block letters person obtaining consent………………..

Appendix 5: Interview Schedule

Interview questions

What is your experience of simulation based learning?

What is good about learning using simulation?

What is not so good?

Why did you participate/not participate in simulation based learning?

Did anything prevent you learning as much as you hoped?

What do you think may hinder some doctors from participating in this type of learning?