

Challenges in the Commencement of Consultant Surgical Practice: A Study of Threshold Concepts in Junior Cardiothoracic Surgeons

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Abstract

The transition from trainee to consultant cardiothoracic surgeon may be challenging. Curricula for cardiothoracic surgical training and for the professional development of cardiothoracic surgeons need to address the issues in transition that are the most difficult. This research used *threshold concepts* to identify the areas within this transition that are the most problematic. Semi-structured, in-depth, face-to-face, individual interviews were conducted with 13 junior cardiothoracic surgeons (in practice for ten years or less) who were purposively recruited. Transcripts were generated from the interviews and subjected to thematic analysis. Data was independently analysed by three researchers. Problematic areas in the transition to consultant practice included: (1) taking ultimate responsibility for patient care including clinical judgment, decision-making and unsupervised operating; (2) designing a career; (3) navigating new work environments; (4) managing relationships with colleagues, trainees and other team members; (5) managing technical challenges; (6) managing the previously unseen or unexpected; and (7) coping with adverse events. *Uncertainty* associated with each of these challenges was the most prominent threshold concept. Successfully addressing some or all of these problematic areas resulted in (8) change as a person or surgeon that positively influenced each individual's sense of worth and identity as a cardiothoracic surgeon. Despite the completion of surgical education and training, time and the passing of the Fellowship examination, significant challenges remain for individuals commencing cardiothoracic surgical practice. There exist further curricular opportunities for the education of senior trainees and for the professional development of junior consultant surgeons to assist in the negotiation of these challenges.

Keywords: cardiothoracic surgery; junior consultant surgeon; liminality; threshold concepts; uncertainty

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Introduction

The personal and professional development of a surgeon is characterised by the transition through a number of important stages: from medical student to pre-vocational doctor to surgical trainee and to practising consultant surgeon. During each stage, the individual experiences a new identity or sense of self where they begin to think and behave as a surgeon ([Land and Meyer 2011](#)). Failure to negotiate and overcome threshold concepts during each stage may impede learning and subsequent movement to the next stage. These can be significant challenges for newcomers (e.g. medical students, recent graduates, junior trainees and junior consultants) to each stage.

The construct of threshold concepts had its origins in higher education, with learning seen as intellectual understanding rather than being in a professional, practical context. Defining characteristics are that they be:

1. **Transformative** – resulting in a sudden or lengthy shift in perception of a subject or discipline; once mastered the threshold concept alters the learner's view of the discipline that is, an epistemological shift.
2. **Integrative** – exposing and bringing together previously unappreciated inter-relatedness within the discipline.
3. **Irreversible** – not being forgotten or unlearned unless via considerable effort.
4. **Bounded** – defining what is and what is not within a field or certain conceptual space; having a specific and limited purpose.
5. **Discursive** – using an enhanced and extended discipline-specific language in crossing a threshold.
6. **Reconstitutive** – altering a learner's subjectivity, sense of self or identity; that is, an ontological shift.
7. **Troublesome** – may appear counterintuitive, alien or incoherent to the learner, creating dissonance or disorientation for learners. ([Flanagan 2018](#))

[Meyer and Land \(2003\)](#) have drawn attention to the potential for the idea of threshold concepts to be applied to more practical disciplines. Within surgery, threshold concepts and troublesome knowledge have been addressed in paediatric surgery trainees ([Blackburn and Nestel 2014](#)), in vascular surgery residents ([Mitchell et al. 2011](#)), and in established practising surgeons ([Land and Meyer 2011](#)). We aimed to answer the following questions with respect to junior consultant cardiothoracic surgeons:

1. What are threshold concepts for cardiothoracic surgeons, especially in their transition to consultant practice?
2. How may these threshold concepts be negotiated and overcome?
3. How do these threshold concepts influence the acquisition of a cardiothoracic surgical identity?
4. What are the implications of these threshold concepts for the cardiothoracic surgical training curriculum or for the professional development of consultant cardiothoracic surgeons?

Methods

We adopted a constructivist qualitative approach using individual in-depth interviews to probe seldom mentioned threshold concepts in junior cardiothoracic surgeons. Purposive sampling was undertaken with each surgeon having been in practice for less than 10 years and working in Australia. The Royal Australasian College of Surgeons defines a *Younger Fellow* as one who has had their Fellowship for less than 10 years and thus this arbitrary cut-off time was chosen for participant recruitment in this study.

Interviews were conducted away from the workplace to allow privacy and confidentiality and to be free from interruptions. A semi-structured individual in-depth format was used to explore possible states of liminality in the transition to consultant practice (See [Box 1](#) for topics). The interviews were audio-recorded and transcribed, and participants were offered the opportunity for respondent validation. Audio-recordings were made by a professional research transcriber. All transcripts were checked against the audio-recordings and de-identified before analysis. The University of Melbourne Human Research Ethics Committee approved the study (Ref ID 1341342.1).

Box 1: Topics discussed at the interviews

1. Theoretical and practical knowledge
2. Technical skill
3. Clinical judgement
4. Uncertainty
5. Surgical complexity
6. Decision making
7. Un-supervised operating
8. Access to cases
9. Relationships with colleagues and trainees
10. Impact of adverse outcomes
11. Events leading to irreversible changes in behaviour, attitude, knowledge
12. Non-clinical tasks – administration, paperwork etc.
13. Setting up a practice
14. Acquisition of a cardiothoracic surgical identity

As data was acquired, an interim analysis was conducted, leading to sampling until saturation was achieved. Thematic analysis ([Braun and Clark 2006](#)) was performed independently by the three authors (JAS, SB, DN). Familiarisation with the transcripts to note the participants' initial ideas was followed by grouping of data into broad themes through open, inductive coding of potential threshold concepts. This first phase of analysis was undertaken independently as a means of surfacing interpretations from members of the research team who each brought different professional perspectives to the analysis. After sharing initial themes and agreeing a coding framework, JAS returned to each transcript, seeking the presence (or absence) of the codes and an opportunity to identify sub-themes. The final opportunity for analysis came in preparing this manuscript through the selection of vivid, compelling transcript examples, relating back to the research question and literature.

The research team comprised: JAS, a professor and very experienced cardiothoracic surgeon working in the Australian hospital system where the study was located; SB, a paediatric surgeon within the first five years of consultant practice in the National Health Service, England; and DN, a professor and surgical educator with experience of working in Hong Kong, London and Melbourne. DN is an experienced qualitative researcher. SB had recent experience of qualitative research, having undertaken a project that explored threshold concepts in paediatric trainees, and this was the first qualitative research project that JAS had led although he has had experience in others. JAS undertook each interview. While JAS was known to all interviewees, he was not involved in the recruitment process – to minimize any sense of coercion. DN, who had no direct relationship with any of the participants, sent emails and only made available to JAS the contact details of those who had agreed. Notes from interviews suggest that all participants fully engaged and there was no evidence that participants withheld information owing to experience and/or status differences between JAS and interviewees. All participants were very willing to share experiences of their practice that had caused difficulties for them, and appreciated the opportunity to have them heard.

Results

Participants

Nineteen junior cardiothoracic surgeons were invited via e-mail to participate in the study. Four did not respond to multiple e-mail requests, two declined to participate owing to a lack of time, and 13 accepted the invitation. Interviews were conducted between April and July 2014, and took between 45 and 90 minutes. The first two interviews (P01 and P02) constituted a pilot study, and these transcripts were analysed during May and June with the results used to further guide subsequent interviews (S01 to S11). We included the data from the two pilot interviews since no alterations were made to our research process (Morrison *et al.* 2016). All of the participants were male. Ages ranged from 37 to 52 years (mean of 43 years), and the duration of consultant cardiothoracic surgical practice (all in Australia) ranged from five months to nine years (median of three years). Four participants practised exclusively in the public sector, and nine had combined public and private sector practices.

Thematic analysis

By way of introduction, some quite strong statements were made concerning the commencement of consultant cardiothoracic surgery practice:

... I don't think anything quite prepares you for consultant life. (S05, p17)

The learning curve is so steep. (S04, p21)

It's not a pleasant transition because there's always a degree of uncertainty. (S09, p35)

Box 2 summarises the threshold concepts resulting from our analysis of data expressed as themes and sub-themes.

Box 2: Challenges in commencing consultant cardiothoracic surgical practice

- **Responsibility**
 - Clinical judgement and decision-making
 - Independent operating
 - Intra-operative decision-making
- **Career design**
- **New work environments**
 - Hospital
 - Cardiothoracic department
- **Relationships**
 - Senior surgical consultants and colleagues
 - Trainees (including surgical assistants)
 - Other team members
- **Technical challenges**
 - Speed of operating
 - Complexity
- **Managing the previously unseen or unexpected**
- **Coping with adverse events**
- **Change as a person or as a surgeon**

Responsibility

The stark reality of being directly responsible for a patient's welfare created a high level of anxiety for most of those interviewed:

... but then it seems that when you become a consultant, that a safety valve is not there anymore and you have to be responsible for everything. (S03, p9)

Certainly, as a first-year consultant it can be quite overwhelming, you realise quite quickly that the buck stops with you; and I found that very challenging myself. (S04, p2)

Particularly concerning was the responsibility of clinical judgment and decision-making especially with respect to deciding whether to actually operate upon a patient or not:

I think the most challenging aspects of your early stages as a consultant cardiac surgeon involve critical decision-making with regards to operative surgery. (P01, p2)

It is the unsupervised, if you like, decision-making that's the hardest thing. (S06, p18)

The responsibility of operating independently as a consultant surgeon was an immediate challenge and an individual's experience as a trainee or as a fellow strongly influenced their preparedness:

I thought before I start I was really afraid of that moment, because when you have your surgeon there, as a trainee or fellow you know you will be bailed out of the problem; because managing the patient on bypass can be very complex sometimes, and I didn't know how I will perform this. But surprisingly enough for myself, it all went quite all right. Maybe because in the training or in Fellowships, either I was enough the primary operator of many cases; it actually started surprisingly fine. (S08, p12)

Decision-making, during surgery, was especially difficult in the presence of mild to moderate pathology and in deciding on whether to operate in the first place. The majority of participants relied heavily on the advice and reassurance of other consultant colleagues or the department head to assist with challenging pre-operative, operative or post-operative decisions:

Very important that you have a person from whom you can take the advice, who you respect as a surgeon and who, in a way, is your mentor. (S09, p2)

I think you knew that somebody was there and at your back. I think that knowledge in itself was often probably more useful than necessarily having their support in theatre. (S07, p2)

There was the constant conflict between seeking additional assistance and pressing on regardless. The importance of having to eventually make these decisions themselves was often recognised:

I think for me it's a matter of sometimes, yeah, you do have to take a punt if there's a bit of uncertainty; you know what the odds are, and you take a punt. (S02, p8)

Career design

At an early stage, each new consultant had to decide what pattern of practice (public, private, combined public/private, part- or full-time academic) he wished to pursue:

Yeah, a career design threshold I've crossed, which I've made decisions about as well. That's definitely a practice threshold. (S02, p24&25)

These choices were frequently influenced by workforce issues and employment prospects. All participants had public hospital appointments but the preparation received for setting up of a private practice was quite limited:

Private practice, the college training prepared me for not one skerrick. (S06, p21)

Non-clinical tasks such as paperwork and administrative roles were variably time-consuming and burdensome. Clinical duties tended to dominate practice patterns in the early years with little time being devoted to teaching, research and administrative roles:

... because the clinical work takes a little bit longer and the practice management stuff takes a little bit longer, the teaching and research are what get left behind. (S10, p14)

Once the clinical aspects of cardiothoracic practice had been mastered there was a desire to pursue additional roles of teaching, research and administration with a willingness to eventually put back into cardiothoracic practice. It was evident at the early stage of their careers that the participants were heavily focused upon the clinical and technical components of their practice. First and foremost, they wished to be respected as a competent practitioner of their craft.

Relationships

A major challenge in taking on a consultant surgical role was in developing relationships as a more senior participant within the local community of cardiothoracic surgical practice such as with (1) senior surgical consultants and colleagues, (2) trainees (including surgical assistants), and (3) other team members. The weekend transition from being a registrar to being a consultant could place additional strain on these relationships:

I didn't want to be the registrar on a Friday and be the consultant on the Monday. So, when I came back I had a Fellowship, I'd been away, I had a Fellowship and came back; and so that meant there was a clear break and I came back as a consultant. (S02, p12)

The politics involved in developing these relationships could be particularly demanding and the participants were again poorly prepared to handle these political challenges:

I probably wasn't prepared for the politics ... And I think that politics was something that I wasn't expecting, and was challenging. (S05, p27&28)

So, you can't blame people who are established in the field to be less inviting, but that's what I think leads to a lot of the politics, and one of my favourite sayings is ... cardiac surgeons always look after each other - I stab your back, you stab mine. (S09, p22)

Having collegial relationships with an individual's senior consultants and peers contributed substantially to a successful transition into consultant practice. This made the seeking and reception of advice much less burdensome:

... and I think that was largely aided by the fact that I had immense support from the head of the unit when I started to work as a consultant. I didn't feel like I was sort of left alone. I had very strong support. (S07, p1&2)

The most difficult aspect in the relationship with trainees was in deciding if and when to delegate technical tasks to them during an operation:

If you were trained in the places where there is a culture of letting the registrars operate, you somehow unconsciously try to let them operate more. (S08, 1426)

The most out of depth I've been is, out of control I felt as being, trying to supervise some of our trainees and overseas Fellows to do cases. I don't know how you get prepared for that. That's been the hardest thing for me. (S06, p11)

Certainly, in the first few years I was very reluctant to delegate intraoperative work to trainees. I tended to do everything myself due to the fact that intraoperative aspects of the procedure if they're not done correctly can lead to significant morbidity for the patients. With time, I was able to comfortably delegate intraoperative aspects of the procedure to trainees, but only to trainees who I felt were competent. (S11, p11)

Surgical assistants play an important role in the conduct of major cardiothoracic surgical procedures. Having to rely upon trainees and other junior medical staff rather than experienced consultants as surgical assistants meant an altered operative approach was required. Patient outcomes in cardiothoracic surgery have been strongly dependent upon effective multi-disciplinary teamwork and the junior consultant must rapidly transition into a strong leadership role. A collegial relationship with all team members, especially within the intensive care unit, was essential.

Technical challenges

The earliest technical challenge for the junior surgeon was in deciding how to actually conduct a given procedure now that independent consultant practice had begun. This reality was driven home when the operating theatre nursing staff requested a list of preferences (instruments, sutures and other requirements) for the common cardiac and thoracic surgical procedures prior to the first operation being performed:

... the first adjustment I had to make really was when the nurses were asking me how I would do it ... the actual practicalities of writing my own preference book of the sutures that I'd like and how I do things; and the step-by-step process of even the most basic of operations. (S02, p2)

I was definitely a blend of all the surgeons I've worked with. (S02, p3)

The speed of operating, the timely completion of procedures and the public scrutiny of this was quite troublesome. Many were also troubled by the speed of operating especially in comparison with their more senior colleagues:

But I think you do get into a cycle where you do feel rushed, you do feel that people are, as I said, perhaps not cutting you the same amount of slack with respect to operating times, as they might some of your senior colleagues. (S05, p7&8)

Technical decision-making in the operating theatre could be troublesome especially with complex and potentially lengthy procedures such as re-operations, major aortic surgery, and emergency surgery. It was, therefore, essential to prepare well when tackling these procedures:

For the complex surgery, in my view the most important part is the pre-operative preparation, and to see what can go wrong and to have your plan A and B, number one, number two, to discuss things pre-operatively with the members of the team. (S08, p10)

... obviously when it comes to the more complex cases you go through in your mind in a dry run a couple of times, or I do, and I believe a lot of people do that as well too. (S03, p8)

Some participants were very careful with scheduling of cases and making sure experienced back-up was readily available. Seeking expert assistance from colleagues who provided advice, technical assistance or reassurance gave the surgeons confidence with which to overcome these challenges:

I've asked, I've had at least four other surgeons scrub in with me for operations in the last year. (S02, p9)

Successful completion of these operative tasks was extremely gratifying and generated enormous confidence:

So, I think that was an operation where I took a lot of strength. I was just saying, well, gee, if I can deal with this, there is probably not a huge amount that I can't deal with in terms of complexity of heart disease, in some ways. (S07, p17)

Managing the previously unseen or unexpected

All participants described having to deal with previously unseen or unexpected situations in the operating theatre. Careful preparation and having an effective management strategy assisted the surgeons in overcoming this challenge:

Certainly, there are operations that you do when you're a consultant, but which you've never done as a registrar. (S02, p7)

It was important to be prepared and to have a coping strategy which was frequently just adhering to basic principles:

... the importance is actually to be prepared for the unexpected ... to be able to foresee and address any issues that may interfere with the smooth operation. (S09, p3)

I thought how you can get a long way with a basic set of knowledge and skills. You just keep it really simple, and make very solid, good decisions. (S04, p16)

Seeking experienced assistance was critical in times of difficulty:

And the other thing, and it's not an exam answer, it's a real-life answer, in these situations you ask for help. (S09, p11)

It is very important to recognise that if something is wrong you do not continue but you need to get the senior colleague to come and give you a hand. (S08, p3)

Coping with adverse events

Adverse events (patient morbidity and mortality) are, owing to the high-risk nature of operating on the heart and lungs, regular occurrences in cardiothoracic surgery. The potential for these adverse events provided significant stress. However, surgeons always tried to avoid adverse events in the first place:

Well, as I said I had almost 14 years of training and exposure to more than 50 surgeons and a few very large institutions, and I've seen a lot of complications which helps me to avoid getting into those complications. (S11, p5)

The approach to the handling of adverse events depended on whether they were expected or unexpected:

But the ones that are most difficult to get over, and I think that even these days it would be hard to get over, is the ones that are perfectly normal, the elective cases that you didn't expect anything to go wrong and something goes wrong. (S03, p15)

The initial grief associated with an adverse event was often profound:

... you see it all through your training, but it sort of just bounces off you emotionally until it happens to you, and you almost need grief counselling for the next few days. (S04, p10)

The adverse outcomes traumatise you and they shake your confidence. (P02, p9)

The response to – and learning arising from – adverse events were greatly facilitated by discussions with colleagues, participation in mortality and morbidity meetings, and the contribution to surgical audits.

Change as a person or as a surgeon

Having faced and negotiated the challenges outlined above, the participants observed significant personal and professional changes that contributed to the acquisition of a cardiothoracic surgical identity. These changes tended to occur gradually over a period of time and were usually described as irreversible:

Well, I think I have moved on. I think I have an understanding now completely different from the beginning when I came out. I have matured. I have become more confident, comfortable dealing with a variety of routine or complex situations in cardiothoracic surgery. (S01, p18)

I can actually do this job, you know, maybe I am actually all right, you know, as a surgeon; and I guess it gives you some confidence. (S10, p12)

Successful patient outcomes and their affirmation also contributed to a positive sense of worth and identity as a cardiothoracic surgeon:

But at the end of the day the patient results speak for you. I mean, you don't need to tell how good you are or how bad you are; the patient in ICU, the patient performance, the patient outcome is the evidence. (S01, p5)

Patients speaking highly of you. Patients recommending you to their family members, I think more than anything else validates what I do. (S07, p20)

These changes tended to occur gradually. However, references to significant breakthrough moments were sometimes made and included: successful patient outcomes following complex (and indeed some simple) cardiac and thoracic surgical procedures; successful management of complex cases turned down by other more experienced surgeons; facing and coping with the stressors of responsibility; learning from adverse outcomes; negotiating the previously unseen, unexpected and unknown; and, realising the transition from an apprentice to a teacher.

A highly irreversible state exists following the meeting of the various challenges. This was emphasised by the participants responding as to whether they could return to the earliest days, weeks and months of their consultant practice:

No. I don't think you could. I honestly think your perspective changes very quickly once you've done this, so I'm convinced that you can't erase all this. (S07, p23)

No, I'm glad to have those behind me. Happy to leave that one behind. (S09, p35)

I don't think you could undo what you've learnt, yeah. I mean, you couldn't. The experiences that you have in the first few years that give you confidence, or give you learning, I don't think you can undo that. It's a one-way ticket. Nor would you want to. (S10, p17)

Discussion

The many challenges encountered upon commencing consultant cardiothoracic surgical practice have been revealed in this study. The successful negotiation of these challenges has resulted in a heightened sense of worth and the acquisition of a cardiothoracic surgical identity.

Threshold concepts in junior consultant cardiothoracic surgeons

Consistent with the only previous study of threshold concepts in practising consultant surgeons (Land and Meyer 2011), *uncertainty* has emerged as the major threshold concept in cardiothoracic surgeons in their transition to consultant practice. Uncertainty has been reflected in each of the eight major challenges described by the surgeons. This study also confirmed the suggestion by the same authors that the *speed of operating* and the *handling of surgical complexity* could be troublesome for surgeons. Additionally, we have identified *change* as a possible threshold concept.

Uncertainty

The characteristics of uncertainty as a threshold concept underpinned each of the challenges identified by the participants. There was uncertainty with respect to the responsibility of clinical judgement and decision-making, in career design, in coping with new work environments and their associated interpersonal relationships, in overcoming technical challenges especially those of the previously unseen or unexpected, and in coming to terms with adverse events.

In the operating theatre, uncertainty was characterised by the unpredictability and volatility of the surgery, the uncertainty of technical knowledge (see below) and occasionally the uncertainty of recognition (variant anatomy and tissues distorted by disease or previous surgery). The temporal urgency of handling operative uncertainty in real time was prominent. There was also the possibility of a low risk procedure becoming high risk owing to a technical or other mishap that presented a situation of “provoked liminality” (Meyer and Land 2005: 373) and the associated uncertainty of getting out of trouble.

The response to uncertainty in decision-making amongst these junior surgeons can be contrasted with that displayed by experienced surgeons (Cristancho, Apramian, *et al.* 2013). The junior surgeons rely very heavily on the advice of colleagues to aid their decision-making whereas the experienced surgeons, can (1) prioritise alternatives, (2) re-evaluate and adapt the plan, and (3) create innovative solutions. Advice was sought only as a last resort when these strategies were unsuccessful. A naturalistic model of intraoperative decision-making has been suggested to explain this difference (Cristancho, Vanstone, *et al.* 2013).

Change

Change has not previously been identified as a threshold concept in studies involving surgery. However, in this study, *troublesome change* during the commencement of practice was evident in the taking of additional responsibility for patient care, in designing a career, and particularly in managing a new work environment and the accompanying interpersonal relationships. A very practical aspect of troublesome change was the difficulty encountered in trying to introduce new technologies into a new work place.

Complexity

Complexity of a technical nature was a prominent threshold concept. Despite having the theoretical knowledge concerning the majority of cardiothoracic procedures, it was the uncertainty surrounding their previous technical experience and confidence to conduct the procedure that was most troublesome. All the characteristics of technical complexity as a threshold concept were clearly represented particularly being troublesome, transformative and highly reconstitutive once

the technical task had been successfully completed. A threshold of technical proficiency, “proficiency-gain curve” (Land and Meyer 2011: 91) was achieved with respect to each procedure as the surgeon moved through stages of greater complexity, uncertainty, risk, and challenge.

Complexity in the eyes of these junior surgeons was principally technical. However, it has been recently suggested that complexity for experienced surgeons extends beyond the procedural domain (Cristancho *et al.* 2014). Non-technical dimensions such as team dynamics, trust, emotions, and external pressures heightened the uncertainty associated with technical complexity. These elements are infrequently discussed, and learning how to deal with complexity through education is often by random opportunity. The participants mentioned the various relationship challenges which may have impacted upon their response to complex situations in cardiothoracic surgery.

Speed of operating

Related to technical complexity was the speed of operating. Satisfactory patient outcomes from cardiothoracic surgery, and in particular cardiac surgery, are reliant upon timely conduct of the operation. Technical speed, by virtue of its high visibility and potential for public scrutiny, was troublesome, transformative, and also highly reconstitutive once acceptable operating times were achieved. The other characteristics of threshold concepts (integrative, bounded, discursive, and irreversible) were present but to a lesser extent. Having an acceptable speed of operating was a major component of “measuring up” in cardiothoracic surgery (Jin *et al.* 2012: 989).

Negotiating threshold concepts in cardiothoracic surgery

In general, the threshold concepts and the associated challenges especially with respect to the actual conduct of cardiothoracic surgery were handled through having the requisite theoretical knowledge, preparing thoroughly for any challenging procedure, and by seeking the advice, assistance or reassurance of experienced surgical colleagues. The accumulation of experience and reflection upon this experience over time resulted in a successful transformation in learning. Some individual variation in how the threshold concepts were negotiated was demonstrated.

Uncertainty in the operating theatre

Faced with uncertainty in the operating theatre, the surgeons’ response was to slow down, move from a routine mode of practice to one that is more effortful, and to recruit additional cognitive resources in a fashion previously described by Moulton and others (Moulton *et al.* 2007). On occasions, they would un-scrub, phone a colleague for advice or request a colleague to come to the operating room to assist or take over. Factors influencing how they responded were both cognitive (e.g. cognitive heuristics, fatigue, and distractions) and sociocultural (e.g. surgical culture, socialisation, hidden curriculum). How the junior surgeons sat within the social context of the cardiothoracic team impacted upon their clinical judgement and the intra-operative decision-making (Jin *et al.* 2012). In this study, the positive relationship between the junior surgeon and his senior colleagues meant that there were few impediments in asking for help.

Effective socialisation within the cardiothoracic team, combined with the successful completion of a demanding technical task with a satisfactory patient outcome, provided the surgeons with a huge boost in confidence. The self-belief to complete a task generated further successes in a positive feedback loop of self-efficacy. A balance was eventually reached between their confidence, uncertainty, personal image, and technical performance (Jin *et al.* 2012).

The previously unseen or unexpected

The junior cardiothoracic surgeon is constantly challenged by the uncertainty associated with previously unseen or unexpected situations. Some of the strategies employed have been described above. The linking of threshold concepts with capability theory to create threshold

capabilities – the Threshold Capability Integrated Theoretical Framework (TCIF) (Baillie, Bowden, and Meyer 2013) – provides a framework for the design of a training programme aimed at preparing the surgeon to deal with previously unseen or unexpected circumstances. This theory recognises that, in experiencing variation, the surgeon develops the knowledge capability to deal with these circumstances. TCIF has not, to date, been applied in surgery but the findings of this study suggest significant appeal.

Adverse events

Surgical complications and poor patient outcomes provoked strong emotional responses from surgeons. Sensations of being traumatised and grief reactions were common. There was also significant cognitive rationalisation, especially when the adverse event was expected rather than unexpected. These experiences were troublesome, and were addressed through broad discourse with the cardiothoracic team and through being mostly reflective (productive learning) and occasionally defensive (unproductive learning).

Schwartzman (2010: 21), in proposing a theoretical foundation for threshold concepts, provides an explanation of these responses to adverse events as *rupture of the meaning frame* – “structures which embody the categories and rules that order new experience, shaping how we classify our encounters with the world: what we take in and how we act”. Learning fills the meaning frame with content, whereas troublesome knowledge represented by the adverse event cannot be assimilated by the meaning frame and leads to its rupture. A reflective response leads to reforming the meaning frame with transformative learning. A defensive response, however, preserves the existing meaning frame and no learning occurs from the adverse event (Schwartzman 2010). Fortunately, the participants in this study saw adverse events as a positive learning experience particularly in the context of discussions at morbidity and mortality meetings.

Liminality and the transition to consultant cardiothoracic surgical practice

The transitional phase within a threshold concept has been described as a state of *liminality* (Meyer and Land 2005). Drawn from ethnographic studies into social rituals such as rites of passage from adolescence to manhood, the term refers to the *betwixt and between* period during a transitional phase. There is an important transformative component in the acquisition of new knowledge and subsequently a new status and identity within a community. According to Goethe (2003), the transition may be troublesome and involve a major change in status:

In order to do so, he or she must strip away, or have stripped from them, the old identity. The period in which the individual is naked of self – neither fully in one category or another – is the liminal state. (Goethe, cited in Meyer and Land 2005: 376)

Meyer and Land note that the transformation is frequently protracted with considerable ebb and flow between states rather than being a strictly linear change. There may be period of *mimicry* of the new status until the transformation is complete after which there is no return to the pre-liminal state. Failure to progress leaves the individual in a *stuck place*. Epistemological obstacles may be removed through curricular design or re-design (Meyer and Land 2005).

Each participant reported challenges in the transition from trainee to consultant. This transition commenced with the satisfactory completion of training (by achieving the requisite competencies) and with passing the Fellowship exam. In preparing for consultant practice, the majority of participants spent one to three years in a local or international Fellowship position to provide them with additional experience prior to commencing as a consultant. Time spent in this pre-liminal space (Meyer and Land 2005) greatly assisted the participants in overcoming the uncertainty of responsibility (particularly in unsupervised operating) and of technical complexity.

Upon appointment as a consultant, a liminal space was entered and gradually traversed over several years. The anxiety and uncertainty of responsibility (particularly in decision-making),

technical complexity (including the speed of operating), their place in a new institution, and having adverse outcomes were overcome, and the consultants became confident, validated, and more secure in their role. Successful patient outcomes from complex technical procedures were a major contributor to this ontological shift. A pattern of oscillation provoked within a liminal state could occur even in the more experienced surgeons when previously unseen or unencountered technical complexities were faced.

The sense of achievement gained in the process of successfully addressing the challenges faced upon commencing consultant practice and finally passing through a state of liminality resulted in the acquisition of a positive cardiothoracic surgical identity. Multiple opportunities exist in cardiothoracic surgical training curriculum and in the professional development of practising cardiothoracic surgeons including focused workshops, simulation-based education, and mentoring programmes to address the threshold concepts and troublesome knowledge associated with the commencement of consultant practice.

Acquisition of a cardiothoracic surgical identity

Arising out of this liminal state was an identity as a practising cardiothoracic surgeon. Surgical trainees have been described as gaining a mature specialist identity through a process of reflection based upon their direct experiences. This requires an awareness of personal strengths and weaknesses, likes and dislikes, and professional aspirations. Aligning these reflections to the attributes of the specialty results in a mature picture of their professional aspirations. These doctors pass from being a pre-vocational doctor through a state of liminality to having a mature specialist identity ([Rees-Lee and O'Donoghue 2009](#)). Likewise, the transition from trainee to consultant is linked with the shift in identity from that of a mature specialist identity to one of a specialist practitioner through the liminal state described above.

A new cardiothoracic surgical identity was achieved in the operating theatre through successful, autonomous, unsupervised, and timely operating. The novice surgeon was placed in situations that pushed them into a more advanced stage of professional practice associated with a shift in confidence and a sense of worth within the community of cardiothoracic surgical practice. The journey through the various states of liminality is represented in [Figure 1](#).

Implications for cardiothoracic surgery education and practice

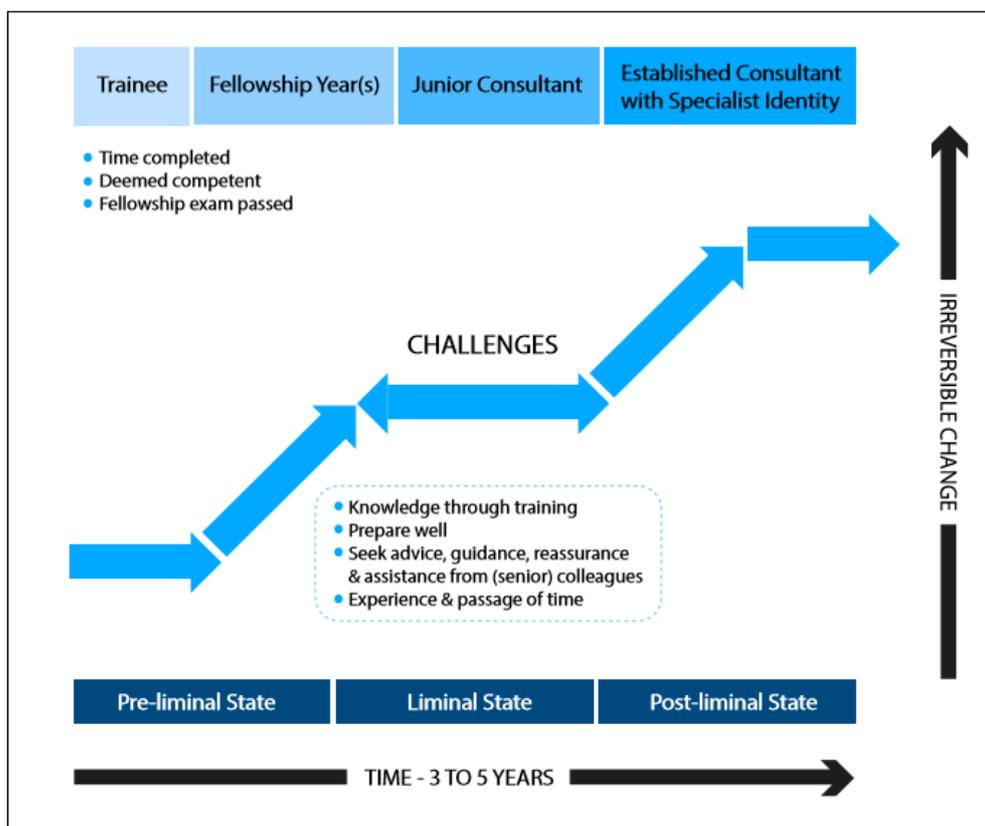
The uncertainty associated with the commencement of cardiothoracic surgical practice as revealed by this study, is seldom discussed either formally or informally by trainees or consultant surgeons. Each of the eight challenges could serve as a curriculum target within cardiothoracic surgical education. Workshops covering cardiothoracic surgical decision-making, the various relationships in new work environments, and handling the emotional impact of adverse events, for example, would be welcome. Robust discussion of these issues amongst senior trainees and junior consultants within cardiothoracic surgery and across other specialties would highlight many of the unseen or unspoken issues. Some of the transcripts analysed in this study could form part of the educational materials for these workshops.

E-learning ([Evgeniou and Loizou 2012](#)) and simulation-based education ([Kneebone 2009](#)) have been proposed as aids to the teaching and assessment of approaches to dealing with threshold concepts, particularly in learning to manage uncertainty. [Kneebone \(2009\)](#) emphasised that the complexities of handling uncertainty must not be oversimplified during the simulated experience. In addition, it has been recognised that more senior surgeons soon forget the uncertainty and troublesomeness associated with commencing practice; and simulated activities that have an “expert centred focus with a learner centred perspective” could reconnect them with the transformative process being experienced by their junior colleagues ([Kneebone 2009: 1337](#)).

Once in practice, the junior cardiothoracic surgeons paid tribute to the advice, assistance, and reassurance provided by their more senior colleagues. It is likely that a more formal mentoring

programme might further enhance the interaction between junior and senior cardiothoracic surgeons.

Figure 1: Threshold concepts in commencing consultant cardiothoracic surgical practice



Strengths and limitations of the study

A study of this kind has not previously been undertaken in a group of consultant surgeons commencing practice. The rich real-world experiences of these surgeons commencing practice in a technically demanding, high-stakes specialty has been described through individual interviews. Threshold concepts have been described through the lens of the highly practical and performance-based discipline of cardiothoracic surgery as compared to many of the more theoretical studies previously conducted within higher education. We sought to increase trustworthiness in the study considering three of Guba’s four constructs (Guba 1981) as described by Shenton (Shenton 2004). *Credibility* was achieved through the appropriateness of the interview format, topic guide, selection of participants, respondent validation, experience of the interviewer truly familiar with the world of the participants, and our research team’s reflexivity. *Dependability* was achieved through our breadth of interviewees and our analytic process. We suspect we would generate a similar dataset if the interviews were repeated although these were undertaken in a specific time and place. We took some steps towards achieving *confirmability* through the reflexivity of our team. Our different experiences likely added balance to the interpretation of data. At times, the surgeon researchers made different analytic judgements from the education researcher; the latter helped to make sure interpretations were derived from the data. However, there are some limitations of the study. No female cardiothoracic surgeons were included and therefore gender-specific challenges, such as bearing children, and their impact on practice were not directly considered. There was an even distribution of participants from five months to nine years after commencing practice. However, the most junior participants were still *work in progress* as they had not fully experienced all the challenges, and the most senior participants were to

some extent relying on memory recall of the challenges in their younger years. The most informative participants were those between two and five years into their practice. Only the consultants' perceptions have been described. It may have been prudent to interview other peers and near-peers, conduct focus groups, and also observations, but each of these was deemed impractical. There was also no discussion from the participants of work-life balance being a challenge at the commencement of practice. It was likely that the young surgeons elected to work very hard in order to establish their careers as quickly as possible. There was also no mention of financial challenges as a result of carrying debt acquired during training or the Fellowship years into consultant practice.

Conclusion

We identified eight challenges in the transition from trainee to consultant cardiothoracic surgeon. The notion of threshold concepts has not been extensively applied within the discipline of surgery. Although rewarding, the commencement of consultant practice can be a particularly challenging time for cardiothoracic surgeons. The uncertainty associated with these challenges can be met and overcome by passing through a state of liminality to achieve a sense of worth and a positive identity as a cardiothoracic surgeon.

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