

The Impact of Complications and Errors on Surgeons

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## Dedication

**This thesis is dedicated to my magnificent parents ~ Laura and Martin Withers (DFC)**

For their endless love, support, and encouragement.

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# **The Impact of Complications and Errors on Surgeons**

Catherine Alice Fleming

## **Abstract**

### **Background**

Adverse events within the context of healthcare can lead to significant physician psychological distress. Contemporary research links the experience of adverse events to the prevalence of burnout, depression, and impaired quality of life. Most of the prevailing literature focuses on the impact of adverse events on all healthcare professionals. This PhD thesis recognises that some aspects of medical practice are exclusive to surgery, and the role of the surgeon. Therefore, this research investigates the unique impact of adverse events on surgeons. Furthermore, sub-types of adverse event (complication vs error) experienced within healthcare are often conflated within the literature, with very little differentiation made between a recognised complication of a surgery, and an error made by the surgeon. This research comprises a quantitative study exploring the impact of complications and errors on surgeons: Exploring the effect of type of adverse event on psychological outcomes and providing insight into the experience of surgeons following an adverse event, using surgeon responses to standardised measures to establish predictive statistical models.

### **Methods**

UK Surgeons were invited to participate in an online survey. An opportunistic sampling strategy was used, involving organisations such as the Royal College of Surgeons of England and appeals at surgeons' conferences and events. A single-factor (event: error or complication) between-groups design was used. Demographic and professional information, such as current grade and surgical specialty was collected. A detailed account of the nominated adverse event and the impact that this had on them in both a professional and personal capacity was then gathered. Standardised measures utilised within the survey, included the Work-related Acceptance and Action Questionnaire (WAAQ), the Primary Care

PTSD Screen (PC-PTSD), the Brief Resilience Scale (BRS), the 21 item Depression, Anxiety and Stress Scale (DASS-21) and the Big Five Inventory personality measure (BFI).

## **Results**

445 surgeons completed the online survey. The extent to which surgeons are negatively affected by adverse events is significant. The data demonstrates that surgeons are negatively affected by adverse events, but do not possess the adaptive coping strategies to deal with them effectively.

Confirmatory factor analysis confirmed five input variables within the model: event type (complication or error), nature of event (emergency or elective), severity of patient outcome (categorised by Clavien-Dindo score), timeframe of event occurring, and formal investigation. SEM identified three observed variables; feelings, PTS symptomology and worry about colleagues. The relationships between the input and observed variables were found to be moderated by training and personality factors and were mediated by resilience and psychological flexibility.

## **Conclusion**

Prior to this research, it was unclear how surgeons were psychologically affected when they experienced an adverse surgical event. This gap within our understanding meant that any training, support, or intervention strategies would be unlikely to meet the specific needs of surgeons who were negatively affected. Given the mediating effects of resilience and psychological flexibility against negative outcomes, strategies should be incorporated to maximise these traits within surgeons. The findings from this research support targeted interventions focussing on the development of individual resilience and psychological flexibility. The need for changes to surgical culture are addressed, and recommendations are made to ensure that training, interventions, and support pathways within surgical training and the wider NHS are fit for purpose.

## **Thesis related publications and presentations**

### **Invited talks**

Wessex Surgical conference - 28.1.16

Oxford University Grand Round (John Radcliffe Hospital) - 2nd December 2016

COPMRE visiting faculty day - 24th January 2017

RCS England Surgeon Educators Day - 17th March 2017

RCS England Never Events Workshop - 7th April 2017

Bournemouth University Surgeon Wellbeing Conference - 8th September 2017

Operating with Feeling - Royal College of Surgeons England - 1st June 2018

### **Conference presentations**

EAPH Conference Paris - 24th - 25th April 2017

Wounded Healer Conference – 4<sup>th</sup> October 2018

### **Poster**

RCS England Surgeon Educator Day - 20.5.16: Poster

### **Related publications**

Turner, K., Johnson, C., Thomas, K., Bolderston, H., & McDougall, S. (2016). The impact of complications and errors on surgeons. *The Bulletin of the Royal College of Surgeons of England*, 98(9), 404-407.

Turner, K., Bolderston, H., Thomas, K., Greville-Harris, M., Withers, C., & McDougall, S. (2022). Impact of adverse events on surgeons. *British Journal of Surgery*.

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## The impact of complications and errors on surgeons

### 1. Introduction

“Doctors should learn from, not fear, mistakes” – Jeremy Hunt, 2018

The Health Secretary of February 2018, Jeremy Hunt, stated that ‘Doctors should learn from, not fear, mistakes’ (Lay, 2018). Yet, when mistakes have very negative outcomes, directly affecting the quality of life of others, it could be argued that these are only made by ‘bad doctors’ (Lawton et al., 2019) and are unacceptable acts that should be met with investigative, if not punitive, action. This raises the questions of what is meant by the term ‘mistake’? When does a mistake, or lapse of judgement, become gross negligence? How is it determined that it was an individual’s lack of care or reckless disregard that caused any negative outcomes? These questions are important as much research investigating the impact of adverse events within healthcare conflates avoidable mistakes and errors with complications that are ubiquitous within healthcare. Two well-publicised cases within the last decade show how difficult these questions can be to answer.

In 2013 David Sellu, a consultant colorectal surgeon, was convicted of gross negligence manslaughter following the death of a patient in his care. Sellu served 15 months of a two-and-a-half-year sentence before having his conviction quashed in the court of appeal in 2016, due to the trial judge’s direction to the jury regarding the nature of the crime having been deemed inadequate (Dyer, 2016).

In 2015, a conviction of gross negligence manslaughter was issued to Dr Hadiza Bawa-Garba, a trainee paediatrician (Specialist Trainee in year 6 of training pathway (ST6)) following the death of a six-year-old boy, for whom she was responsible. Following 24

months suspended sentence, the General Medical Council (GMC) initially removed Dr Bawa-Garba permanently from the medical register in 2018 for her ‘lapse of judgement’, before an appeal concluding in 2019 saw her reinstated.

Whilst these specific cases have gained much media attention, they are not the only cases in which healthcare professionals have been faced with disciplinary action or even criminal charges following the occurrence of an adverse event. Between 2010 and 2013 there was a 64% rise in the number of complaints received by the GMC from patients regarding the treatment they received (O’Dowd, 2015). Such complaints have been linked with a decrease in physician psychological wellbeing as well as an increase in defensive practice behaviours such as performing more tests than necessary, over-referral and overprescribing as well as avoiding procedures, not accepting high-risk patients or abandoning procedures early (Bourne et al., 2017).

Despite the Health Secretary’s 2018 sentiment that doctors should utilise mistakes as learning opportunities, research indicates that experience of an adverse event has a detrimental effect on the psychological state of physicians (Pinto et al., 2013; Seys & Wu, 2012; Shanafelt, 2009; West et al., 2006). For example, Pinto et al. (2013) found that surgeons were seriously affected by major surgical complications and that this was moderated by factors such as the preventability of the complications, their personality and experience, and patient outcomes, as well as colleagues' reactions and the general culture of the institution. When harm is caused by the action (e.g., wrong site surgery) or inaction (e.g., failure to correctly diagnose or order tests) of a physician, it is vital that the needs of the patient are appropriately managed and, if possible, any anguish – either physical or psychological – rectified. However, the needs of the physician following such events are often unmet or overlooked, with many becoming the inadvertent ‘second victim’ of the adverse event (Wu, 2000).



### **Adverse events in surgery**

A scoping review of 25 studies conducted across 27 countries examined the prevalence of adverse events within a hospital setting (Schwendimann et al., 2018). The findings indicated that 10% of patients were affected by at least one adverse event, 7.3% of which were fatal in nature. Within the study it was revealed that adverse events were mostly of surgical, medication, or infection origin, and it was concluded that between 34.3 and 83% of adverse events were considered to have been preventable, such as avoidable operative events, medication or drug/fluid related events, and healthcare-associated infections. A separate systematic review of 14 retrospective studies analysing patient records (n=16424) from 9 countries, quantified the prevalence of adverse events specifically associated with surgery (Anderson et al., 2013). The study concluded that 14.4% of surgical patients experienced at least one adverse event, although most events were minor (40.5%) or moderate (35.3%) in nature. Through extrapolation of the findings, the prevalence rate makes it seem likely that most surgeons will experience an adverse event throughout the duration of their career. The issue of supporting surgeons following adverse events, to reduce impact on both the surgeon and the service they continue to provide, is therefore a healthcare-wide issue.

It is so far unclear as to whether surgeons are disproportionately affected by such occurrences in comparison with other healthcare workers, as most research considers doctors and other healthcare professionals as one homogenous group (Thomas et al., 2003). The present research, which treats surgeons as a discreet group of individuals, will allow for future comparisons to be made between different healthcare working roles. The effect for surgeons, whether a heightened sensitivity to such events, or conversely a desensitisation, will therefore be investigated within the research.

## **The effects of adverse events on surgeons**

Some investigation has been conducted into the impact of adverse outcomes on healthcare professionals and physicians within a UK setting (Harrison et al., 2014; Strobl et al., 2014; Bourne et al., 2017; Biggs et al., 2020). However, there are few studies which have conducted a systematic and in-depth quantitative analysis of the psychological impact of adverse events within a purely surgical population. Most research into the effect of adverse events on surgeons has been conducted in the USA, a country with a medical culture markedly different from that of the UK (Kossarova et al., 2015). For example, West et al. (2006) examined the impact of errors on a large sample of hospital residents in North America. They showed that self-perceived medical errors were associated with increased symptoms of depression, burnout, suicidal ideation and decreased quality of life (see also Shanafelt et al., 2012; Fahrenkopf et al., 2008). Self-blame was common, with most respondents attributing errors to an ‘individual level factor’ rather than to a ‘system issue’ (West et al., 2006).

In a UK study, Pinto et al. (2013), interviewed 27 surgeons about the impact of adverse events and found that many of the effects reported by surgeons within the sample were serious and could result in a detrimental impact on subsequent patient care. They concluded that there was a need for future quantitative studies to provide larger scale data to help identify the impact of adverse events on surgeons and to consider how to improve support for surgeons. Following this study, more research has been conducted into the impact of adverse events on the wellbeing of surgeons within an NHS setting (Pinto et al., 2014; Strobl et al., 2014; Orri et al., 2015; Bunni, 2017; Chan et al., 2017; Thompson et al., 2017; Mobilio & Moulton, 2018; Biggs et al., 2020). This present research will build upon their findings and fill in gaps within the current research within an NHS setting.

Biggs et al. (2020) investigated the impact of adverse surgical events on general, gastrointestinal, hepato-pancreato-biliary (HPB) and vascular surgeons by means of an online

survey. 95% of participants responded that their work life and practice had been affected by a serious complication, with 54% stating that this had also negatively impacted their life outside of work. The researchers state that most surgeons involved in serious complications are adversely affected, with specific mention of an institutional blame culture meaning that those involved in the management of surgical services need to improve both the culture of institutions and the support offered to surgeons following such events. With most surgeons reporting an impact on their professional or personal lives following an adverse event, more research is required to fully investigate the extent to which these impact surgeons, and the factors which contribute to both the negative and protective aspects of such an experience.

The present research examines the effects of adverse events on surgeons' wellbeing to establish an understanding of how surgeons are affected and the ways in which they may best be supported following the experience of an adverse event. A large-scale online survey (examining; mental health and wellbeing, support and coping and surgeon personality and psychological characteristics) provides quantitative data to offer clarity on how surgeons experience both complications and errors and the impact that these adverse events have on their working and personal lives.

### **Adverse events: Complications or errors?**

As well as research grouping different roles within healthcare into one homogenous group (as continues to be the case within this research's literature considerations in which the terms 'physician' or 'healthcare worker' are used), much of the literature to date has approached all adverse events as similar incidents, regardless of cause or outcome (Adedeji et al., 2009; Anderson & Wearne, 2007; Biggs et al., 2020; Chan et al., 2017; Delbanco & Bell, 2007; Pinto et al., 2013; Pinto et al., 2014). This approach risks overlooking key insights into the psychological effect of different categories, types, or outcomes of adverse events.

Although often conflated, working definitions found in some literature delineates between the two: errors are typically referred to in the literature as preventable adverse events arising from shortfalls in the standard of care expected (Brennan et al., 1991) whereas complications are an acknowledged risk of surgical care or procedures (Veen et al., 1999; Healey et al., 2002), yet much of the existing literature either unwittingly - or deliberately - conflates the two (Adedeji et al., 2009; Anderson & Wearne, 2007; Biggs et al., 2020; Chan et al., 2017; Delbanco & Bell, 2007; Pinto et al., 2013; Pinto et al., 2014). This causes issues within the literature as it is dealing with a wide range of different experiences and their subsequent psychological impact they may have. There is the potential that the term 'adverse events', without further delineation into more defined categories which consider cause or patient outcome, is diluting or skewing the research findings.

The aim of this research is to therefore provide clarity surrounding this issue. To clearly distinguish surgeons as a distinct group, separate from the rest of the healthcare/physician community, and to examine different types of adverse events as discreet entities, with individual contributing factors and outcomes. This research hypothesises that as a group, surgeons might be affected differently by an error compared to a complication. That there are factors specific to the event itself which must be considered to predict or determine the psychological outcome of the surgeon.

## **Consent**

Before surgical procedures, informed consent is obtained from patients, during which they are informed of any potential risk factors or complications. The consenting process has been a legal requirement for all surgical procedures in the UK since 2001, and current guidance states that the person obtaining consent must either be capable of performing the procedure themselves or have received specific specialist training in advising patients about the procedure (Department of Health and Social Care, 2009). Informed consent requires that the patient is given sufficient information about the surgical procedure so that they may make their own, informed decision about whether to go ahead.

It is expected that any complication likely to occur more than 1% of the time is mentioned within the consenting conversation (Anderson & Wearne, 2007). Such complications range from minor negative outcomes ubiquitous with certain surgical procedures, such as pain, bruising, swelling etc. through to much more serious outcomes, ranging up to and including death depending on the procedure.

Given the wide-ranging nature of surgical complications (Dindo, 2014), patients may not necessarily be aware of, nor experience long term physiological or psychological trauma from being involved in an adverse surgical event. However, for the surgeon, who has far higher levels of exposure to such events as they occur during their working life, it is unknown the degree to which they are psychologically affected by inflicting harm on patients, whether this was a preventable occurrence or not. For those who base a career on doing no harm, does the high prevalence of adverse events in surgery take a psychological toll?

The consenting process is thought to be used by some surgeons to indemnify against any negative outcomes resulting from the surgical procedure, (Jones et al., 2007), reducing the personal burden on the individual surgeon (Bognár, 2008). With surgeons including

preventable adverse events within the consenting process due to their high prevalence breaching the 1% occurrence rate. This may be a protective behaviour adopted by some surgeons (Clarke, 2006), but it also contributes to the general conflation that exists within the literature and surgical communities of the terms 'complication' and 'error'. Therefore, the terminology surrounding adverse events, specifically the classification of a complication or an error, has been carefully considered, communicated, and shared with participants throughout this research.

### **Surgeons: Second victims or resilient individuals?**

Much of the research within this area has considered physicians as one homogenous group. For example, the “To Err is Human” report (Donaldson et al., 2000) called for a systemic effort to make health care safer yet did not distinguish between different groups and roles within a healthcare setting. This is a cause for concern as there are obvious distinctions between different specialties and subspecialties that would bring this kind of generalisation into question (Reed et al., 2010). Within the field of surgery, there are many aspects of practice that are not present within many of the other areas of medicine (Leach et al., 2011). Behaviours such as risk taking and rapid decision making, along with a larger emphasis on practical procedures and a perceived individual responsibility for outcomes are all examples of this. There are compelling reasons then, to focus specifically on the impact of adverse events on surgeons. There are also significant differences between surgical specialties and therefore this will be considered when interpreting the data.

#### **Second victims**

There are currently two dichotomous views put forward in the literature with respect to the effects of adverse events on surgeons; one which emphasises the difficulties surgeons experience as a result of adverse events – that they are the ‘second victims’ when things go wrong (Wu, 2000; Delbanco & Bell, 2007; Scott et al., 2009; Seys et al., 2012; McCay & Wu, 2012) and another which emphasises the resilience innately possessed by surgeons that allows them to successfully deal with these events (Borges & Osmon, 2001; Pegrum & Pearce, 2015). While there are often standard protocols in place regarding how to manage patients and families, it is far less clear how, and to what extent, surgeons need support (Kronman et al., 2011; Wu & Steckleberg, 2012). It is therefore clear that more research is required to provide clarity regarding the types of provision needed to safeguard surgeons’ welfare following their experience of an adverse event.

Those who take the view of surgeons as victims report that the experience of adverse events can have a negative effect on mental health and wellbeing (West et al., 2006; Fahrenkopf et al., 2008; Scott et al., 2009; Shanafelt et al., 2009). Research indicates that surgeons are more likely to be burned out, screen positive for symptoms of depression, and have quality of life well below the population norm (Shanafelt, 2009). The limited evidence available to date suggests that the high-pressure work environment in which individuals are exhibiting such levels of burnout and depression is leading to more mistakes being made. For example, depressed surgical residents were found to make over 6 times as many medication errors as those who were not depressed (Fahrenkopf, 2008), while in other research the number of errors reported were correlated with depression, burnout, lower quality of life and emotional exhaustion (West et al., 2006). Indicating that surgeons are not only personally affected by adverse events, but that they have a demonstrable effect on the service and patient safety.

A systematic review examining the consequences of patient complications on surgeon wellbeing (Srinivasa et al., 2019) examined 9 studies that had been conducted within both the UK and USA. The review findings support the concept of surgeons as ‘victims’ of adverse events; suggesting that complications affect surgeons across multiple domains; adversely affecting surgeons’ psychological well-being across many facets of their professional and personal lives.

These findings build upon research that suggested that the impact of errors on surgeons may in fact be considerable (Seys & Wu, 2012). The review of the literature found that the prevalence of physician second victims following adverse events varied from 10% to over 40%. Such ‘victims’ reported strong negative affect, including anger, irritation, sadness, depression, self-doubt, shame, and self-blame. However, as with many studies within this field, the review encompassed all medical professions, and the results are



therefore not surgeon specific. In addition, the terms on which searches were made of research databases were negative response biased (e.g. ‘medical error’ ‘burnout’ ‘depression’ ‘empathy’). Of the 32 studies included, the majority were from relatively small samples and 15 studies were qualitative rather than quantitative – further limiting their generalisability. Finally, the precise definition of a ‘second victim’ remains unclear and is predominantly based on the assumption that individuals have actively made a major error to which they attribute personal blame. Within this present research the terminology used will be clear and precise to be sure to avoid similar pitfalls and provide a clearer picture of the impact on surgeons within the UK.

### **Resilient individuals**

In sharp contrast to the ‘second victim’ literature, other research suggests that, as a group, surgeons may have some degree of stress immunity (Borges & Osmon, 2001; Pegrum & Pearce, 2015). A study examining personality differences between medical specialties found that surgeons scored more highly on a tough-mindedness scale, indicating that they were less likely to be distracted by emotions when problem-solving than other physician communities (Borges & Osmon, 2001). Similarly, Pegrum and Pearce (2015) found significantly higher levels of stress immunity for physicians when compared against the population norms, the research attributed this to surgeons having increased psychiatric tendencies when compared with the general population. Pegrum and Pearce concluded that “the prevalence of stress immunity as the overriding personality trait in consultants may better facilitate patient care” (p.334). Such a positive or protective perspective is missing in the ‘second victim’ literature and suggests that a more balanced approach is warranted in which individual differences in both protective psychological traits and the tendency to experience difficulties in the face of adverse events are examined.

If some surgeons do have protective traits that enable them to avoid the negative effects of adverse events, then it may be possible to isolate the factors responsible for this. By identifying these it would then be possible to create a model outlining the ways in which surgeons are affected, and the domains that may be manipulated or strengthened through interventions or training which support surgeons and protect them from harm. Such a model would need to highlight moderating and mediating factors responsible for the variance between surgeons. However, it could then be utilised to inform training and support pathways to meet the specific needs of surgeons within the NHS.

## **Research outline**

The survey reported in this thesis examines the possible deleterious effects of adverse events on surgeons, as well as the possibility that they may be in some way innately protected, whether by developing higher levels of protective psychological mechanisms or traits or by adopting effective coping strategies that allow them to flourish under difficult and psychologically taxing circumstances.

Psychometric tests such as the 21 item Depression, Anxiety and Stress Scale (DASS-21) (Henry & Crawford, 2005) and Primary Care PTSD scale (PC-PTSD) (Cameron & Gusman, 2003). were utilised to assess aspects of psychological distress and the Copenhagen Burnout Inventory (CBI) (Kristensen et al., 2005) measured to assess levels of burnout. The inclusion of such measures will give an understanding of surgeon psychological distress and will enable a comparison between sample scores and the general population. The Brief Resilience Scale (BRS) (Smith et al., 2008) and Big Five Personality Inventory (BFI) (John et al., 1991) were included within the survey to give an indication of the participant's characteristics that may be specific to the surgeon population or moderate the negative impact of adverse events. Participants' levels of psychological flexibility were examined within this research by the inclusion of the work-related acceptance and action questionnaire (WAAQ) within the survey (Bond et al., 2008). Although not yet examined within surgeons, is a process that has been shown to be a key predictor of positive mental health in the workplace, as well as improving behavioural effectiveness.

The inclusion of these measures made it possible to take a broader view of surgeons' wellbeing than hitherto investigated. This novel approach will not only allow for a descriptive analysis of the impact of adverse events on surgeons, but also for moderation and mediation analysis and statistical modelling, of which there is a paucity within this research area. Each measure included within the survey will be discussed at length in future chapters.

## **The impact of Covid-19**

The events of 2020 onwards have placed even more pressure on healthcare and healthcare providers (Tsamakis et al., 2020). The novel Coronavirus disease 2019 (COVID-19) pandemic has stretched healthcare workers across the world to their maximum capacity, in both a physiological and psychological sense (Spoorthy et al., 2020). Greenberg et al. (2020) refer to the moral injuries healthcare workers have experienced throughout this pandemic, which they define as the psychological stressors which are a result of actions, or inactions, which violate someone's moral or ethical code (Litz et al., 2009). This extra burden of moral injury when harm is caused has a direct effect on the wellbeing of the healthcare worker. A unique aspect of the pandemic experience being that many healthcare workers, including surgeons, have been exposed to new duties outside of their typical job roles. With many surgeons finding themselves removed from their operating environment and redeployed to work within a Covid Intensive Care Unit (ICU) setting, being tasked with responsibilities that fall outside of their general competencies (Carnduff & Place, 2022).

Psychological problems have been found to be pervasive among healthcare workers during the COVID-19 pandemic. When compared against healthcare workers who did not participate in front-line work, front-line healthcare workers had a higher risk of anxiety, insomnia, and overall psychological problems (Que et al., 2020). Experiencing negative events and participating in front-line work appear to be important risk factors for psychological problems, with evidence from prior research suggesting a reciprocal cycle of outcomes - negative experiences leading to personal distress and decreased empathy, which in turn are associated with a higher likelihood of errors made, which leads to subsequent harm being caused to patients (West et al., 2006). Thus, the possible experience of moral injury is exacerbated, and the cycle continues.

Research by Boluarte (2009) highlights that this reciprocal cycle of error involvement and personal distress is not a new phenomenon, nor is it unique to healthcare during a pandemic. The findings of their study demonstrate that experience of self-perceived ‘major errors’ significantly associated with decreased quality of life, higher levels of burnout, and psychological stressors such as clinical depression. Findings demonstrated a significant association between distress and a self-perceived error in the following 3 months – for example, a 1-point increase within a domain of burnout was associated with a 10% increase in the probability of reporting an error within the next 3 months. These findings suggest that there is a cycle of behaviours that cause distress to physicians and subsequent harm to patients, that needs to be addressed to ensure a mentally healthy workforce and patient safety.

For future research to analyse the impact of the pandemic on physicians, there must be an established baseline understanding of wellbeing in response to the general sequelae faced within their typical working lives. Whilst prior research has established this for physicians and healthcare workers generally, (Delbanco & Bell, 2007; Devencenzi & O’Keefe, 2006; Giannetti, 2003; Regehr et al. 2002; Wu, 2000), there is a paucity of research into this phenomenon within an NHS and, more specifically, a surgical setting. This research offers such a perspective, which will enable future researchers to specifically analyse the impact of the pandemic and post Covid 19 wellbeing with surgeons as discrete entities, separate from the general population.

## **Summary and Research Aims**

The aims of this research can be summarised as follows:

1. To understand the range of surgeons' psychological reactions to different types of adverse events within surgery and how this may impact upon their mental health and wellbeing.
2. To identify the psychological factors that potentially moderate or mediate surgeons' psychological reactions to adverse events within surgery.
3. To develop a statistical model that explains variance in outcome measures for surgeons following an adverse event.

There has been no large-scale UK sample used to obtain a national picture of how surgeons are affected when things go wrong in the operating theatre and therefore no real insight into how adverse events impact upon surgeons in both a professional and personal capacity. This is important as it has not yet been investigated how surgeons within systems such as the NHS, coming from British surgical training pathways are responding when things go wrong and what the potential impact is within the UK on subsequent patient care.

Whilst it is largely unknown what the general impact of adverse events is on surgeons, there is also little data available regarding the way in which personality, psychological state/traits and demographic variables moderate the impact or norms for the surgeons' population. Nor is there any data about any possible mediators of distress and poor mental health functioning related to adverse events. Without this information effective targeted intervention cannot possibly be implemented and brings into question the efficacy of existing support facilities.

There has been little investigation of the types of support available to surgeons within the UK, nor has the efficacy of any existing formal or informal strategies to support surgeons following adverse events been examined. As a result, there is no foundation on which to build an effective platform of support and training for surgeons following adverse events. By gaining more understanding into the areas in which surgeons need support following adverse events it may also be possible to highlight training needs that would equip future surgeons with the psychological tools that they need, so that when something goes wrong the negative impact on both surgeons [and patients] is minimised. This is compounded by a lack of clarity regarding the nature of adverse events and how they arise.

The data collected within this research will also allow for normative data to be created for surgeons within the UK allowing for analysis of a surgeon's psychological state compared to their peers rather than to the general population. This also provides ample opportunities for publication, with an article possible for each of the standardised measures used within the survey with the norms for the surgeon population.

## **Research Overview**

### **National survey**

Analysis of the effect of adverse events on surgeons' mental health and wellbeing, including but not limited to responses to DASS-21, PC-PTSD and CBI measures analysis. This will include the stand-alone analyses of individual items and intra-item relationships.

This will also include the analysis of measures relating to surgeon personality and psychological traits, including BFI, BRS and WAAQ. Within each focus area the effects of complications vs errors, the severity of the adverse event, as well as the context of the event will be evaluated.

### **Mediation and moderation analysis and statistical data modelling**

Analysis of the interactions between individual and groups of variables within the survey, to generate an in-depth model that will highlight key factors responsible for outcomes of surgeons following adverse events.



## **Hypotheses**

This research proposes three central hypotheses derived from the main gaps and confluences within the current literature. Specifically, hypothesis 1 concerns the difference between complications and errors and hypotheses 2 and 3 concerns the relationship between mental health outcomes on surgeons. Given the ambiguity regarding the findings within previous research, the hypotheses are deliberately two-tailed (non-directional). The overarching hypotheses have then been broken down to provide clarity of the more specific hypotheses for this research.

**H1** – The following areas will be affected by type of adverse event:

1. General physical health
2. General mental health
3. Feelings about event
4. Perception of support available
5. Perception of own capability
6. Post-traumatic stress symptomology

**H2** – The following scores will differ between surgeon participant scores and published population means:

1. CBI
2. DASS-21
3. PC-PTSD
4. BRS
5. BFI
6. WAAQ

**H3** – the relationship between adverse events and psychological distress will be affected by the following psychological and environmental factors:

1. Personality type
2. Resilience
3. Psychological flexibility

4. Severity of event/patient outcome
5. Efficacy of training received by surgeons
6. Availability of support

Findings from the survey will generate a quantifiable description of the impact of adverse events on surgeons, will enable the comparison of effects of complications and errors on surgeons' lives, and to isolate the factors that are associated with impact. Results will provide a national picture that is currently lacking; and allow for the generation of a predictive model that will provide an evidence base to inform decision making and provide quantifiable leverage for influencing policy change. Such a model will also help to guide the development of better targeted education and support for surgeons.

## **Thesis content overview**

The following section provides an overview of the content of the following chapters within the thesis:

### *Literature review*

The literature review chapter presents the background literature on the impact of complications and errors on surgeons. This chapter examines the literature surrounding key factors within this research, and how those manifests within a surgical setting.

### *Survey methods and rationale*

The survey methods and rationale chapter presents the research methodology adopted within this thesis, outlining the philosophical underpinnings of the approach taken within the research. The chapter then outlines the reasons for the adoption of the survey design, providing an overview of the data collection methods used for the thesis, as well as a detailed rationale for the inclusion of specific measures within the survey and the means used to analyse the data. The chapter concludes with an overview of the data collection and analysis methodology that will be employed within this research.

### *Results – Descriptive characterisation and main impact of adverse events*

The first results chapter presents the statistical findings pertaining to data collected from the respondents of the research study, providing the descriptive results of the quantitative data.

### *Results - Mediation and Moderation Analyses*

The second results chapter presents the mediation and moderation analyses conducted on the sample dataset.

### *Results - Structural Equation Modelling*

The third results chapter presents the results of the structural equation modelling process and outlines the final model.

### *Discussion*

The final chapter within the thesis contains the discussion of the research findings. It examines the main findings of the survey in detail, alongside discussion of the key strengths and limitations of this research and proposed avenues for future research.

## **2. Literature Review**

### **Introduction**

This chapter presents the background literature on the impact of complications and errors on surgeons. Due to the paucity of research within this specific area - and the wealth of research within an occupational psychology setting regarding the effect of workplace stressors on quality of life - this chapter examines the literature surrounding key factors within this research, and how those manifests within a healthcare setting. Finally, if available, this chapter will examine how this has been explored within a specifically surgical population.

The paucity of research surrounding this area of research has driven the structure of this review. To be able to clearly demonstrate the current gaps within the literature, each component must be examined thoroughly to establish a clear rationale for its inclusion within the study. Therefore, the literature surrounding the following areas will be considered:

1. The impact of adverse events on surgeons
2. Errors vs Complication
3. Mental Health
4. Burnout
5. Resilience
6. Post-Traumatic Stress Symptomology
7. Psychological Flexibility
8. Personality

## **Literature review method**

A structured approach was implemented within the literature search and review process to reduce bias and ensure comprehensiveness. The procedural process of the literature search is outlined below:

### *Establishing and defining the research question*

The starting point of the literature search was to establish the research question clearly and precisely. Within this thesis, the question is 'how do complications and errors affect surgeons?', therefore the following considerations were made with the complexities of this question – and its included terminology – in mind.

### *Identification of relevant keywords and synonyms*

To fully encapsulate the range of terms related to the research question and construct an effective search query, a list of related keywords and synonyms were compiled. This list included terms such as "surgical complications," "surgical errors," "surgeon performance," "surgeon mental health and "surgeon well-being."

### *Selection of appropriate search databases*

The most relevant databases to search for scholarly articles were identified. A combination of these databases were used to ensure a comprehensive coverage of the literature.

### *Development of search strings*

Search strings were created that combined keywords and synonyms using Boolean operators. For example, a search string could be: ("surgical complications" OR "surgical errors") AND "surgeon performance" AND ("surgeon mental health" OR "professional well-being").

#### *Application of inclusion and exclusion criteria*

Clear criteria for selecting or excluding studies was established. This included factors such as publication date (e.g., the last five years), study design (e.g., quantitative, or cross-sectional studies), and language restrictions (e.g., English).

#### *Initial screening of the search results*

Review of the titles and abstracts of the retrieved articles. This initial screening was used to identify the most relevant studies.

#### *Evaluation of full-text articles*

Full texts of the selected articles were obtained and carefully analysed. Assessing their quality, relevance, and applicability to the research question before being included within the literature review within the thesis.

### **The impact of adverse events on surgeons**

The literature to date suggests that doctors are negatively affected when things go wrong within their working lives. A North American survey completed within the fields of internal medicine, paediatrics, family medicine, and surgery (N=3171) examined how errors affected five work and life domains (Waterman et al., 2007). The research concluded that many doctors experience significant emotional distress and job-related stress following serious errors and near misses. They experienced phenomena such as anxiety (61%), loss of confidence (44%), sleeping difficulties (42%) and reduced job satisfaction (42%) following the experience of errors. Generally, doctors reported that their levels of job-related stress increased when they had been involved with a serious error. However, this is not only the case for those who experienced an error with a serious outcome for the patient, one third of doctors who reported near miss events also reported increased levels of stress.

A North American cohort of surgeons (N=123) were surveyed about the impact of complications on their wellbeing (Patel et al., 2010). The purpose of this study was to examine the point at which the first complication of key significance occurs within a surgeon's career and investigate its subsequent effect on the emotional state and the job performance of the participant. The research revealed that, for most participants, the first complication that had a significant emotional impact on them occurred during their surgical training or residency (51.2%). However, 77.2% of respondents reported this did not have an impact on their professional functioning or ability. Experience of a major complication after residency was found to have a greater likelihood of having a negative effect on wellbeing. 58.5% of respondents felt it was difficult to handle the emotional effects of complications throughout their careers and that this did not improve with experience. The authors attributed this finding to higher levels of accountability, lower levels of support and the higher likelihood of potential legal ramifications as a more experienced surgeon. Surgeons reported difficulty with concentration, deterioration of their perceived clinical judgment, a



loss of confidence, trouble associated with sleeping, interference with leisure activities, and reduced quality of life following their experiences of surgical complications. The authors suggest that changes are needed within surgical training pathways to better train and support surgeons to deal with such events so that trainees may be better protected against these negative outcomes.

The experience of medical errors has also been linked with burnout, depression, suicidal ideation, and reduced quality of life. A longitudinal North American study (West et al., 2006) investigated the frequency of self-perceived medical errors and its association with quality of life, burnout, empathy, and symptoms of depression. The study analysed the experience of trainee internal medicine doctors who completed self-assessment surveys of medical errors along with quality of life measures every 3 months, and the Maslach Burnout Inventory (Maslach et al. 1996), Interpersonal Reactivity Index (Davis, 1980), and a validated depression screening tool (Spitzer et al., 1994) every 6 months. 34% of participants reported making a major medical error during the duration of the research. Self-perceived medical errors were associated with a subsequent decrease in quality of life and worsened measures in all domains of burnout (MBI domains: depersonalisation, emotional exhaustion, and personal accomplishment). There was an association found between self-perceived errors and depression, and increased burnout in all domains and reduced empathy were associated with increased odds of self-perceived error in the following 3 months. Thus, creating a cyclical series of events leading to more errors and ever worsening mental health. This research suggests that errors represent an important contributor to the personal distress and loss of compassion reported in trainee doctors, which is significant due to the impact that this has on both the life of the doctor and its potential subsequent impact on patient care. The reciprocal cycle of errors and distress within medicine highlights the importance of designing and implementing effective interventions that will break the pattern of behaviours which lead to harm for both doctors and patients.

A prospective cohort study (N=123) investigating the rates of medication errors among depressed and burnt-out residents (Fahrenkopf et al., 2008) found that depression and burnout are major problems among trainee medics, with depressed residents being found to make significantly more medical errors than their non-depressed peers. However, the findings of this study indicate that although burnout was a significant issue for participants - with 75% of those within the study screening positively for burnout using the MBI - burnout did not seem to correlate with an increased rate of medical errors.

Within a similarly conducted prospective cohort study (Brunsberg et al., 2019) resident doctors (N=388) were screened for burnout and depression using the Maslach Burnout Inventory – Human Services Survey (MBI-HSS) and Harvard Department of Psychiatry/National Depression Screening Day Scale (HANDS) to determine whether higher rates of medical errors were associated with positive screenings for depression or burnout. The findings supported those of Fahrenkopf et al. (2008), with participants with a positive depression screen being three times more likely to make harmful errors than those who screened negative. However, as with the previous study, there was no statistically significant association between burnout and errors being made. This suggests that whilst depression affects doctors' ability and subsequently puts patients at risk of harm, those experiencing burnout (as defined by the MBI) do not pose the same risk of harm.

The hypothesis of this thesis assumes that the direction of causality within the association between depressive symptomology and medical errors is the reverse of the above research. However, if depression has been found to lead to an increase of error making, then the cyclical nature of the phenomena could be a very important consideration for both patient safety and for supporting doctors who are experiencing depression. If surgeons are

suffering from clinical depression, then it is possible that interventions and support structures are required to ensure that there is no impact on patient safety.

A large-scale examination of longitudinal studies (11 studies: N=21517) demonstrated that the association between doctor depressive symptoms and medical errors is bidirectional (Pereira-Lima et al., 2019). The findings agree that doctor depressive symptoms were positively associated with subsequent medical errors. However, 4 of the longitudinal studies contained within the meta-analysis (N=4462) found that medical errors associated with subsequent depressive symptoms. This finding suggests that there is still a ‘chicken or the egg’ debate regarding the relationship between depression and adverse events. This will need to be considered when interpreting findings related to depression within this thesis, as it will not be known whether participants were suffering from depressive symptomology before, or because of, an adverse event.

It is therefore apparent that the literature surrounding the impact of adverse events on medical professionals does indeed suggest that they are negatively affected when things go wrong. However, there is an evident paucity within the literature when we are looking for specificity surrounding the following criterion, which will be considered in turn below:

1. Research conducted within a UK NHS setting
2. Research examining surgeons as a discrete group within healthcare
3. Research examining complications and errors as different types of events

### **Research within the NHS**

To allow insight into how UK surgeons are affected by adverse events in surgery, the NHS context must be taken into consideration. There are notable differences between healthcare settings across the world and these differences may be reflected within the way surgeons respond to survey measures. In a pre-Covid international comparison, the

Commonwealth Fund ranked the NHS as the world's best healthcare system (The Commonwealth Fund, 2017), despite being relatively poorly resourced in terms of staff, physical equipment, and funding. A UK based report comparing NHS resources with global healthcare services (Dayan et al., 2018) revealed that the UK spent 9.7% of its GDP on healthcare, compared with the USA who spent 17.2%. This difference in funding could reflect the lack of nationalisation of healthcare within the USA - by making healthcare a corporate enterprise prices will naturally rise. However, it could also reflect how underfunded the NHS has become and be an additional stressor within the working lives of healthcare professionals that would not be present within a cohort from another setting. The NHS has 2.8 doctors per 1,000 population compared with an average of 3.6 and is above the global average for the percentage of its doctors from overseas (28.1%). Low staffing levels and subsequent rota gaps may influence the responses of participants from an NHS setting that we would not be able to account for by using data derived from overseas. The NHS has a very low number of hospital beds: 2.6 per 1,000 population, compared with an average of 4.5 within other socioeconomically comparable countries. However, despite these limitations, waiting times within the NHS are comparable to other countries within both an acute and chronic setting, meaning that NHS staff are meeting the same standards of care as other providers, but with fewer available resources. These additional burdens will not be directly reported on within this research, however, the results from this survey will allow for a unique picture to be generated of respondents from the NHS, participants who are dealing with these additional stressors – and many more unique to the UK workforce - within their daily working lives.

The differences between healthcare systems such as those reported in the previous literature (Brunsberg et al., 2019; Fahrenkopf et al., 2008; Patel et al., 2010; Waterman et al., 2007; West et al., 2006) and the NHS are notable, and it therefore highlights that it may not be possible to accurately compare the experiences of doctors working within such markedly

different systems. Any direct comparisons between findings derived from other healthcare settings must therefore be considered with caution.

### **Surgeons as a discrete group**

The literature regarding the impact of adverse events has typically viewed doctors as one homogenous group (e.g., Brunsberg et al., 2019; Fahrenkopf et al., 2008; Waterman et al., 2007; West et al., 2006). However, this may be problematic as research demonstrates measurable differences between those within medical and surgical specialties (Stienen et al., 2018). The cross-sectional observational study (N=2345) conducted by Stienen et al. across countries in Europe and Canada utilised the Ten-Item Personality Inventory (Gosling et al., 2003) to compare the surgical and medical personality. Medical doctors scored significantly higher levels of neuroticism than their surgical counterparts (however, medical doctors still scored below the general population mean), whereas surgeons scored higher within the domains of openness to experience and extraversion – a finding which the researchers suggest is appropriate for both the dynamics of the physician-patient relationship and for the functionality of interdisciplinary teamwork.

As well as trait differences between surgeons and other doctors, researchers have found key differences between those wishing to pursue a surgical career from as early as medical school (Baschera et al., 2015). Participants within the study (N=2351) who planned to choose surgery (n=383) were 50% more likely to be male and were 20 % more likely to be single. The main motivating factors selected by those choosing a surgical career were that of “social prestige” and “remuneration” and these participants also stated that they were prepared to work longer hours than the respondents who were not aspiring towards a surgical career. These key differences demonstrate that whilst variability remains within the surgical group, there are significant differences that mean research cannot view all roles within

healthcare as homogenous, with some differences between medical and surgical specialties being deep rooted and present from the onset of initial training.

Research that has considered surgeons as a discrete working group within an NHS setting does exist (e.g., Pinto et al., 2013), however, such research still does not generate a clear picture, as only certain sub-specialties within surgery were included (for example, vascular and general surgeons). Whilst such research gives excellent insight into the phenomena within these groups, the findings cannot be confidently generalised to all surgical specialties within all deaneries/areas of the country. To accurately portray surgeon reactions to adverse events, all specialties must be included within research to account for any within group variability that may exist within different specialties, hospital types and locations.

### **Complications and errors**

Much of the research investigating adverse events within surgery focusses on just errors or conflates terminology relating to both complications and errors. Within just the papers mentioned so far within this chapter; Waterman et al. (2007) and West et al. (2006) only examined the effect of errors on the mental health of doctors. Patel et al. (2010) claims to examine complications, however, include instances such as ‘retained instrument’ or ‘delayed diagnoses’ within this definition, leading to lack of clarity regarding what exactly is being investigated. This suggests that there is a huge variety of different phenomena being examined and conflated under one umbrella term ‘adverse events’ without any real clarity regarding what is being studied. It must then be questioned whether the findings from such studies can even be compared against one another, as there is no consistent definition of what is being tested. The next stage of this review will look in more depth at how these terms have been used and conflated within the literature to date. Demonstrating the need for clear precise definitions of such terminology and examination of each as a discrete event type.

## **Complication or Error**

Questions regarding causality and the attribution of blame following an adverse event in healthcare is a common process, with doctors often facing litigation following the occurrence of a surgical adverse event (Ford & Cooper, 2016). A total of 31,697 legal claims were made regarding perceived surgical complications and errors between 2004 and 2014, with the NHS paying out approximately £1.5 billion in damages, legal fees, and additional bed days.

An online literature search into the topic of ‘surgical complications and errors’ returns over two hundred thousand results (Google Scholar: 2022). Although not all documents contained within this capture are specifically relevant for this area of research, the result does begin to give some insight into the scale of this area of study. Adedeji et al. (2009) conducted a similar PubMed search to investigate the prevalence of literature relating to this topic of research and concluded that, despite the extent of research into surgical complications, there is in fact no consistently used and agreed upon definition or use of the key terminology. Given the significant lack of clarity surrounding the distinct nature of the terminology, it raises questions regarding the comparability of studies in which these terms have been utilised, especially in cases in which the researcher has neglected to clearly define the phenomena.

Previous research appears to indicate that surgeons’ responses do depend on the nature of the adverse event. For example, the severity of the outcome and the patient’s/the family’s reactions are reported determinants of a surgeon’s reaction (Pinto et al., 2013). Despite variation in adverse events, most of the research has treated complications and errors in an undifferentiated way (for example, Patel et al., 2010). Although some previous research has specifically focused on errors rather than complications, this is often conducted under an assumption that errors have unique adverse effects on health professionals (Sirriyeh et al.

2010; Wolf et al., 2000). This may be in part due to the perceived added fear of litigation following errors, with research suggesting that when it comes to the reporting of harm caused to patients, health care professionals are much more likely to report 'non-preventable' harms than harm caused to patients that may be considered as 'preventable' (Lamb et al., 2003). This suggests that research in this field needs to establish clear definitions of the terms they are investigating, so that results may be consistently reported and analysed. The confusion and conflation of definitions within this area is easily rectifiable by establishing clarity surrounding the terms of 'complication' and 'error'. However, these terms are not only confused within the literature, with a lack of clarity also existing within day-to-day surgical practice.

A systematic review by Marsh et al. (2022) investigated the extent to which surgical disciplines categorise, define, and study errors. The findings of the investigation state that there are 6 broad categories of surgical errors (for example, technical errors or system errors), that there are 13 different definitions of error within the literature (such as failure of planned action or wrong plan, and preventable adverse event/complication/problem), and 14 different study methods (including, medical record reviews, morbidity and mortality conferences and direct observations). Due to this lack of standardised categorisation, definitions, and study methods, the reported prevalence of error will vary widely.

Therefore, it is the view taken in this thesis is that a balanced overview of the impact of *all* types of adverse events is needed to be able to fully understand the effect that adverse events have on surgeons. Clear definitions must be established that may be used consistently in future studies. Such definitions will allow researchers to acknowledge the distinction between complications, errors, and adverse events, as well as establishing a consistent use of language within the field of study.



What is not yet known is whether complications, particularly if severe, are just as difficult for surgeons to deal with psychologically as errors. The present research therefore sought to evaluate the impact on surgeons when dealing with both complications and errors by establishing between group conditions examining this difference, with clear definitions established for each distinct term (e.g., whether errors and complications differentially influence surgeon well-being). The working definitions and findings relating to complications and items as distinct variables will be discussed in future chapters.

## **Errors**

Sociologist, Bosk (1979), analysed errors in the practice of surgery through an 18-month observational study, specifically analysing errors which occur during the journey taken from trainee to experienced surgeon. In his book Bosk delineates four types of errors, which he refers to as ‘technical’, ‘judgmental’, ‘normative’, and ‘quasi-normative’.

Bosk’s interpretation of error is as separate from surgical complications and places human action and the meeting of accepted norms at its centre. Technical errors relate to skill deficits, events in which lack of knowledge and experience, rather than negligence, cause failures within surgery. Bosk acknowledges that this kind of error is expected within training and when completing unfamiliar or experimental procedures and are therefore deemed forgivable. According to Bosk (1979, p. 38), regarding technical errors, “it [the error] is plain dumb, but it’s not unforgivable. It’s a mistake and everybody makes mistakes one way or another. Our job is to minimise these mistakes and give people the training that makes them rare”.

Gawande’s memoirs of his personal experience of training (2002) also refers to technical errors, equating them to rites of passage for junior surgeons. Gawande argues that

it is through these mistakes surgeons learn how procedures should be performed in future. That the events themselves act as a traumatic reminder to the doctor of their requirement to maintain consistent high standards. Suggesting that patient harm is a necessary evil to support the training and development of junior surgeons.

Judgmental errors relate to surgeon decision making and their ability to choose the correct course of action for their patient. In these situations, it is often only the subsequent patient outcome that will reveal whether an error has occurred or whether the surgeon's judgement was correct. By making this distinction Bosk (1979) is highlighting that errors can occur due to both action and non-action, by process and by outcome.

Whereas judgmental and technical errors relate to the surgeon's ability to carry out their role, normative and quasi-normative errors relate to errors within the code of conduct and thereby is an error in the surgeon assuming their role (Bosk, 1979). Normative errors regard the surgeon's ability to conform to the behaviours expected of them within the work environment; from working within a hierarchical reporting system to assuming reasonable conduct with patients and other staff. Quasi-normative errors however are more subjective and relate to surgeons meeting the expectations set out for them by their superiors. i.e., doing things how others 'like them done'. Bosk speculates that these types of error may not specifically have any direct impact on patients and may not cause harm to anyone but the professional reputation of the surgeon themselves. However, these errors may still have an impact on a surgeon's mental wellbeing and their ability to perform in subsequent practice. This could therefore highlight an aspect of 'error' that falls outside the realm of 'complication' - if no one is affected by the error other than the surgeon then it does not fit the definition of a complication.

In a conceptual theoretical interrogation and systematic review, Reason (1990) discusses yet another form of error: latent errors. Latent errors are those which have not yet happened, but which are at risk of occurring at any time. Reason claims that these errors occur due to the human brain's exceptional capacity to act instinctively. With so much information being rapidly processed, mistakes can be made when a deviation from the norm is overlooked and assumed knowledge is incorrect. In surgery this could be an error such as the misreading of a chart or prescribing the wrong dosage of medication. These errors, unlike technical or judgemental errors, are not due to a deficit in knowledge or experience, rather due to inadequate concentration or scrutiny of a situation and, when looked at specifically within the context of the surgical profession, highlights the fallibility of surgeons as human beings. Due to the systemic nature of the NHS, it is highly likely that such errors of omission resulting from latent errors may be picked up on by other healthcare professionals and therefore cause no direct harm to a patient. It is not true to say however that just because no harm resulted from the error that no error occurred. Given the nature of such an error there may be very little evidence to support the occurrence of such an event (Rassweiler et al., 2011), although near miss events are often reported as learning points and are important for establishing systemic change. However, a lack of transparency regarding this kind of error will have a notable impact on findings regarding their impact within the literature.

Almost a decade after Reason's publication, the Institute of Medicine (IOM) defined an error as "the failure of a planned action to be completed as intended (i.e., error of execution) or the use of a wrong plan to achieve an aim (i.e., error of planning)." (Kohn et al., 1999, page 28), specifically relating to Bosk's (1979) definitions of technical and judgmental errors, with errors of omission such as Reason's (1990) latent error becoming enmeshed within errors of execution. However, it is apparent that errors are defined by failures within processes and are not linked to whether there is any subsequent harm directly caused by the event, further distancing itself from the definition of a complication (Hofer et

al., 2000). This adds further confusion and complexity to the definitions of adverse events, which may explain why the literature is littered with a plethora of ways in which these terms are utilised. However, this further supports the need for the establishment of clear definitions and a consistency of their application within future research.

Rassweiler et al. (2011) use the findings of a systematic review into the classification of surgical errors within minimally invasive surgery to classify errors in which no one is harmed as 'near miss errors' or 'errors without consequence'. They separate errors into two categories: systemic errors and co-face errors. Systemic errors are not always controllable by the surgeon and are dependent on external events. However, co-face errors occur within the surgeon's control and are based on Reason's (1995) categories of 'slips', 'lapses' and 'mistakes' - each of which are distinguished by cognitive stage. They define a slip as the 'right thing done incorrectly' and associate it with the execution stage and a mistake as the 'doing of the wrong thing' linked with knowledge-based behaviour. Bosk (1979) would have defined both errors as technical. Whereas a lapse relates to 'wrong indication' and cognitively to the storage phase between planning and execution, therefore such events are more closely linked to judgmental errors. Although the classifications were published decades apart there are apparent similarities. One key feature being that there is no one definition for what constitutes an error, rather the definition is reliant on sub-classifications to encompass all facets of the term. This again suggests that it is vital to not only establish a clear and consistent definition of errors, but also that such a definition considers the complexity of such events.

## **Complications**

Pinto et al. (2013) examined the impact of surgical 'complications' on the well-being of surgeons through single time point, semi-structured interviews (N=27), and found that many participants had been adversely affected by major surgical complications. However,

the research also includes reference to errors, misjudgements, and failures, whilst alluding to the ‘catastrophic consequences’ faced by such events in the sphere of medicine. Their research also discusses the concept of causal attributions and how the prevalent blame culture within surgery can have a negative impact upon staff involved. However, the remainder of the paper refers instead to ‘complications’ as if the terms of error and complication were synonymous with one another. This example clearly highlights the confusion in the literature regarding the precise definitions of key terminology and raises questions about the ways in which researchers should use specific language when analysing such events or, if they wish to deviate from agreed definitions, how their work should clearly state the way in which they are using such terminology.

Several papers have attempted to clearly outline the parameters for the term ‘complication’ in relation to surgical procedures (Sokol & Wilson, 2008). One commonly used definition of a complication is that it is an event that is undesirable, unintentional and is a direct result of an operation. That the event would not have occurred had the operation gone as well as could reasonably be hoped, and that the event has a negative impact on the patient (Adedeji et al., 2009; Sokol & Wilson, 2008). From this definition it is therefore possible to identify four key tenets. The first identified within this thesis is that a complication must always be an action that deviates from the preferred course of action. The second, the action must be a mistake and not the intention of the surgeon or the surgical team. Thirdly that the event is because of the surgery itself and does not result from any underlying cause and finally that the event has some negative impact on the patient.

Questions are however raised from this definition. Such as what is the role of negligence and preventability within complications? (Chung & Kotsis, 2012). Who judges the desirability of the outcome? How is it proven whether the outcome is a direct or indirect result of the procedure? Without clarity on these areas, the definition has notable weaknesses.

The definition also encompasses definitions of error and adverse events and does not account for events within surgery where issues arise but no adverse event - defined by Kerr (2000) as bad outcomes, and by Brennan et al. (1991) as ‘an injury that was caused by medical management and that prolonged the hospitalisation, produced a disability at the time of discharge or both’ (Page 145) - is suffered by the patient? An example of this would be the failure to ensure that surgical equipment is correctly sterilised prior to use, yet, luckily, unsterilised equipment having no adverse effect on the patient. This further supports the need for a definition of error that includes the complexity of patient outcomes, as well as the cause or nature of the event itself.

Chung and Kotsis (2012) highlight the lack of consistency regarding definitions of ‘surgical complications’ and that there is much overlap between the use of complication and error, especially when patient co-morbidities mask whether the outcome is due to an error or underlying disease (Brennan et al., 2004). Chung does however allude to the grey area between the two terms when discussing the idea of ‘preventable complications’, which attributes a causal factor to the occurrence of a complication and provides the ground for argument that some complications need not happen and may be linked to some level of negligence. Creating discrete definitions, with no overlap, will therefore be problematic. This will therefore have an impact on the interpretation of the results of this study when it comes to looking at event type as a key determinant. Caution will be taken when interpreting the results.

Recognition of lack of widely accepted classification of terms and of language being used interchangeably and inconsistently throughout the literature was also discussed by Clavien et al. (2009) who reflected on the recognised the lack of consensus with the regards to the definition and severity of adverse events in surgery. To establish more clarity regarding the nature of surgical complications, the Clavien-Dindo classification system was established

(Clavien et al., 1992) as a way of ranking the severity of a complication based on the type of therapy required to treat the incident. This measure emphasises the patients' perspective and is used as a tool for quality assessment of everyday practice. The grading system does a great deal to enable adverse events to be classified/categorised however it does not investigate the root cause of the adverse event, nor does it attribute causal factors. Examples from the extremes of the scale demonstrate the classifications, from grade 1. - 'Any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic and radiological interventions.' to grade 5. - 'Death of a patient' (Clavien et al., 2009). Therefore, as with the above definition, it groups together all adverse events as 'complications' and does not refer to errors as a separate entity. Although it could be argued that this is positive as it does not look for individual blame, it does leave a question mark over the distinction between the two terms and mean that the question remains regarding the distinct nature of complications verses errors.

The Clavien-Dindo classification system does not rely on the cause or clinical appearance of a complication, rather it refers to its treatment modality (Clavien et al., 2009). Because of the nature of the construct, Rassweiler et al. (2012) argue that the classification system could be utilised not just for the classification of complications, but also the analysis of; safety of procedures, the comparison of different approaches related to outcome, improvements in surgical techniques as a basis for internal quality control and standardisation of surgical errors. They argue that the cause of complications should be analysed within the scale as well as the treatment modality of the adverse event. However De la Rosette et al. (2012) criticise the suggestion that the scale is used to assess errors, as when it comes to the grading of a complication there is already much disparity between surgeons due to subjective interpretation of situations, they therefore question the ability of surgeons to objectively analyse their own actions, or systemic errors, effectively enough to allow for a consistent reporting system as well as the difficulties in establishing a set of classifications of errors

which may be linked to patient outcome and adverse events. However, as outlined in Hofer's (2000) paper, unlike complications there is no clarity regarding the direct link between error and adverse events, this would therefore require an alteration of the Clavien-Dindo scale to include a grading system without negative outcomes, however this would not necessarily relate directly to the level of negligence that occurred. However, Wilson et al. (1995) refers to error as an act of commission or omission that caused, or contributed to the cause of, the unintended injury, thereby linking the action with patient outcome and bringing into question and thereby demonstrating another way in which the term complication has been used and confused within the literature.

Without a clear classification system to analyse and measure error rates and types it is unclear as to how errors can be monitored and standardised. A common theme within the studies which links together the many definitions of error, is the level of preventability linked to the event and therefore the implied inherent negligence or failure on an individual or system level. This differs significantly from commonly used definitions of complications in which no causal attributions are made and only the impact of the outcome on the patient is considered a key indicator (Adedeji et al., 2009; Sokol & Wilson, 2008). This suggests that the concept of preventability/locus of control should be central to the definitions of both complications and errors.

### **Implications for the present research**

The between groups distinction of event type within this study (complication vs error) was established to provide an environment in which the analysis of the impact of causal attributions following adverse events could be possible. The definitions given to participants of complications and errors, if applied as the researcher intended, makes a clear distinction regarding the causal attributions of an event. The definition of an error as **'avoidable commissions or omissions with potentially negative consequences: they**



would have been judged as poor practice by skilled and knowledgeable peers at the time when they occurred, independent of whether there were any negative consequences' (Wu et al., 1997, page 143) clearly attributes cause in the realm of the surgeons' actions or inactions. Complications by contrast, defined as adverse events which are an **acknowledged risk of surgical care or procedures, i.e., when a standard medical procedure is undertaken there are risks that are not avoidable** (Clavien et al. 2009; Dindo & Clavien, 2008), are potentially events outside of the surgeons' control. Therefore, it is hypothesised that surgeons will feel less to blame for any patient harm experienced through the occurrence of a surgical complication as opposed to an error.

## **Mental Health**

### **Mental Health and Wellbeing in the Workplace**

Most individuals experience extreme pinch points within their working lives, acute times at which more effort is required to meet a deadline or to achieve a particular target (Spielberger et al., 2003). For the majority however, these experiences are not the everyday normality of their professional lives. Yet certain professions do face more consistent pressure, with a constant expectation of high-level output that does not allow for an individual to return to a more reposed baseline within their everyday professional arena. Research suggests that some professionals, such as lawyers, corporate CEOs, teachers, therapists, academics and medics are more likely to experience higher degrees of pressure within the workplace than those in other, comparatively less demanding professions (Arasteh, et al., 2018; Briggs & Munley, 2008; Fisher, 1994; Jacobson & McGrath, 1983; Sandilos et al., 2018; Shearer, 2013), although the level of negative affect experienced by individuals working in such professions is subject to individual differences (Semmer & Meier, 2009). This suggests that individuals within higher demand professions may be at higher risk of mental health conditions, and that the phenomena should be investigated in order to ameliorate the impact of this on the workforce.

The detrimental impact that demanding employment environments can have on workers' mental wellbeing - and the subsequent effect that this has on physiological health and work performance - is therefore an important consideration (Kivimäki et al., 2006). High demand work environments are rife with stressors, defined as 'stress producing events and conditions' (SPECs) (McGrath & Beehr, 1990). Research suggests that workplace stressors derive from a range of sources, such as schedules, poor leadership, work-family conflicts, as well as harassment and discrimination (Barling et al., 2004). While stress (defined as the physical and emotional outcomes that occur when there is disparity between the demands of

the job and the amount of control the individual has in meeting those demands (Lambert & Lambert, 2008)) is oft anecdotally the most cited workplace mental health complaint (Michie, 2002), research demonstrates that there are also other ways in which individuals feel or manifest the experience of stressors within the workplace (Jones et al., 2016; King et al., 2016; Stewart et al., 2003; Wright & Bonett, 1997). Psychological phenomena such as burnout, depression, anxiety, and diminished resilience may also be a response to the stressors and demands of a highly pressurised work environment. The potential implications of such manifestations of distress within the workplace will be explored within this chapter.

Work-related psychological distress is regularly reported within the mainstream media, especially the financial implications of mental health issues and the prevention and consequence of work absences or loss of productivity (Hughes, 2018). The media has also argued that mental health should be a regular and commonplace part of the workplace agenda, and that it should be a key consideration of employers to protect and support their employees (Done, 2019). The recent move towards including mental health leads within organisations demonstrates a paradigm shift towards the importance of maintaining wellbeing within the workplace (Ward, 2018). This change in attitude may be in part a reflection of the fact that more and more celebrities are endorsing the importance of mental health (Hoffman & Tan, 2015), bringing the topic of wellbeing into the mainstream, and removing much of the stigma associated with mental illness. The stigma surrounding mental health issues will be discussed in more detail within this chapter.

Many factors have been blamed for the negative impact that certain professions or work environments have on employee wellbeing. For example, the pervasiveness of technology has been shown to have a detrimental impact on many professionals, for example teachers and medics, leading to higher levels of psychological distress (Cadieux et al., 2019). Specifically, that the growing level of perceived permeability between the different spheres

of life means that there is no break from the work environment. Other factors which have been associated with negative affect include workplace bullying (Pei & Cochran, 2019), work-life conflict (Houfort et al., 2018), shift work (Nena et al., 2018) and low income (Adynski et al., 2019). Research suggests that there is no one cause leading to distress within a work environment, that it is multifactorial and subject to individual differences. Therefore, distress has many causes, the range of which may not always be adequately addressed within the research literature.

Whilst many professions cater for mental health concerns of their employees, this is not always the case. Especially in environments where the needs of the organisation are deemed to outweigh the need of the individual. For example, a teacher during an Ofsted inspection, a lawyer during a trial or a CEO during the closing of a large corporate deal. The utilitarian approach within these kinds of situations may be understandable (Cavanagh et al., 1981), but it does not protect those who are vulnerable and in need of support. There is therefore a need to provide such employees with the tools to enable them to flourish, or at least cope, during such acute and potentially traumatic events within their working life, if such events are unavoidable.

Whilst many solutions to address psychiatric distress are focussed on the individual, such as medical or therapeutic interventions and lifestyle changes (Cuijpers et al., 2013), it should be considered that systemic changes are required to alleviate the pressure experienced by some within their work environments. Can an individual really be expected to change or remain fluid within a fixed system? Therefore, many solutions to the causes of distress within the workplace are human factors based or implemented at an organisational level. A systematic review commissioned by the UK Department of Health (Boorman, 2010) reviewed a large number of international healthy workplace interventions and recommended the following five whole-system changes to improve healthcare staff health and wellbeing; 1.

Ensuring that health and wellbeing initiatives are backed visibly by healthcare leadership. 2. The development and implementation of evidence-based wellbeing plans to meet the specific needs of the individual organisation. 3. Ensuring that management at all levels have the capacity and capability to improve the wellbeing of staff. 4. Engage staff with improving their own health through education, encouragement, and support. 5. Use the NHS occupational health service to offer a targeted, proactive, and accredited support system for staff.

A systematic review examined the impact of the implementation of these changes (Brand et al., 2017), and identified 11 studies which incorporate at least one of the Boorman recommendations and provides evidence to support the argument that whole-system healthy workplace interventions can improve health and wellbeing and promote healthier behaviours in healthcare staff.

The landscape of the world has changed in past years due to the pandemic. However, a systematic review and meta-analysis of longitudinal cohort studies (65 studies), which examined changes in mental health among participants before vs. during the pandemic in 2020 (Robinson et al., 2022), found that within the general population there was a small increase in mental health symptoms soon after the outbreak of the COVID-19 pandemic. However, this decreased and was comparable to pre-pandemic levels by mid-2020 within most population sub-groups. Therefore, it appears that the general population's mental health has been considerably resilient. However, this statement is an oversimplification of the findings given the high level of heterogeneity within the sample, indicating that the change in mental health was highly variable across sample groups. The present research will therefore provide a quantified baseline for pre-pandemic surgeon mental health that will allow for an accurate pre and post pandemic comparison within a surgical sample.

## **The Mental Health and Wellbeing of Medical Professionals**

Mental health within healthcare is a topic gathering momentum within both academia and the media. Pre-Covid anecdotal media reports suggested that doctors and other healthcare practitioners were experiencing higher levels of psychological distress than the general population, which is leading to the subsequent deterioration of their mental health (Hemmings, 2018). This however is not a new phenomenon, with a report within the British Medical Journal in 1989 stating that doctors have 'better physical health but poorer mental health than others' (Pilowski & O'Sullivan, 1989, page 124). It is therefore somewhat surprising that very little research and intervention work has been done to specifically examine this observation.

However, avoidant behaviours are often observed with regards to seeking support for mental health issues, with stigma regarding mental illness having a negative impact on individuals' propensity to seek help (Clement et al., 2011). Mental health problems are often under reported compared to other health concerns and it is hypothesised within the research that this is due to the relationship between mental health concerns and stigma, with individuals therefore feeling incentivised to mask or hide mental illness for fear of negative repercussions (Bharadwaj et al., 2017). Therefore, it may be the case that although help is available to those suffering from mental health concerns, they do not feel able to come forward and get the help that, in some cases, they so desperately need.

Research has shown that English doctors have higher rates of depression and anxiety than population means (Brooks et al., 2011). This research used data from the practitioner health programme, an organisation which medical professionals attend when in crisis. This could suggest a higher prevalence of depression within the sample as the cohort self-referred themselves when experiencing self-diagnosed symptoms. However, the research demonstrated higher severity of illness than would be expected within a depressed cohort.

The researchers suggest that this could be due to doctors delaying help seeking due to a concern about a lack of confidentiality and the possible associated effects this may have on their career. Research from outside of the UK (Shanafelt et al., 2011) supports the findings of higher rates of depression and anxiety, notably going on to state that suicidal ideation is up to three times more prevalent among consultant surgeons than the general population. Figures released by the Office for National Statistics revealed that within the UK 430 health care practitioners took their own lives between 2011 and 2015, with the risk of suicide among female health professionals being 24% higher than the female national average (Windsor-Shellard, 2017). This suggests that there is a real need for research into the area of mental health – specifically depression and anxiety – within medical professionals to support interventions that may reduce the prevalence of physician suicide.

## **Psychiatric Distress and Common Mental Health Disorders**

Within this section, three most common domains of psychiatric distress – as measured by the DASS-21 (Henry & Crawford, 2005) - namely depression, anxiety, and stress, will be examined in relation to the research and their impact upon functionality within the work environment.

### *Depression*

Depression, also known as Major Depressive Disorder or Clinical Depression, is a common mood disorder with varying degrees of severity (American Psychiatric Association, 2013). The criterion for diagnosing depression includes persistent feelings of sadness and hopelessness, and a loss of interest in once enjoyed activities. To be diagnosed with depression, symptoms must persist for at least two weeks. According to the Adult Psychiatric Morbidity Survey (McManus et al., 2016), 3.3% of the population of England are diagnosed with depression annually. However, these findings were taken from a study that excluded potentially high pathologically predominant populations, such as prisons and hospitals. Therefore, the figures may under-represent the prevalence of depression within society.

Depression can affect all domains of life. 60% of the world's population are classified as 'employed' and spend an average of 60% of their waking hours within their place of work (WHO, 2008), therefore depression is likely to have a significant impact within this domain. The impact of depression on job performance is estimated to be more prevalent than that of long-term physiological conditions such as arthritis, back problems, and diabetes (Kessler et al., 2001). Such physiological manifestations of depression do not just have an impact on work attendance levels, but also on overall work performance. This suggests that understanding the levels of depression within a workforce is vital so that interventions and support strategies may be implemented in a timely manner to support employees and reduce missed workdays.



The work environment and depressive symptomology may also have a reciprocal relationship (Madsen et al., 2017; Nakata, 2011; Scott et al., 1997; Thun et al., 2014; Wallace, 2005): Depression impacts work, but work can also impact depression. With factors such as irregular work hours (Scott et al., 1997, Thun et al., 2014), long work hours and a subsequent lack of sleep (Nakata, 2011), work-family conflict (Wallace, 2005) and perceived job strain (Madsen et al., 2017) all positively correlating with depression. This suggests that not only can work conditions exacerbate depressive symptomology, but that depression can lead to negative work conditions associated with higher levels of depressive symptomology. Without addressing such issues this reciprocal relationship could cause a cascade of negative outcomes for the employee and for any stakeholders within that work environment.

The workplace is therefore an important location to target interventions that may work towards diminishing depressive symptomology and support workers at risk of depression. A systemic review and meta-analysis conducted by Tan et al. (2014) investigated the efficacy of such interventions within the workplace. Of the nine Randomised Control Trials (RCT) identified using their selection criteria they were able to conclude that universally delivered workplace mental health interventions can reduce the level of depression symptoms, with a preference for Cognitive Behavioural Therapy- (CBT) based programs over other interventions due to the efficacy of the intervention within this specific domain. Their research suggests that workplace interventions should be considered a key component of efforts to prevent the development of depression and highlights an important consideration; that environmental and systemic changes can act as a key role in preventing depressive symptomology, rather than seeing it as an individual problem requiring a pharmacological intervention.

Despite the efficacy of some interventions focussing on relieving depressive symptomology and their onset within the workplace, for some individuals this type of prevention or treatment is ineffectual (Weck et al., 2015). In these cases, other treatment options should be considered, including both therapeutic and pharmacological avenues. Left untreated, clinical depression can lead to significant negative outcomes including insomnia (Walsh, 2004), co-morbid medical conditions (Katon, 2003), social isolation (Grippe et al., 2007) and suicide (Turecki. & Brent, 2016). This suggests that it is an important consideration of research to examine a range of interventions that will support those with depressive symptomology within the workplace. There is no one-size fits all model to support workers and a range of individual and systemic interventions may need to be explored.

Suicide and suicidal ideation remain a large concern within the United Kingdom. Despite the rate of suicides among men being at its lowest point in 30 years, there were still 6213 suicides within the UK in 2017 with men remaining three times more likely to end their own life than women (Simms & Scowcroft, 2018), fortunately provisional data for 2020 has found no evidence of national suicide rates increasing as a result of Covid-19 (Samaritans, 2022). However, research suggests that the cause of suicide is multifactorial and is not necessarily linked to mental illness (O'Neill et al., 2018). Other life events such as relationship issues, and deterioration of physical health have also been attributed to suicide and suicidal ideation. It is therefore difficult to establish a rationale that stressors from a work environment are necessarily directly linked to suicide and suicidal ideation. Conversely, Shepherd and Barraclough (1980) found that a stable job can be a protective factor against suicide, with higher levels of unemployment and frequent job changes correlating with higher levels of suicide. However, factors such as job strain, low decision autonomy, low social support, high psychological demands, effort-reward imbalance, and job insecurity predicted common mental disorders among men (Stansfeld & Candy, 2006). Therefore, despite such

issues leading to negative affect and mental illness, there is no direct causal attribution to suicide and suicidal ideation.

### *Anxiety*

The 5<sup>th</sup> edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM 5) categorises anxiety disorders as those including features of extreme fear and apprehension, with subsequent impacts upon behaviour (American Psychological Association, 2008). The classification makes a distinction between ‘fear’, which is defined as the ‘emotional response to real or perceived imminent threat’, and ‘anxiety’, the ‘anticipation of future threat’. Whilst there is some overlap between these two states, with many individuals exhibiting symptoms of both fear and anxiety (Tovote et al., 2015), fear is more often thought of in terms of physiological ‘fight/flight’ arousal, whilst anxiety is associated with cautious and avoidant behaviours to protect against anticipated future danger.

Anxiety related disorders are the most prevalent mental health disorders within society and are associated with a high financial burden (Tolin et al., 2010). German researchers found that 33.7% of the population are affected by an anxiety disorder within their lifetime, yet all too often those effected go untreated or with their condition unrecognised (Bandelow & Michaelis, 2015). Research suggests that anxiety affects an individual’s performance, specifically their efficiency when completing complex tasks by reducing the capacity of the working memory system (Eysenck & Calvo, 1992). The extent to which anxiety effects overall work ability and performance must therefore be considered.

Much like depression, the relationship between work and anxiety may be reciprocal. With such a relationship compounding and exacerbating anxiety symptomology. Therefore, the recognition of such conditions is vital to ensure that not only is there as little impact on the work environment/productivity, but also that those suffering with such conditions are

supported, with adequate signposting to possible interventions and sources of help which are available to them.

There are various ways in which anxiety disorders may be managed and treated successfully by utilising both pharmacological methods and psychological therapies, such as CBT (Posmontier & Breiter, 2012). According to data from a meta-analysis compiled by Bandelow et al. (2015) however, larger effect sizes were found in relation to improving anxiety related symptoms from psychopharmacological drugs than from CBT, suggesting that a combination of approaches should be considered for maximal efficacy. Yet it is perhaps not appropriate to suggest that all those effected by anxiety should be medicated, and therefore a range of approaches should be considered and as highlighted by Bandelow et al., down to the affected individuals' preference.

### *Stress*

As previously stated, work stress is defined as the 'physical and emotional outcomes that occur when there is disparity between the demands of the job and the amount of control the individual has in meeting those demands' (Lambert & Lambert, 2008). The new category within the DSM 5 of 'Trauma and Stressor Related Disorders' gives clinical insight into disorders such as ASD, Reactive Attachment Disorder and PTSD (to be discussed later within this chapter). The cause of stress is indicated to be varied and multifactorial within the literature (e.g., Mitchie, 2002), depending on the environment and experiences of the individual. Factors such as criticism of work performance (Nichols & Berliner, 2007), the level of emotional involvement required (Roeser et al., 2012) and factors external to the work environment, such as family-work conflict may all contribute to the levels of stress experienced by the individual. This suggests that there may be no one solution to stress and that both an individual and systemic approach would be needed to reduce stress levels within the work environment.

Work stress is significantly correlated with higher levels of anxiety (Fan et al., 2015), and although there is little evidence pertaining to the direction of causality between these two constructs and other possible mitigating factors, the significant relationship indicates that the relationship between the two is an important one to consider in ongoing investigations into the impact of stress within a work environment.

There is a key distinction to be made between different domains or types of stress, as not all stress is inherently negative (Kupriyanov & Zhdanov, 2014). Rather, a certain amount of stress is a necessary motivation to ensure that an individual can perform to their maximum potential or capacity (Gibbons et al., 2008). This phenomenon of optimum stress is referred to as eustress, however there is a large amount of variance with regards to the level at which eustress is achieved. Not only in terms of individual difference, but also with regards to domain specificity and generic daily fluctuation due to other confounding variables. What may be considered an optimum amount of stress one day, could be overwhelming to an individual the next. There is no consistent level for this that may be tapped into to maximise efficacy daily. Finding this optimum level is therefore a balancing act depending on reflection and self-awareness (Gibbons et al., 2008). The implication of stress within employment settings must therefore be analysed so that the distress/eustress relationship may be understood, along with the effect of other mitigating factors and how they may mediate or moderate the stress levels of individuals which may, in turn, lead to negative outcomes.

### **Psychiatric Distress and Common Mental Health Disorders in Medical Professionals**

Research suggests that doctors are particularly vulnerable to experiencing mental illness due to the nature of their work. Doctors work within a stressful, high-pressure

environment which often includes shift work and irregular work hours (Mihailescu & Neiterman, 2019). Not only are doctors not immune to experiencing psychiatric distress and mental health conditions, rather these figures may be under reported due to doctors being reluctant to seek treatment, or self-diagnosing rather than going through official medical channels (Bright & Krahn, 2011). The understanding of these types of distress among doctors is vital. A systematic review (Panagioti et al., 2018) found that psychiatric distress can increase the rate of medical and surgical errors as it impairs cognitive functioning as well as clinical decision-making (Leblanc, 2009). The following section will therefore examine the research surrounding depression, anxiety, and stress within the domain of medical professionals.

### *Depression*

In the UK, 10% - 20% of doctors become depressed at some point in their career (Gerada & Jones, 2014). A systematic review on suicide mortality in doctors (Lindeman et al., 1996) found that suicide rates among doctors were higher than those in the general population and among other academic occupational groups. Relative to the general population, female doctors have a 3.7 - 4.5-fold increased risk of death from suicide. The reason given for these findings are a combination of a greater frequency of obsessive-compulsive personalities seeking a medical profession, and that these personality characteristics together with the pressures and demands of the profession make them more prone to depression and thereby suicide. It is also mentioned that the demands of the family and frustration and dissatisfaction with their career as factors explaining exhaustion and increased suicide mortality among female doctors. It was also observed that the prevalence of substance abuse is significantly higher among medical practitioners which may also contribute to the elevated risk of suicide. However, the actual reasons for the higher levels of suicide mortality among medical practitioners remains highly speculative.

Research suggests that the prevalence of depression starts as early in a doctor's career as medical school (Moir et al., 2018). Key contributing factors to this were found to include the selection procedures utilised to obtain a place at medical school, the likely personalities of those attracted to medicine (e.g. consistent high achievers, obsessive-compulsive traits), the assessment methods utilised within medical education (such as high stakes exams and Objective Structured Clinical Examinations (OSCEs)), and the clinical environment in which they work during training. An observational study in Pakistan by Kumar et al. (2019) examined the prevalence of depression within medical students (n=312). 57.6% of participants within the study were found to suffer from moderate to extremely severe depression, citing causal factors such as the academic burden, being surrounded by highly competent peers, experiencing setbacks in reaching their desired specialty, and stressors within the transition phase between being a school student to a doctor. In general, medical training involves numerous risk factors for mental illness, such as role transition, decreased sleep, relocation resulting in fewer available support systems, and feelings of isolation (Goldman et al., 2015). A substantial body of evidence has demonstrated that trainees are at high risk for depression and suicidal thinking, and this is before they embark on their career within healthcare.

Early career doctors therefore seem to be susceptible to entering the workforce with heightened levels of depressive symptomology and exposure to stressors which may lead to mental health conditions (Tija et al., 2005). However, medical training is itself recognised as a risk period for the development of mental health problems, such as depression (Pereira-Lima & Loureiro, 2015). A longitudinal study conducted in Japan by Ito et al. (2015) following trainees through their medical training found that 23.3% of participants (n=1020) had new onset depressive symptoms. This supports the claim that depressive symptoms begin in training, and that this is not a phenomenon confined to the West. It is suggested

that support and interventions may be required from the offset of a doctor's training to help ameliorate the risk of depression.

A North American survey of 126 residents and fellows found that 15.1% screened positive for major depressive disorder (Mousa et al., 2016). When compared to national estimates within the United States, the prevalence of a positive screen for MDD was over five-fold higher in medical trainees compared to age-matched controls (16% vs. 2.8%,  $p < 0.0001$ ), highlighting the need for additional support for those within this career path. These findings have been attributed to MDD being under recognised within medical trainees, compounded by the social stigma associated with depressive illness, and thus suggest the need for more mental health resources to support those within medical training.

Research conducted in China by Ding et al. (2017) found a 30.5% prevalence of depressive symptoms within trainee doctors ( $n=223$ ). Their findings suggest that a predictor of depression in trainees may be that of self-efficacy, with the study reporting a negative correlation between depression and self-efficacy scores (Patient Health Questionnaire-9, and general self-efficacy scale respectively).

However, there is no clarity within the literature regarding factors associated with doctor depression. For example, Pacheco et al. (2019), found that the female gender was associated with higher prevalence of depression in medical students. Claiming that this gender disparity may be explained by the effect of gender inequality. However, the effect of gender has been examined with mixed results. For example, a Norwegian prospective cohort study (Tyssen et al., 2000) found no gender difference for mental health problems within a similar cohort. In other contradictory findings, an increase in working hours has been found to lead to increased depressive symptoms (Sen et al., 2010). However, so did a reduction in time spent asleep (Goebert et al., 2009) – although the direction of causality must be



questioned within this claim as many depressive illnesses lead to reduced sleep and sleep quality. However, Tyysen et al. found that the amount of time spent on call, the number of hours sleeping whilst on call or the number of working hours per week were not associated with mental health problems and do not influence the rate of depression. This lack of clarity within the literature encapsulates the contradictory nature of the research within this area and the need for further investigation into the characteristics associated with depression within healthcare.

### *Anxiety*

North American research by Mousa et al. (2016) examining the prevalence of anxiety within trainee doctors (N=126) using the generalised anxiety disorder scale (GAD-7) – a screening tool with high levels of specificity - found that the likelihood of a positive screen was over eight times higher in medical trainees than in the general population (19% vs. 2.3%). The survey found no significant difference in age groups, gender, ethnicity, or post-graduate year of study in terms of GAD-7 scores. However, one third of participants within the study believed there was a significant impact of either depression or anxiety on their academic performance. This suggests that anxiety, as well as depression, is present from medical training and thus supportive interventions are needed to reduce anxiety within the medical profession.

A UK based randomised control trial assessed the impact of psychiatric interventions on doctor anxiety (Medisauskaite & Kamau, 2019). In doing so the authors established that the prevalence of severe anxiety among doctors within the UK is 13.2%. The study found that doctors who took part in an intervention - which involved being taught about the psychology of distress - experienced significant reductions in anxiety compared with the control group. These findings indicate that a reduction in anxiety can be achieved by reframing anxiety as a typical phenomenon among doctors, and therefore reducing any

associated stigma. The study found that by teaching doctors about the prevalence of distress within the profession, it helped doctors to realise that their distress is a normal reaction to their specific work environment. However, this inadvertently highlights the levels of stigma perceived by doctors regarding such mental health conditions and the corresponding issues that this causes.

Whilst there is a general paucity of research examining mental health within an explicitly surgical population within the UK/NHS setting, research examining performance anxiety among UK surgeons (defined as ‘anxiety in reaction to perceived threat concerning the performance of a task under pressure’) concluded with a call for action to conduct more research into the effect of such phenomena on surgeons. They propose that surgeons are a discrete group who need to be examined separately from other medical professionals. Especially when it pertains to how psychological phenomena link with concepts such as coping strategies and factors such as years of experience (Hotton et al., 2019). More studies with a focus on surgeons within a UK setting have begun to emerge. A nationwide cross-sectional study (N=631) has provided more insight into performance anxiety amongst UK based surgeons (Miller et al., 2022). All participants within the study stated that they felt that surgeons were affected by performance anxiety, with 87% of respondents reporting having experienced it themselves. Surgeons who had experienced performance anxiety reported significantly worse wellbeing compared with surgeons who had not. Therefore, anxiety is not only an independent concern for surgeons, but also a potential predictor of other mental health conditions – the interaction between which require further examination.

### *Stress*

The domain of stress within the profession of medicine has been relatively thoroughly examined. In 1982, it was commented within the literature that the stressors faced by doctors had been underemphasised (Bates, 1982). Since then, the growth within this field

of enquiry has been exponential. The lack of stigma surrounding stress making it an easier concept to examine (Firth-Cozens & Greenhalgh, 1997).

This thorough examination of the construct of stress has included the analysis of the impact of stress on surgeons as a discrete group. Surgeons in a 1990 UK survey (N=672) reported three major individual stressors: (1) the interference of the job with personal life, (2) general administration, and (3) the number of patients in clinics (Green et al., 1990). However, more recent qualitative research reveals that the number of stressors has grown, with the most stressful events being reported as unexpected surgical complications and emergency cases (Wetzel et al., 2006). A global survey (N=3391) of the psychological health of surgeons during the pandemic reported a growth of stress of 3.8% (Tan et al., 2022). 25.9% of respondents screened positive for stress. When this was broken down by surgical specialty, Ophthalmology had the highest proportion of respondents screening positive (34.6%), followed by Neurosurgery (33.3%) and Cardiothoracic Surgery (32.1%) – specialities who were unlikely to be able to carry on with their previous, pre-pandemic roles during this time and therefore unable to meet the ongoing needs of their patients. Female participants were 1.6 times more likely than males to screen positive for stress and younger respondents were more likely to screen positive than older respondents, a difference that was significant. This suggests that there are a variety of contributing factors to the levels of stress experienced by surgeons, and as such the investigation into such causal factors would be complex in nature.

Whilst it is commonly accepted that being a surgeon is a stressful occupation (Pegrum & Pearce, 2015), what is less clear is the interaction between stress and other factors that may be detrimental to wellbeing and their predictive values when it comes to negative affect and mental health conditions. Through the development of a statistical model, the

present research will be able to analyse the role that stress plays within the larger context of surgeon wellbeing.

## **Burnout**

How do workers cope with emotional arousal whilst performing their demanding jobs? The answer is, not everyone does. Research suggests that prolonged exposure to such arousal can leave workers in a state of stress and emotional exhaustion that inhibits their ability to flourish within their work environment (Maslach, 1976). This is known as burnout. Burnout was originally defined as the response to chronic emotional and interpersonal stressors on the job (Maslach & Leiter, 2016). It is characterised as a form of job stress, in which the stress experience of an individual is placed within the context of their work (Schaufeli et al, 2017). The psychological phenomenon of burnout was established within the United States in the 1970s before rapidly becoming prevalent within research across the globe (Maslach et al., 2001). Burnout was originally thought to be specific to those working within the ‘caring professions’, although this criterion was later superseded in the 1990s with the creation of a general measure of burnout (Maslach et al., 1996). This new measure reflected the concept that burnout is not a psychological phenomenon restricted to certain types of workers, but rather something that can affect anyone if they are predisposed or exposed to the right conditions.

The Maslach Burnout Inventory (MBI) has become synonymous with burnout, having been used in more than 90% of burnout studies since its conception (Schaufeli & Enzmann, 1998). The present research will not however be using this measure, and therefore the in-depth discussion of the three domains of Maslach’s burnout definition (Depersonalisation, emotional exhaustion, and low personal accomplishment) will not be debated at this stage. The critique of the MBI and the associated rationale for the use of the Copenhagen Burnout Inventory (CBI) (Kristensen et al., 2005) within this research will be addressed in the Methods chapter of this thesis.

There has been an exponential increase in the number of research papers published regarding burnout since the 1980s (e.g., Edú-Valsania et al., 2022; Maslach et al., 2001; McGeary & McGeary, 2012). One of the main reasons why this may be the case is that the phenomenon of burnout is deemed to be non-medical and a socially accepted label, with the core symptom – exhaustion – being a universal, psychological experience that carries very little stigma (Schaufeli, 2017). Therefore, people may be more willing to accept that they are ‘burned out’ and subsequently engage in studies related to this psychological phenomenon free from any associated stigma.

High levels of occupational stress have been found to correlate with burnout symptomology in many different professional environments. For example, Tsai et al. (2009) used the CBI in conjunction with measures of occupational stress and found that high occupational stress was associated with high levels of personal and work-related burnout among lawyers (N=180). A study (N=86) investigating this relationship within a teacher population found similar results, that higher stress on the job did indeed predict greater levels of burnout (Mearns & Cain, 2003). This suggests that occupations deemed as higher stress work environments could lead to more burnout within the employee population. Interventions and support strategies are therefore required within any high stress work environment.

Burnout as a psychological phenomenon, much like many of the constructs examined within this research, has become conflated with other terms, and used colloquially to mean something other than its originally intended definition (Edú-Valsania et al., 2022). Often, burnout is used to refer to such discrete experiences as emotional exhaustion, compassion fatigue, physical exhaustion, and general reduction in functioning (Maslach et al., 2001). Yet burnout is a conceptually different variable from these constructs. It is

therefore vitally important that the integrity of burnout as a unique phenomenon remains intact, and that what is meant by its usage is explicitly stated, to ensure a reduction of confusion within the literature.

There is an inconsistency within the literature regarding the distinction between burnout and depression. For example, an initial small scale meta-analysis conducted by Glass and McKnight (1996) in which 18 studies were analysed, found the two to be discrete constructs. However, the later, more comprehensive meta-analysis of Bianchi et al. (2015) found that depression and burnout overlap, with most individuals suffering from burnout having co-morbid depressive symptomology. However, Bianchi et al. state that there is a paucity of research examining both clinical depression and clinical burnout, with many studies using screening measures rather than diagnostic tools, which will have an impact on findings. They also highlight that there is no current clarity regarding whether vulnerability factors for one condition also predispose individuals to the other. The analysis of this relationship will therefore be an important point of investigation within the present research, analysing the relationship between depression and burnout within the surgical population and thereby adding to the knowledge and understanding of this debate.

### **Burnout in Medical Professionals**

Originally burnout was thought to be a psychological phenomenon limited to those working within 'people centred' professions (Maslach & Jackson, 1981). This may account for the vast scope of research into burnout within the domain of healthcare (e.g. De Hert, 2020, Montgomery et al., 2019; Wood & Killion, 2007). Burnout in healthcare workers has been related to risks to patient safety (Hall et al., 2016), workforce attrition and retention (Fitzgerald, 2017) and productivity (Turner et al., 2017). Burnout among those working in healthcare could not only be putting patients' lives at risk but could also have a significant

impact on the economy and is therefore of considerable importance within future research and intervention design.

The efficacy of rehabilitation interventions focussing on reducing or reversing burnout symptomology has been tested with positive outcomes. For example, Häätinen et al. (2007) compared the effects of two rehabilitation interventions on burnout during a one-year intervention period (N=20). Such interventional approaches were found to reduce perceived levels of exhaustion and cynicism within the participants and increased their perceived levels of job control, with job control acting as a key moderator for levels of both exhaustion and cynicism. There are however many different formats/strategies for burnout interventions, many of which have displayed high levels of efficacy and positive outcomes for individuals. For example, evidence indicates that interventions based upon concepts of mindfulness and meditation may be effective treatment options for surgeons suffering from burnout symptomology (Daniels et al., 2016). The concept that burnout can be positively manipulated is of benefit within the domain of healthcare. The implementation of burnout interventions for those working in the healthcare domain may improve patient safety and potentially reduce unnecessary costs to the NHS and the taxpayer.

Although burnout has been found to affect all types of healthcare workers, research indicates that it specifically effects surgeons in a profound way (Patti et al., 2018). Although doctors in general are at an increased risk of burnout due to their experience of long work hours, challenges with work and home balance, and issues associated with patient care (Dimou et al., 2016), Shanafelt et al. (2010) reported from their large American dataset (n=7905) that experience of error, for surgeons, had a significant adverse relationship with reported levels of burnout. The rate of burnout among surgeons is much greater than that of the general population (40% vs 28%). This suggests that burnout is more prevalent within a surgeon population and therefore the need for a thorough investigation into the predictive



factors leading to burnout amongst surgeons, so that interventions may be established to ameliorate their impact.

However, with regards to the causality of burnout, research indicates that error cannot be empirically proven to be the main contributing factor, with other, confounding variables being contributing factors to the cause of burnout (O'Connor et al., 2017). American research preceding the Shanafelt et al. study (n=582) highlights that stress, specifically chronic, long-term stress, is a key factor leading to burnout within a surgeon sample (Campbell et al., 2001). The Campbell et al. research also highlighted various factors regarding the aetiology of burnout, such as: perceptions of the work being overwhelming, work/life balance, the rewarding nature of the job and levels of autonomy. They also found that those who scored more highly within the domains of burnout (MBI) were more likely to display a desire to retire early. Therefore, the cause of burnout must be considered multifactorial and burnout interventions must take this into consideration.

Shanafelt et al. (2009) conducted a national study of burnout in a large sample of US physicians from all specialty disciplines, using the MBI as a measure of burnout. The research found that 40% of their sample (N=7905) screened positively for burnout symptomology. Their findings suggest that burnout is the single greatest predictor of career satisfaction among surgeons, with causes for higher levels of burnout symptomology being linked to age, having children, surgical speciality, nights per week on call, hours worked, and, given that this was a study located in the United States, having professional earnings based entirely on billing. With such a range of factors associated with this umbrella construct of burnout, it is important that individual factors are assessed, so that their impact on surgeon wellbeing can be determined - rather than just associating outcomes with an overarching domain. Future research will therefore benefit from including individual measures for wellbeing and quality of life alongside measures of burnout.

## **Post-traumatic stress**

Post-Traumatic Stress Disorder (PTSD), previously referred to as ‘traumatic neurosis’, was recognised as a psychological construct within the 3<sup>rd</sup> edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-III) in 1980. Whilst once included within the category of general anxiety disorders, PTSD has subsequently been categorised as a discrete ‘Trauma and Stressor-Related Disorder’ (American Psychological Association, 2008). However, PTSD is not a new psychological phenomenon. The disorder has been documented anecdotally, or under different names, from a number of different sources, including combatants from wars throughout history (Gersons & Carlier, 1992), accident victims (Delahanty et al., 2003) and victims of rape and sexual abuse (Rothbaum et al., 1992) long before the 1980s, with some historians claiming that it has been a psychological battle fought by humans throughout history, with documentation to support its occurrence for thousands of years (Ustinova & Cardeña, 2014). PTSD is also not excessively rare. According to the 2014 Adult Psychiatric Morbidity Survey the condition is experienced by 3.7% of men and 5.1% of women within England, with 12.6% of women aged 16-24 screening positively for PTSD symptomology (McManus et al., 2016), compared with a 6.8% prevalence within the general population in the United States (Akiki et al., 2017). Therefore, PTSD or PTS symptomology is a notable issue faced by individuals today and the impact of this – both individually and systemically – should be considered by researchers and other stakeholders such as employers and educational bodies.

By means of possible explanation for the high prevalence of PTSD within the general population, it is important to refer to research such as that conducted by Breslau et al. (1998). Within this research, a representative sample of a US city (N=2181) were interviewed to assess their lifetime history of traumatic events and PTSD. The findings suggest that most people within this setting had been exposed to an event within their lifetime involving actual

or threatened death, serious injury or a threat of serious injury to themselves or others. Such traumatic events fall within the accepted criteria for triggers of PTSD and could therefore explain why there is such a high prevalence of PTS symptomology within the general population.

It was once believed that PTSD could only develop after such direct experiences of trauma (Ustinova & Cardena, 2014), however revisions to the PTSD criteria now ascertain that PTSD can manifest through indirect exposure to aversive details of the trauma, usually in the course of professional duties (American Psychological Association, 2013). It is therefore recognised that PTSD can occur because of experiences within a work domain and does not necessarily necessitate an individual to have feared for their own lives or the life of a significant other.

This revelation is notable when deliberating the impact of traumas faced by workers within their work environment. Such events can cause significant psychological distress, and this should be taken into consideration with regards to the implementation of protective interventions within high-risk occupations. High risk occupations may not necessarily be confined to those where workers' lives are potentially risked within the line of duty, such as the military or the emergency services. However, there is a remarkable paucity of research into screening, monitoring and the effectiveness of empirically based treatments within different occupational groups (McFarlane & Bryant, 2007). This suggests that there is a need for research to address these gaps and examine the impact that high risk professions have on the wellbeing of workers – especially in relation to PTS symptomology. Through the examination of the scale of this issue, individual and systemic changes can then be developed using evidence-based interventions to ensure that the prevalence of PTS symptomology is reduced wherever possible.

PTSD is one of a few psychiatric conditions for which the aetiology is clearly established. In PTSD, individuals develop a collection of symptoms following an emotionally traumatic event. The DSM 5 outlines these as rumination or re-experiencing of the traumatic event, avoidance of trauma related stimuli, negative thoughts and feelings, and trauma related arousal and reactivity (American Psychological Association, 2013). To be classified as PTSD the symptoms must persist for more than a month and create distress or impairment of functionality within the affected individual. It must also be confirmed that the symptoms are not being caused by any medications or any co-morbid disorders. Somewhat understandably, such symptoms may impair ability to function within a work environment, but also, the root cause of trauma is likely to be linked to such a domain, and therefore avoidant behaviours may be utilised to limit exposure to any trauma related stimuli. Absenteeism may therefore increase within these circumstances, leading to a loss of productivity, a diminished workforce and, in some circumstances, a loss of profit (American Psychological Association, 2013).

As well as behavioural and psychological changes within individuals affected by PTSD, neuroimaging studies have also demonstrated significant neuro-biological changes (Nutt & Malizia, 2004). Examples of such neuro-biological changes are amplified amygdala responses, leading to heightened fear associations and intensified fear responses; deficient frontal cortical function, which mediates the capacity to suppress responses to trauma-related stimuli; and a deficiency in hippocampal function, accounting for deficits in the ability to recognise safety (Rauch et al., 2006). These changes to brain structure must be considered when thinking about the implications of PTSD on functionality. For example, the implication of reduced hippocampal functioning on wayfinding and navigation will be discussed later in this chapter.

PTSD is a known risk factor for suicide and suicidal ideation. A 2004 study – one of the few focussing on a civilian population – of 94 participants with a diagnosis of PTSD

found that over half of their sample (56.4%) reported some aspect of suicidality. Of that figure, 38.3% reported suicidal ideation, 8.5% reported that they had made plans of suicide and 9.6% having attempted suicide since they experienced the traumatic event that triggered their condition (Tarrier & Gregg, 2004). It is therefore vital that PTSD is diagnosed within a timely fashion so that effective interventions may be implemented to reduce negative affect and detriment to wellbeing and quality of life.

### **Post-Traumatic Stress in Medical Professionals**

Within the global survey of the psychological health of surgeons during the Covid-19 pandemic, it was found that 24.0% of respondents screened positive for PTSD (Tan et al., 2022). Surgical personnel demonstrated noteworthy levels of psychological trauma because of the pandemic, including moral injury due to lack of manpower, personal protective equipment, and social support and with conditions comparable to that of warfare due to the heavy loss of life experienced by those on the front line of healthcare, and the disruption experienced to their daily routines. However, this is not the only causal factor for PTSD symptomology within healthcare. A Polish meta-analysis examining the prevalence of PTSD among healthcare workers reported a prevalence of 15 to 25% of doctors screening positive for PTSD (Jacob-Sendler et al., 2016). The analysis found four distinct stressors within healthcare leading to PTSD symptoms. Two of the four distinct stressors identified were the general stress associated training and the treating trauma of patients. The significance of these events is that – unlike the other two stressors: working in either a conflict zone or a rural area – almost all surgeons will experience these within their careers. Meaning that most surgeons are predisposed to PTSD symptomology through the very nature of their training.

Research conducted by Jacob-Sendler et al. (2016) demonstrates that protective factors against PTSD symptomology are that of social support and training specifically

designed to support doctors in dealing with patient deaths. Lack of either of these preventative measures resulted in a higher prevalence of PTSD within doctors (Jacob-Sendler et al., 2016). However, much research conducted into PTSD within medical professionals focuses on samples working within extraordinary environments, such as those who work with victims of terror (Weiniger et al., 2006), or those who experienced conflict (Luce & Firth-Cozens, 2002) and are therefore unlikely to generalise to the entire population.

Specific groups within medicine are therefore more likely to suffer PTSD symptomology than others, with those with higher exposure to trauma are more likely to develop symptoms and be negatively affected. A north American national survey (N=453) examining the prevalence of PTSD within trauma surgeons by Joseph et al. (2014) found that PTSD symptoms were present in 40% of the trauma surgeons, with 15% of participants meeting the diagnostic criteria for PTSD, suggesting that a higher prevalence of PTSD symptoms could be caused by exposure to other people's trauma experienced through being a trauma surgeon. However, prior research suggests that there is no correlation between PTSD symptoms and caring for trauma patients (Warrant et al., 2013). This result comes from a survey of various surgical specialties (N=133) in which 22% of participants were found to have diagnostic symptom criteria for PTSD, with 65% of participants exhibiting at least one symptom. However, the magnitude of exposure to trauma patients was similar between surgeons with and without PTSD symptoms. This suggests that it is not necessarily exposure to trauma patients that leads to PTSD symptomology but could rather be some other factor innately within the surgeons' role.

Warrant et al. (2013) measured the interaction between PTSD (using the Secondary Traumatic Stress Scale (STSS; Bride et al., 2004), resilience (using the Connor-Davidson Resilience Scale; Connor & Davidson, 2003) and exposure to trauma. Higher resilience scores were found to be associated with lower STSS scores, with surgeons who met symptom

criteria for PTSD exhibiting significantly lower resilience scores. This suggests that higher levels of resilience could protect surgeons from developing PTSD symptoms. The protective role of resilience will be discussed later within this chapter, as this may be a significant relationship within this research and one that needs further investigation within the context of surgeons within the UK.

Whilst traits such as resilience are known to be psychological constructs, PTSD is not a purely behavioural or psychological phenomenon. PTSD has also been found to cause notable neuro-biological changes, suggesting that it has a physical impact on the structure and neuro-biological components of the brain (Karl et al., 2006). The neuro-biological changes caused by PTSD are important considerations and are a patient safety consideration when linked to issues such as the wayfinding implications of diminished hippocampal functioning.

Surgeons are required to have excellent spatial awareness, navigation, and wayfinding capacities, whilst also making correct decisions and solving problems to enable them to do their job and operate successfully on the human body (Stüdeli, 2009). However, high levels of cortisol associated with stress have been found to have neurotoxic effects on the hippocampus (Bremner et al., 1995), with PTSD patients being found to have an average 8% smaller right hippocampal volume relative to that of the comparison subjects. The hippocampus is critical for spatial navigation - our ability to calculate and navigate our environment (Sodoma et al., 2021). When surgeons are operating, their main source of navigation is their spatial-mental model of the patient's body (Stüdeli, 2009). Any reduction in the functionality of this wayfinding ability could potentially cause harm to patients and lead to an increase in surgical errors – thereby leading to a cyclical process of error, trauma, and PTSD symptomology. Investigation of the prevalence of PTSD symptomology, as well

as possible predictive and protective factors, are therefore of interest from both a surgeon and patient safety perspective.



## **Resilience**

The demands expected of employees by their employers/institution is ever increasing, with higher expectations of output, alongside a potentially diminishing workforce, leading to more reports of work-related illness. Winwood et al. (2013) conducted two separate cross-sectional studies utilising confirmatory factor analysis to analyse the relationship between the factors underpinning workplace resilience. They highlight that ‘work related stress’ accounts for 50% to 60% of lost working days within Europe, with an accompanying financial implication of €22billion per annum. A common response to stress-related lost working days is that employees need to be ‘more resilient’; the expectation that they need to somehow ‘cope’ with the demands of the work, despite facing chronic or acute stressors which affect them psychologically within their working life. Research is required to ascertain whether this is actually the case. Whether it is indeed a personal failing of individual employees that is leading to diminished operating profits and work productivity, or whether there are larger systemic causes that could be adapted to cater for the needs of employees. This section will introduce the concept of resilience and examine its perceived ‘role’ within the workplace; analysing the research within this area and the efficacy of resilience-based interventions designed to positively affect employee wellbeing.

There is, to date, no universally accepted definition of ‘resilience’. However, the term is often described containing the following two facets; facing adversity/challenges, and subsequently adapting positively to meet them (Winwood et al., 2013), these concepts are observable in definitions of resilience, such as: ‘the flexible response to changing situational demands, with the ability to recover from negative emotional experiences’ (Block & Block, 1980) and the ‘positive adaptation in the context of significant adversity’ (Masten & Reed, 2002). However, this two-factor definition is not universal. Taormina (2015) presented a four-factor resilience model, which includes determination (the determination of the

individual to survive), endurance (the ability to endure/cope with hardships), adaptability (the ability to adapt to changing conditions) and recuperability (recovery from hardships). This thesis argues that the delineation between such factors as determination and endurance, or adaptability and recovery may be weak, it brings to question whether a two or four factor construct would be found if an in-depth factor analysis was run on resilience measure data; specifically, as the findings put forward by Taormina are purely theoretical in nature. Previous literature does however support various dimensions of this multi-faceted view of resilience (Bandura, 1989; Bonanno, 2004; Rutter, 1987; Tugade et al., 2004), with a key tenet of each definition being that resilience is an internal process. Whilst there is an acceptance that resilience may be moderated by external factors such as social support, it is much agreed that it is a process internal to the individual (Taormina, 2015). This view of resilience as restricted to an individual psychological process is to be discussed in more detail later in this section.

It is commonly accepted that individuals with high levels of resilience exhibit the ability to experience positive affect even during stressful events (Tugade et al., 2004) and this spectrum of response - exhibited by those with 'high' vs 'low' resilience - can be witnessed in many workplaces; with some workers coping with the high demands and expectations, whilst others fail to thrive under the same conditions. What is perhaps less apparent is how the construct of resilience differs from other much utilised terms such as 'coping' and 'tolerance' (as mentioned before with regards to terms such as 'adaptability' and 'recovery', there seems to be conflation between the use of such terminology that may confuse the way in which the phenomenon is viewed). Whilst the terms may be synonymous in general parlance, resilience within this context is regarded as a specific psychological construct, a process that must be defined to a higher degree than someone's innate 'bounce-back-ability'. Therefore, the historical context, mechanisms and aetiology of resilience will now be discussed.

The concept of resilience emerged from investigations into individual differences in responses to adversity (Garmezy, 1974; Rutter, 1979; Rutter et al., 1993; Wemer & Smith, 1982), with initial research focussing on the prevalence of protective factors within some children, which allows for them to thrive despite experience of adverse, or even traumatic, life events (Luthar et al., 2000). Specifically, the findings of a longitudinal study investigating children from birth to 18 years in Hawaii (n=660) shed insight into what became known as the phenomenon of 'resilience' (Werner et al., 1971). The implications of factors such as social class on a child's vulnerability to childhood mental disorders was analysed, as well as the effect that the quality of interactions with caretakers had on children, and the importance of communication skills in allowing children to overcome emotional and educational barriers. This research provided much needed detail about the concept of resilience that had until that point been lacking an empirical evidence base. Werner et al.'s research being longitudinal gave real insight into the factors that may exacerbate or protect against negative outcomes, and the concept of resilience was born.

Research into the psychological determinants of children with schizophrenic mothers also supported this development in understanding (Garmezy, 1974). The ability of some children to flourish within such adverse developmental environments led to empirical research into which individual differences may act as protective factors against negative affect. Garmezy investigated the relationship between the exhibited behaviours of children deemed to be potentially vulnerable to psychopathology, and a criterion of their qualities of competence. The emergence of an understanding of adaptability to negative experiences provided a more solid foundation on which the literature regarding childhood resilience could be built. Further research went on to examine the phenomenon of child resilience in a wide range of contexts, such as socioeconomic diversity (Rutter, 1979), dealing with mental illness of key caregivers (Masten & Coatsworth, 1995) and coping with being neglected, abused, or maltreated (Cicchetti, 1996). This suggests that the psychological construct of

resilience is a protective factor within many domains and seems to be innately developed within individuals, starting from childhood.

Although these pieces of research, in their day, were hugely significant with regards to moving forward the psychological understanding of the concept of resilience and ‘resiliency’, their findings have been superseded in subsequent decades. Initial research within this field focussed primarily on external factors as a determinant for the individuals’ level of resilience. However, as mentioned earlier in this section, research has since shifted its focus from examining possible protective factors to instead investigating the possible underlying internal psychological processes that determine how an individual reacts when they encounter adverse life events (Luthar et al., 2000). Although more recent studies examining the underlying processes within the construct of resilience have indicated potential psychosocial factors that may influence an individuals’ resilience (Ballenger-Browning & Johnson, 2010), one of the key advancements within the understanding the internal processes linked to resilience have been made in the field of neurochemistry; specifically through analysis of the hormones, neurotransmitters and neuropeptides linked to the stress response that may account for individual variants in resilience levels of different individuals (e.g. Averill et al., 2018; Charney, 2004; Feder et al., 2009; Feder et al., 2010). This shift has a significant impact on the way in which the construct of resilience is conceptualised, it is now viewed as a psychological and neurological process with internal mechanisms, rather than something that is solely determined by external or environmental factors.

However, this internalisation of the construct presents its own issues within this field of research: If it is an internal process, then is resilience therefore the responsibility of the individual? Are some people just ‘less resilient’ than others, and is a ‘lack’ of resilience a personal weakness or failing? Is resilience a fixed construct, one that is stable and unchanging across all domains? Although aspects of the literature have tried to address these questions,

much debate regarding the nature of the construct is ongoing and will be outlined within this section. What is more apparent however, is how the term has been misappropriated within mainstream usage. In workplaces, resilience is seen to be used as a weapon; employers are demanding that their workforce 'be more resilient' and utilising the term as a synonym for 'work harder'; with an expectation that employees should not be distracted or negatively affected by adverse life events (McCrae, 2019). There is very little evidence currently supporting the weaponization of resilience. However, anecdotally, resilience is accruing a negative connotation in certain domains, and the understanding and acceptance of the phenomenon as a specific psychological construct is being lost.

This lack of consensus with regards to how to use the term 'resilient' continues to be an issue not just in everyday discourse, but also within academia. The variety of definitions utilised in research has led to a vast range of measures being developed, with a range of factor structures. For example, the Dispositional Resilience Scale (Bartone, 1991) a 45 item, 3 factor construct derived from literature surrounding the concept of hardiness; the ER 89 (Block & Kremen, 1996) a 14 item single factor measure examining ego-resilience, which assumes that ego resilience provides individuals with the ability to resist anxiety; the Resilience scale for adults (Friborg et al., 2003) a 37 item, 5 factor construct examining the intrapersonal and interpersonal features of resilient people. However, the validity of such measures must be brought under scrutiny when a clear classification of the construct cannot be attained, as how can something be measured if there is no clear, agreed upon definition of the thing itself? Different methodologies may therefore be leading to an understanding of discrete psychological processes, rather than adding to the wealth of understanding surrounding this one unique term. However, within a presentation at the 104<sup>th</sup> annual convention for the APA, Luthar (1996) argued that through the application of a diverse range of empirical methodologies the understanding of any scientific construct, but specifically resilience, can be expanded. An important caveat to this argument however is that the theoretical

underpinnings of such empirical research must be robust enough to justify why such an approach was deemed to be relevant to this area of research. Such theoretical foundations are essential to ensure that the validity of the construct of resilience is maintained.

Ambiguity also surrounds the nature of resilience, questioning whether resilience is an enduring personal characteristic (Aspinwall, 2001; Block & Block, 1980) or whether it is a dynamic process that can change and fluctuate over an individual's lifetime (Block & Kremen, 1996; Luthar et al., 2000). This 'process vs trait' debate is of key importance when considering utilising interventions that aim to increase/manipulate levels of resilience within individuals. If an individuals' level of resilience has a fixed capacity, then psychological interventions could have no meaningful impact, with any improvements in wellbeing resulting from such studies only being accounted for by mediating or confounding variables. However, despite the obvious need for clarity researchers often use the term interchangeably to refer to resilience as a trait or a process (Luthar et al., 2000). Luthar et al. argue that it is the separate construct of 'ego-resiliency'; a set of personal traits related to resourcefulness, sturdiness of character and a degree of psychological flexibility (Block & Block, 1980), which has been conflated with resilience to create this confusion. Ego-resilience is a fixed personality characteristic and does not rely on the experience of an adverse life event (Luthar et al., 2000). Resilience, in contrast is a reactionary process (Luthar et al., 2000). This understanding that resilience is a fluid construct highlights the underlying psychological and neurological processes from which it manifests, and therefore supports the concept that resilience may be amenable to manipulation through psychological intervention.

Domain specificity is another factor for consideration within the resilience literature, as it argues that resilience levels can change depending on the situation someone finds themselves in. This is important to consider as someone may be resilient within their personal life but have lower levels of resilience within their work domain. Hunter (2001) used focus

groups to qualitatively explore the perceptions of resilience in varied socioeconomic and cultural environments and supports the argument that resilience is domain specific, meaning that one individual may be resilient and not resilient at the same time, as well as concluding that there are a range of different types of resilience – some more helpful than others. Thereby asserting that resilience is not an overarching construct; that one may be more resilient in one context than another. Given its roots within developmental psychology (Masten& Reed, 2002), an appropriate example may be one utilised within Tusaie and Dyer’s (2004) paper regarding the history of resilience. Their systematic review of physiological and psychological research from the 19<sup>th</sup> century provides evidence to support the claim that an individual who experienced abuse and neglect as a child may grow up to be an adult who demonstrates high levels of resilience within an academic and employment capacity, however they may demonstrate an inability to maintain relationships or flourish within a psycho-social domain. They may classify as having high levels of resilience in some environments, but in others their diminished resilience is debilitating, potentially having a negative impact on their wellbeing and quality of life. This supports the domain specificity of resilience and may have implications for the analysis of resilience when looked at in all contexts of a person’s life, rather than being domain specific.

### **Resilience in the workplace**

Individual resilience within the workplace is seen by some to be a vital component for overcoming adverse events and enabling success (King et al., 2015), with those deemed as ‘more resilient’ demonstrating a more effective ability to effectively bounce back from stressful experiences without them having a detrimental impact on their psychological wellbeing (Fredrickson, 2001). Within a commissioned thought piece for the British Medical Journal, Oliver (2017) argues that the construct is being used as a tool to shift the blame for failings in the workplace away from understaffed and underfunded systems and onto

individuals. He argues that the focus should be on developing robust systems that support their employees, allowing them to flourish despite the demands of their jobs, rather than expecting individuals to take responsibility for their own ability to cope with adverse conditions by being 'more resilient'. Whilst this may be salient point, it again demonstrates how it is vital to first delineate between what is meant by resilience within a specifically psychological context, and how the term has come to be used in everyday discourse. One of the main issues faced when looking at resilience systemically, however, is how it is measured and monitored, and that reducing 'systemic resilience' to a measurable unit may inhibit the deeper understanding of system dynamics that are needed to apply resilience thinking in this way (Quinlan et al., 2016).

The leap from individual resilience to systemic resilience may seem vast, but what is often overlooked is that another significant shift in thinking has already taken place within the resilience literature (e.g. Howard et al., 1999); that of taking a developmental theory and applying it to an adult population. Resilience as a successful adaptation to adversity is now frequently utilised in reference to adults, within a multitude of domains, such as examining how resilient people are at work (McEwen, 2011), after experiencing trauma (Bonanno, 2004) and illness (Kross & Hough, 2016). However, questions must be raised regarding the validity of converting the concept of resilience from a childhood psychological phenomenon to an adult process, and the potential for misapplication of the concept to inappropriate populations must therefore be a consideration. Bonanno (2004) conducted a meta-analysis to review the psychological research regarding resilience and argues that adult resilience is however a common phenomenon, a key component of the healthy functioning of adults following any type of trauma. However, Bonanno (2004) defined adult resilience as stress resistance. Although this is one plausible way of defining resilience, it is by no means an exclusive definition. This suggests that while resilience may be more of a common phenomenon within adults than previous research suggests (Ungar, 2010), there are still



issues within this research area relating to the definition of the construct and therefore the associated measures used to examine its prevalence within the population.

Resilience within the workplace, whether individual or systemic, should be a concern for employers/institutions given it is a cognitively protective process supporting the ability to recover from the experience of negative emotions. Positive affect is proposed to significantly impact on health and wellbeing (Folkman & Moskowitz, 2000). In physiological capacity positive emotions improve the immune system, sleep quality and longevity whilst reducing heart disease and hypotension (Tugade et al., 2004). Regarding wellbeing and mental health, experience of positive affect can reduce stress (Folkman & Moskowitz, 2000) and ameliorate depressive symptomology (Davis et al., 1998). Therefore, resilience, may in fact reduce both the physiological and psychological impact of negative events, meaning a reduction in sickness and absenteeism and potentially an improvement in profit and/or general productivity. Limited research has considered the relationship, or possible interaction between, resilience and burnout, with fewer still investigating the ways in which positive and negative emotions are interconnected in times of stress (Ong et al., 2006). The model put forward by Dunn et al. (2008) is that both burnout and resilience are outcomes of psychological distress. It is suggested that the ability to cope is finite and once depleted the outcome for the individual is either burnout or resilience. It must be considered however that resilience may take on a mediating role, explaining the variance in the relationship between the impact of the adverse event and burnout, or even a moderating role, impacting the strength of the relationship between adverse event and burnout. Analyses of a structural model that examines these relationships may provide a theoretical understanding of resilience's role in burnout and this is examined in the present research.

## **Resilience in Medical Professionals**

A General Medical Council (GMC) internal review (Horsfall, 2014) examining the prevalence of suicide within doctors under fitness to practice investigation recognised that the medical workforce needs to be resilient to cope with difficult situations. The report advised that doctors should be taught emotional resilience, starting in medical school, and continuing throughout their career. However, resilience within healthcare is more than just ‘not burning out’. An international systematic review with the aim of providing a current understanding of health professional resilience has been able to shed light on the key associated characteristics and factors (Robertson et al. 2016). The study confirmed that resilience within a healthcare setting is multi-factorial – a combination of positive personal traits and the experiences of the individual. The synthesis of findings from the study resulted in a plausible model for professional resilience specific to healthcare. In that model, resilience permits the individual to manage high workplace demand, assisted by external supports – from both a social and employment setting. Resilience is demonstrated within individuals who continue to perform well, adapt to changing circumstances, and can maintain professional and personal fulfilment. Resilience in healthcare professionals is underpinned by the traits of high self-determination, high persistence, and low harm avoidance. However, the systematic review found few studies with a focus on resilience within healthcare (13 studies: 8 quantitative, 5 qualitative), with the majority focusing on the resilience of doctors as one, undifferentiated group. This suggests that high levels of resilience are required to function at optimal efficacy within an NHS setting and that this should be supported through training and interventions throughout a medical professional’s career.

Resiliency training is a contentious issue within healthcare. A systematic review and meta-analysis of resilience training programmes and interventions found that resilience interventions based on a combination of cognitive behavioural therapy (CBT) and

mindfulness techniques appear to have a positive impact on individual resilience (Joyce et al., 2018). Both CBT and mindfulness were found to positively treat other common mental health conditions such as anxiety and depression, and the meta-analysis highlighted that there is a growing consensus that using such treatment to support the development of resilience have been successful – supporting the idea that resilience is a malleable characteristic. However, a review into psychological interventions to foster resilience in healthcare professionals suggests positive effects of resilience training for healthcare professionals but highlight that the current evidence to support this claim is very uncertain (Kunzler et al., 2020). Kunzler et al. examined RCTs in healthcare professionals, comparing any form of psychological intervention to foster resilience with a control or waitlist measure. The research revealed a paucity of medium and long-term data regarding these interventions and a clear need for high-quality replications and improved study designs.

The American Psychological Association notes that ‘resilience is an ongoing process that requires time and effort and engages people in taking a number of steps.’ (Coleman, 2017, page 177). However, more important is the recognition that resilience can be learned. On the website of the Royal College of Surgeons of Edinburgh (2022) it is stated that ‘resilience is now recognised in healthcare as a collection of features that can be learned by individual doctors.’ However, as will be discussed within the Measures section of this thesis, there are currently no robust measures of an individual's resilience, nor any way to assess the efficacy of interventions designed to improve it (Arnold-Forster, 2020). Given that it is such an important protective factor against detrimental effects on wellbeing, this gap within the wellbeing landscape needs to be addressed. This present research is unable to make recommendations for resilience measures or interventions; however, data gathered under the auspices of this research will support such endeavours, by providing a pre-pandemic picture of resilience within the UK surgical community.

## Psychological flexibility

Biglan et al. (2008) defined psychological flexibility as an ability to remain fully in contact with the present moment and to pursue behaviours that will serve valued ends. Similarly, Bond et al. (2008) define it as the ability to focus on the present moment and, depending upon what the situation affords, persist with, or change one's behaviour in the pursuit of goals and values. Psychological flexibility might therefore be thought of as the ability to be more aware, more engaged, and more focused on goals, with the ability to accept difficult thoughts or emotions as part of the ongoing human experience (Wegner, 1994). Others view psychological flexibility as a more complex concept, relating to several dynamic processes which are utilised and developed over time (Kashdan & Rottenberg, 2010). This process approach is reflected in recent models of psychological flexibility. The psychological flexibility model proposed by Hayes et al. (1999) is composed of six processes as demonstrated in Figure 1. The figure is known as the 'Hexaflex', and it illustrates the way that these processes are all connected to and support each other. Each of these core processes is then discussed.

Figure 1

The ACT Hexaflex: The six core processes of psychological flexibility (Harris, 2008)



### *(1) Cognitive defusion*

Cognitive fusion can be described as a problematic manifestation in which internal stimuli (thoughts, memories, beliefs) dominate the regulation of behaviour to the detriment of other sources of behavioural regulation (Bond et al., 2006). Cognitive fusion leads to individuals getting entangled in their own negative thoughts, allowing for their behaviours and actions to be determined by internal experiences rather than the reality of the external situation.

Cognitive defusion is the process of change for treatment of cognitive fusion. Defusion allows for the decreased believability of the internal stimuli. Whilst such thoughts still occur, their legitimacy can be assessed, creating a break in the cycle of negative thoughts affecting behaviour. Thoughts or feelings may be noticed and evaluated as negative, but these thoughts and feelings no longer evoke behavioural changes or life restricting avoidance. Changing the relationship to the internal experience rather than changing the content of the experience (Hayes et al., 2004).

### *(2) Experiential acceptance*

Experiential avoidance is an inflexible response to negative thoughts, memories, and feelings. A phenomenon that occurs when a person is unwilling to remain in contact with internal stimuli (Hayes et al., 1996). Rather than confronting such internal experiences individuals may choose to avoid certain contexts that bring them to mind and take steps to alter the form or frequency of these events. Experiential avoidance has been implicated in a wide range of psychological problems and disorders, from substance abuse to suicide (Hayes et al., 2004). Experiential avoidance can be harmful due to the potential for internal stimuli being unresponsive or even increased by efforts to deliberately control. It is noted that many healthy behavioural changes often initially cause psychological discomfort (Hayes et al.,

1996). By actively avoiding such experiences it could lead to higher levels of psychopathology and a lower quality of life (Hayes et al., 2004).

Experiential acceptance is the process of change for treatment of experiential avoidance. Based on being open to internal experiences as they arise, even when they are unpleasant. Experiential acceptance allows individuals to make healthy behavioural changes and develop strategies for dealing with negative internal experiences. Like cognitive defusion, experiential acceptance does not assume a change in the frequency or occurrence of negative internal stimuli, but rather refers to a difference in approach to internal experiences. Whereas avoidant behaviours can lead to negative outcomes, a flexible approach through experiential acceptance can reduce psychological harm.

### *(3) Present moment focus*

Loss of flexible contact with the now can be described as a problematic manifestation in which individuals lose touch with the present moment: both in terms of the immediate physical or social environment and their psychological reactions (Bond et al., 2006). Present moment focus is the process of change for treatment of loss of flexible contact with the now. Present moment focus is the process of being psychologically present, consciously connecting with the here and now. Individuals with more present moment focus experience the world more directly and exhibit ongoing non-judgmental contact with psychological and environmental events as they occur (Harris, 2008). Rumination is a key indicator of loss of flexible contact with the now, in which individuals are entangled with events of the past and how they will affect their lives in the future, thereby degrading the here and now experience. Psychological flexibility, and therefore present moment focus, will mitigate against rumination and allow individuals to focus on achieving in the present moment.

#### *(4) Self as context/the observing self*

The ability to recognise the self as context or the observing self and work on letting go of their attachment to a conceptualised self, i.e. I am useless; I am a failure, is a key process of psychological flexibility (Hayes et al., 2015). The ways in which individuals define themselves, particularly when referring to the conceptualised self, can be problematic. A flexible hold of the definition of self can allow individuals to reach goals and hold on to values they hold as important. However, an inflexible or fused definition of self can lead to scenarios in which psychological wellbeing is negatively affected.

#### *(5) Chosen values*

The chosen values of an individual are key drivers in determining their behaviours and actions on an ongoing basis. For an individual to be psychologically flexible they must have a clear set of values that act as a guide for their behaviours, actions, and psychological processes. It is however possible that values can get lost, neglected or forgotten. Those with more psychological flexibility will not allow their values to be influenced by fusion or avoidance but would ensure that their values drive their behaviours and actions (Bond et al., 2006).

#### *(6) Committed action*

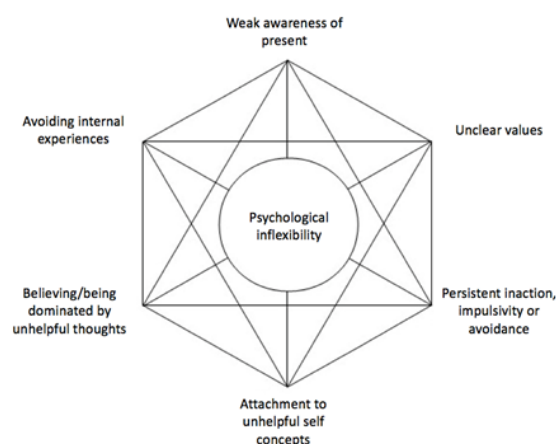
The values that individuals strive to uphold are often not easy to achieve. Committed action refers to behaviour patterns that are linked to the achievement of such values and goals even if they cause pain and discomfort (Harris, 2008). Committed action is defined as action that is 1) connected to goals and values, 2) persistent, and adaptable, 3) sensitive to what situations offer, and what they do not offer, 4) able to incorporate pain, distress, failure, and other experiences that are part of a process of engagement and 5) able to stop when it is inconsistent with the reaching of goals (McCracken, 2013). Choosing to pursue a value is not a permanent thing. Actions to achieve goals must be re-evaluated and the choice to pursue those values must be made again and again, for example, after failure.

## Psychological inflexibility

Psychological inflexibility is the problematic manifestation of the core processes of psychological flexibility. For example, the inability to have present moment focus is represented as weak awareness of present, (see Fig. 2) and has been defined as the inability to behave flexibly in the presence of difficult thoughts, feelings, and bodily sensations (Merwin et al., 2010). A key factor of psychological inflexibility is experiential avoidance, along with diminished psychological functioning (Latzman & Masuda, 2013). Psychological inflexibility is associated with a wide range of psychopathology, including psychological distress (Masuda et al., 2012), depression (Bond et al., 2011) and anxiety (Masuda & Tully, 2012), whereas psychological flexibility correlates with, and longitudinally predicts, better mental health, better job performance, and an increased capacity to learn skills at work (Bond & Bunce, 2001; Bond & Flaxman, 2006; Hayes et al., 2004).

Figure 2

The 'Inhexaflex': The six core processes of psychological inflexibility (Bach & Moran, 2008)



Psychological flexibility is proposed as a key contributor to daily well-being and lasting psychological health (Kashdan & Rottenberg, 2010). High levels of psychological flexibility can provide balance among life domains, ensuring that differing elements of a



person's identity are being satisfied. Rottenberg (2005) regards psychological inflexibility as a core contributor to depression, with phenomena such as rumination and emotion context insensitivity demonstrating an inability to establish healthy and flexible cognitive processes. Psychological flexibility may also mitigate against anxiety disorders, of which a key construct is that of experiential avoidance and an avoidance response style (Kashdan & Rottenberg, 2010).

The role of psychological flexibility has received particular attention in psychological interventions designed to ameliorate outcomes and particularly recently with the use of acceptance-oriented forms of cognitive behaviour therapy such as Acceptance and Commitment Therapy (ACT; Hayes et al., 1999). The aim of ACT-based interventions is to utilise the six core processes to increase psychological flexibility to establish healthier cognitive processes (Bond et al., 2006). ACT is not aimed at physically reducing pain or distress, instead it promotes greater acceptance of negative experiences to increase psychological flexibility (Wicksell et al., 2010). ACT theory maintains that individuals are more psychologically healthy and perform more effectively when their decisions are based on their own goals and set of values (Bond et al., 2016).

Research therefore suggests that measures of psychological flexibility predict a wide range of outcomes. For the individual, higher levels of flexibility are likely to enhance the cognitive processing of difficult events and promote both productivity and emotional health in a work environment (Bond et al., 2013).

## **Psychological Flexibility in Surgeons**

For surgeons the process of cognitive fusion within psychological flexibility is particularly pertinent as it links to the rumination of past mistakes, errors, or concerns. This thesis proposes that if the negative internal stimuli relate to professional ability following adverse events, then cognitive fusion may lead to surgeon behaviours and actions being negatively affected, such as withdrawal from performing certain operations or even causing unintentional harm to subsequent patients. The ability to recognise such negative internal stimuli and differentiate them from behaviours would allow surgeons to maintain the highest possible standards of patient care following adverse events.

This thesis proposes that surgeons with higher levels of experiential acceptance may continue to flourish in their professional capacity following adverse events. Surgeons who exhibit experiential acceptance will be more likely to learn from mistakes made in surgery and ensure that these events do not occur again with subsequent benefits for patients. Surgeons with higher levels of experiential acceptance will also not avoid situations that recall previous experience of adverse events, meaning that they will be able to continue functioning within their professional environment and continue to perform procedures that they have experienced difficulties with in the past.

For surgeons who are only able to see themselves as ‘outstanding practitioners’ they will be more likely to take risks or be more negatively impacted when things do not go to plan. Harris (2008) examines the ACT literature and concludes that for individuals who have made a mistake and fuse to negative identifiers such as ‘I am a bad surgeon’ this can lead to negative outcomes such as experiential avoidance or event psychopathology (Harris, 2008). Thus, a flexible approach to how one views oneself means that surgeons will be less likely to ‘lock onto’ single definitions of self (‘I am an outstanding surgeon’ → ‘I am a bad surgeon’) which may have a negative impact on psychological wellbeing following adverse events. This

suggests that an increase in psychological flexibility, or the use of psychological flexibility-based interventions (such as ACT) could be protective against negative outcomes for surgeons.

The chosen values of an individual are key drivers in determining their behaviours and actions on an ongoing basis. For most surgeons, a key value would be to cause no harm and to help others. This value will determine their actions within their work environment and would explain the negative impact on surgeons when adverse events occur.

If surgeons highly value doing well at their work, whether to help patients or even if it is just to get paid, greater psychological flexibility increases their sensitivity to the performance-related, value-driven reinforcements within their work environment (Bond et al., 2006.)

For surgeons, specifically in the aftermath of adverse events, those with higher levels of psychological flexibility may exhibit an ability to commit to the work-related values they uphold, despite the psychological discomfort and distress they may experience.

Specifically, the present research hypothesises that psychological flexibility will ameliorate the impact of adverse events, reducing the sequelae typically associated with inflexibility such as depression, burnout, and perceived wellbeing. It would therefore be expected that the impact of adverse events will be reduced – irrespective of severity – in surgeons with higher flexibility. An interaction may also be apparent; when surgeons are subject to severe errors, the extent to which they can be psychologically flexible may be a critical factor in determining the extent to which they are subject to possible sequelae.

## **Burnout, Resilience and Psychological Flexibility**

It is important to note that while the hypothesised relationships between psychological constructs represents a strong basis for examination of the data, the relationships between psychological constructs may be more complex than suggested in the research reported hitherto. This is, in part, because research to date has tended to consider these constructs in isolation and because the relationships between these concepts may be more complex in a surgical population. The relationship between burnout, resilience, and psychological distress, for example, may be more complex in surgeons than the general population. This is because the research to date suggests not only that surgeons may be subject to high levels of burnout but, conversely, that as a population they may be more resilient (Pegrum & Pearce, 2015). Furthermore, the extent to which measures of burnout, resilience and psychological flexibility measure entirely separate constructs is an open question. This highlights the fact that this is - in part - an exploratory study cannot always be totally hypothesis driven.

There are however several prominent psychological models that explore the relationship between stress, resilience, and burnout. These models provide valuable insights into understanding the complex interplay between these factors and may support the development of the modelling within this thesis.

### *Job Demands-Resources (JD-R) Model*

The JD-R model, developed by Xanthopoulou et al. (2007), focuses on the work environment and how it influences employee well-being. According to this model, job demands refer to the physical, psychological, social, or organizational aspects of work that require effort. Job resources, on the other hand, are the physical, psychological, social, or organizational factors that can help individuals achieve work goals, reduce job demands, and stimulate personal growth. The model proposes that high job demands, such as workload

and time pressure, can lead to burnout when resources are insufficient. However, high job resources, such as autonomy and social support, can buffer the negative impact of job demands and enhance resilience, reducing burnout risk.

### *Conservation of Resources (COR) Theory*

COR theory, developed by Hobfoll (1989), focuses on the role of resources in individuals' well-being and stress experiences. It suggests that individuals strive to acquire, retain, and protect resources because losing resources or having resource deficiencies can lead to stress and burnout. Resources can be personal (e.g., self-esteem, coping skills) or external (e.g., social support, job control). According to the COR theory, resilient individuals possess more personal and social resources, enabling them to better cope with stressors and prevent burnout. Additionally, the theory emphasizes the importance of resource gains and resource investment, as these contribute to resilience and buffer against burnout.

### *Transactional Model of Stress and Coping*

The Transactional Model of Stress and Coping, proposed by Lazarus and Folkman (1984), focuses on the cognitive appraisal process individuals undergo when confronted with stressful situations. According to this model, stress is not solely determined by external events but also by individuals' subjective evaluations and coping strategies. When individuals perceive a situation as stressful, they engage in primary appraisal (evaluating the significance of the stressor) and secondary appraisal (evaluating their coping resources and options). The model suggests that resilient individuals engage in adaptive coping strategies, such as problem-solving and seeking social support, to manage stressors effectively and reduce burnout risk. In contrast, maladaptive coping strategies, such as avoidance or denial, may contribute to higher burnout levels.

These models provide frameworks for understanding the relationship between stress, resilience, and burnout. They highlight the importance of job resources, personal and social resources, and coping strategies in promoting resilience and preventing burnout.

## **Personality**

The Five Factor Model of personality (FFM), or the Big Five, is the dominant model of personality within trait psychology (Laverdière et al., 2007). The five “OCEAN” factors are (Costa & McCrae, 1992):

1. Openness (fantasy, aesthetics, feelings, actions, ideas, and values)
2. Conscientiousness (vs. disinhibition) (competence, order, dutifulness, achievement, self-discipline, and deliberation)
3. Extraversion (vs. introversion) (warmth, gregariousness, assertiveness, activity, excitement-seeking, and positive emotions)
4. Agreeableness (vs. antagonism) (trust, straightforwardness, altruism, compliance, modesty, and tendermindedness)
5. Neuroticism (vs. stability) (anxiousness, angry hostility, depressiveness, self-consciousness, impulsivity, and vulnerability)

Empirical support for the FFM as a structural model of personality is substantial, including multivariate behaviour genetics, childhood antecedents, temporal stability across the lifespan, cognitive neuroscience coordination, and cross-cultural replication (McCrae, 2010; Widiger, 2017; Widiger et al., 2013). This measure will be discussed in more detail within the Methods chapter of this thesis.

Personality dispositions/characteristics are strong predictors when it comes to the construct of subjective wellbeing (SWB) – an individual’s subjective interpretation of the state of their own life and wellbeing, whereas demographic and contextual factors are only weakly to moderately related (Diener et al., 1999; Ryan & Deci, 2001). Research investigating the relationship between FFM and mental health among university students (n=296) found a partial fit between measures for subjective wellbeing and factors of the FFM (Compton, 1998). The majority of variance (70%) in measures of mental health and wellbeing were explained by personality factors of neuroticism, openness, and agreeableness. However, the results indicate that some constructs of mental health such as self-actualisation, may not be

explained by factors contained within the FFM. This suggests that the FFM can be a useful tool to examine the relationship between personality and some aspects of mental health and wellbeing.

A meta-analysis of personality traits and SWB found that studies trying to unpack the link between personality dispositions and SWB mainly point to the relations between neuroticism and extraversion and the way individuals react to environmental rewards and punishments (DeNeve & Cooper, 1998). Specifically, individuals high in extraversion and low in neuroticism tend to see events and situations more positively, respond less to negative feedback, and tend to discount unavailable opportunities. Neuroticism was found to be the strongest predictor of life satisfaction, happiness, and negative affect, whereas positive affect was predicted by high levels of extraversion and agreeableness. This suggests that personality characteristics could be key moderators within a model examining negative and positive affect and should be included within theoretical model building.

Initially, research into the relationship between personality types and job performance had very low levels of validity due to the absence of robust measures for personality (Barrick & Mount, 1991). However, subsequent developments in measures have vastly increased empirical evidence supporting personality as a valid predictor of employee performance. A meta-analytic investigation of the relative validity of contextualised and non-contextualised personality measures (Shaffer & Postlethwaite, 2012) demonstrated that measures of personality within the context of work are stronger predictors of job performance than are non-work contextualised measures of personality. The findings of the meta-analysis found that this was consistent across all the Big Five personality traits. This suggests that personality – as measured by the FFM – could be an accurate predictor of job performance and could be a useful screening tool to support individuals who are struggling with efficacy and job performance to create targeted interventions.



## **Personality in Surgeons**

The concept of a ‘surgical personality’ has been considered previously within surgical research. Utilising measures such as the Myers-Briggs Type Indicator Personality Inventory (Contessa et al., 2013), the Revised NEO Personality Inventory (McGreevy & Wiebe, 2002) and the Five Factor personality assessment (Whitaker, 2017) to establish whether a surgical personality exists, and, if so, the impact of such personality factors on aspects of the surgeons’ role.

Whitaker’s (2017) analysis of surgeon personality types demonstrated significantly higher scores for surgeons within the personality domains of conscientiousness, agreeableness, openness, and neuroticism than the general population. However, in a British study comparing medical students and surgical trainees there was a lack of significant difference found between the two groups for all domains except Neuroticism, with medical students scoring significantly higher than trainees (Preece & Cope, 2016). It is therefore unclear as to whether there is a specific personality type for surgeons, or whether the difference in personality can be attributed to physicians in general. It is also unclear as to whether this is a top-down or bottom-up argument – do individuals become surgeons because they have certain dominant personality traits, or is this something that is brought out in people through the process of medical education? Given the cross-sectional and temporal limitations of this study these questions cannot be addressed by the data presented within this thesis, however it is a gap to consider addressing within future longitudinal research.

It is however important to consider the role of personality factors within surgeons and whether attributing stereotypical personality characteristics to surgeons in general, ignoring individual differences, is a positive thing. This could potentially lead to negative

implications with regards to aptitude type testing for suitability for the role, which would potentially not be of benefit for the surgeons or for the health service. If, however certain personality types are found to be protective against negative outcomes then screening for personality may enable trusts to understand the ways in which their surgeons may require support following the occurrence of adverse events.

## Conclusion

The main research question of this present research is ‘**How do complications and errors** affect surgeons?’. However, it is clear from the literature surrounding this topic (for example Pinto et al., 2013; Shanafelt, 2009), that to successfully address this question a plethora of other considerations must be made. Previous research has given insight into various aspects of this research area (Dimou, 2016; Pinto et al., 2013; Shanafelt, 2009), yet to date there has been no comprehensive research that provides a clear, national picture of how surgeons are affected when they experience adverse events within surgery.

To bridge the present gaps within the existing literature, the present research will provide baseline data and analysis of UK surgeons’ experiences of both **complications** and **errors**. The definitions of each type of event will be clearly conveyed to the participants from the outset of their involvement with the research, and a between groups condition will be established within the survey to accurately analyse the impact of event type which has so far been missing from the literature.

In the present research, the inclusion of pre-validated measures to analyse the impact of adverse events on wellbeing will provide insight into how surgeons across all specialties are affected when things go wrong. This will provide more generalisable data than previous UK research has been able to provide, due to their use of smaller or speciality specific samples. The use of validated measures means that the data from surgeons will be comparable with general population means. Generating a detailed comparative picture that will help to settle debate regarding surgeon wellbeing, resilience, and personality relative to the general public.

More than anything, the present research aims to add depth to the understanding of how surgeons are affected by negative events. Rather than conducting correlational studies that will add little to the understanding, this data will be used to generate a quantified model that will provide insight into the key predictive factors associated with surgeon wellbeing. Through moderation and mediation analysis – alongside rigorous structural equation modelling – this research will aim to settle contentious issues presently within the literature. Such as - the role of anxiety in predicting negative mental health outcomes; the moderating relationship between stress and other wellbeing outcomes; the mediating effect of resilience and thereby the benefit of its role within training; possible interactions between burnout prevalence and protective factors such as resilience and psychological flexibility; the role of the surgical personality in dealing with adverse events.

### **3. Survey Methods and Rationale**

#### **Introduction**

This chapter presents the research methodology adopted within this thesis, outlining the philosophical underpinnings of the approach taken within the research. This chapter provides an overview of the positivist stance taken within this research and the consequent choice of a cross-sectional, quantitative-deductive approach. The chapter then outlines the reasons for the adoption of the survey design, providing an overview of the data collection methods used for the thesis, as well as a detailed rationale for the inclusion of specific measures within the survey and the means used to analyse the data. The chapter concludes with an overview of the data collection and analysis methodology that will be employed within this research.

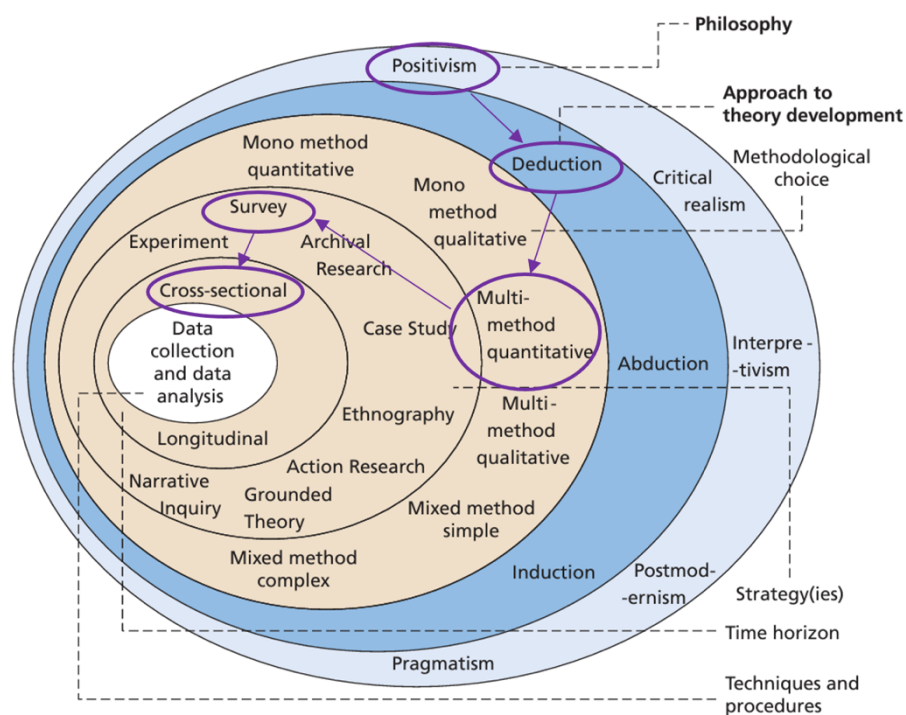
The overarching aim of this research is to examine the impact of adverse events on surgeons with a view to informing decision-making and policy with respect to surgical training and support for surgeons practicing professionally. As noted previously, it will be the first UK-wide survey of its type and will, uniquely, examine the differences in impact between errors and complications.

#### **Research Design**

The design choices made within this research are summarised below using the illustration of the ‘research onion’ (Fig. 3; Saunders et al., 2019), in which each layer of the research rationale can be clearly observed - research philosophy, approach to theory development, methodological choices, research strategy and time horizon. This chapter will briefly give detail regarding each section of the research design.

Figure 3

Illustration of Methodological choices using the ‘Research Onion’ (Saunders, Lewis & Thornhill, 2019)



Source: ©2018 Mark Saunders, Philip Lewis and Adrian Thornhill

### Research Philosophy

The scientific observation of social behaviour with an objective analysis of data is the central tenet of the positivist approach to research. Although there are some differences between positivism and the scientific method (Bryman, 2007), the positivist paradigm leads to a scientific, systematic approach to research, making possible to measure social behaviour independent of context and that such phenomena are ‘things’ that can be viewed objectively (Hughes & Sharrock, 2016). This research aims to examine the experiences of surgeons following adverse events using such an objective, and therefore positivist, approach – creating a generalisable model that will support the development of all surgeons throughout their training and career. This research falls within the positivist paradigm.

## Research Approach

Research from a positivistic approach assumes that hypotheses are derived from theoretical or hypothetical constructs and are therefore deductive in nature (Newman, 2000). Given the scope of previous investigations into this research area outlined within the literature review, there is enough compelling empirical evidence to allow for a deductive approach to this research. Although the gaps within the literature regarding the surgeon specific effects of adverse events are significant (Bolderston et al., 2020), the underpinning psychological phenomena being examined are robust enough for the development of a compelling theory and the development of testable hypotheses. Some of the hypotheses that will be tested within this research (see below) are however directionless, due to a lack of clarity within some previous findings:

### *Hypothesis 1*

Given the work of previous research such as Brookes et al. (2011), Pinto et al. (2013) and Shanafelt et al. (2009), it was predicted that surgeons would be negatively affected by adverse events. However, the degree to which event type effects such outcomes is hitherto unclear within the research. Therefore, the following hypotheses are non-directional. However, it is tentatively predicted through intuition that an error would lead to more negative outcomes, due to the occurrence of such events being caused by factors within the surgeon's locus of control.

**H1** – The following areas will be affected by type of adverse event:

- General physical health
- General mental health
- Feelings about event
- Perception of support available

- Perception of own capability
- Post-traumatic stress symptomology

### *Hypothesis 2*

Given the work of previous research (Campbell et al., 2001, Dimou et al., 2016; Gerada & Jones, 2014; Jacob Sendler et al., 2016; Mousa et al., 2016; Shanafelt et al., 2009; Whitaker, 2017) it is predicted that surgeons will be more negatively affected than the general population within outcome measures and that their trait characteristics will differ significantly from those of the general population.

**H2** – The following scores will differ between surgeon participant scores and published population means:

- CBI
- DASS-21
- PC-PTSD
- BRS
- BFI
- WAAQ

### *Hypothesis 3*

Whilst very little research has been conducted investigating the role of mediating and moderating variables specifically related to surgeon wellbeing following adverse events, the following relationships have been tentatively predicted due to research into moderating and mediating effects of measures within a general population (Kashdan & Rottenberg, 2010, Shaffer & Postlethwaite, 2012).



**H3** – the relationship between adverse events and psychological distress will be affected by the following psychological and environmental factors:

- Personality type
- Resilience
- Psychological flexibility
- Severity of event/patient outcome
- Outcome for the surgeon (investigation/litigation)
- Efficacy of training received by surgeons
- Availability of support

### **Methodological choice**

The positivist paradigm leads to a scientific, systematic approach to research and as such lends itself to the use of quantitative methodology. To test the hypotheses presented above and to generate both the national picture of the effect of adverse events on surgeons, and a predictive Structural Equation Model (SEM) will require the use of a quantitative methodological approach. Given the range of analyses required to fully explore the impact of complications and errors on surgeons, multiple quantitative methodologies will be utilised - including mediation and moderation analysis and structural equation modelling.

This research will make use of previously published and validated measures (See Table 1). Not only will this give insight into the psychological state of surgeons following either a complication or an error, but it will also allow for the direct comparison between surgeon scores and those of the general population. The standardised measures used within this research will be examined later within this chapter.

## **Research Strategy**

Given the aim of the study to generate a national picture of the impact of adverse events on surgeons, a survey design was deemed to be the most appropriate strategy for gathering the data required. Specifically, the use of an online survey would enable the greatest reach of participants and therefore increase participation. Electronically based surveys reach large numbers of respondents quickly and inexpensively. However, the design and implementation of such online surveys involve unique methodological issues, such as participant accessibility and data collection and storage concerns, that must be considered within the design of such surveys (Jansen & Corley, 2007). The survey was hosted by Qualtrics, an online survey platform, with a personalised link distributed to participants through various means including but not limited to; emails from RCSEng and RCSEd, an article published in the RCS Bulletin, access to the website [www.surgeonwellbeing.co.uk](http://www.surgeonwellbeing.co.uk) and researcher attendance at surgical conferences.

## **Time Horizon**

The research aims and hypotheses made a cross-sectional time horizon appropriate for this study. Surgeons within each condition were asked to reflect on their most recent adverse event and to report the timeframe in which that event had occurred, establishing a retrospective record of the event and the feelings and psychological phenomena associated with it. Findings suggest that under certain conditions, the results from cross-sectional data exhibit validity comparable to the results obtained from longitudinal data (Rindfleisch et al., 2008). Therefore, by making use of previously validated measures within this cross-sectional survey, the highest possible levels of validity can be maintained whilst surveying participants within a single time point. Whilst selection and recall biases have been found to affect the results within retrospective studies (Talari & Goyal, 2020), the inclusion of the most recent event – rather than the most memorable, is hoped to reduce this within this study.

## **Survey Design**

The survey will be non-linear (containing multiple conditional branches), with the pseudo-randomisation of participants categorising them into one of two conditions: complication or error. For the purposes of this research errors will be defined as ‘avoidable commissions or omissions with potentially negative consequences: they would have been judged as poor practice by skilled and knowledgeable peers at the time when they occurred, independent of whether there were any negative consequences’ (Wu, et al., 2003). Complications, by contrast, are adverse events which are ‘an acknowledged risk of surgical care or procedures, i.e., when a standard medical procedure is undertaken there are risks that are not avoidable’ (Clavien et al. 2009, Dindo & Clavien, 2008). The term ‘adverse events’ will be used as a collective term for both complication and error when an explicit distinction is not required. Participants were clearly presented with the definition of the condition in which they had been placed – along with the definition of the contrasting condition – before commencement of any case related questions. The inclusion of conditional items within the survey branched participants into the completion of specific items within the survey depending on their preceding answers. An overview of the main branches can be seen in Figure 4.

Participants were eliminated from the survey if there were not currently practicing clinically within the United Kingdom, this removed any retired or overseas participants from taking part in the main body of the survey.

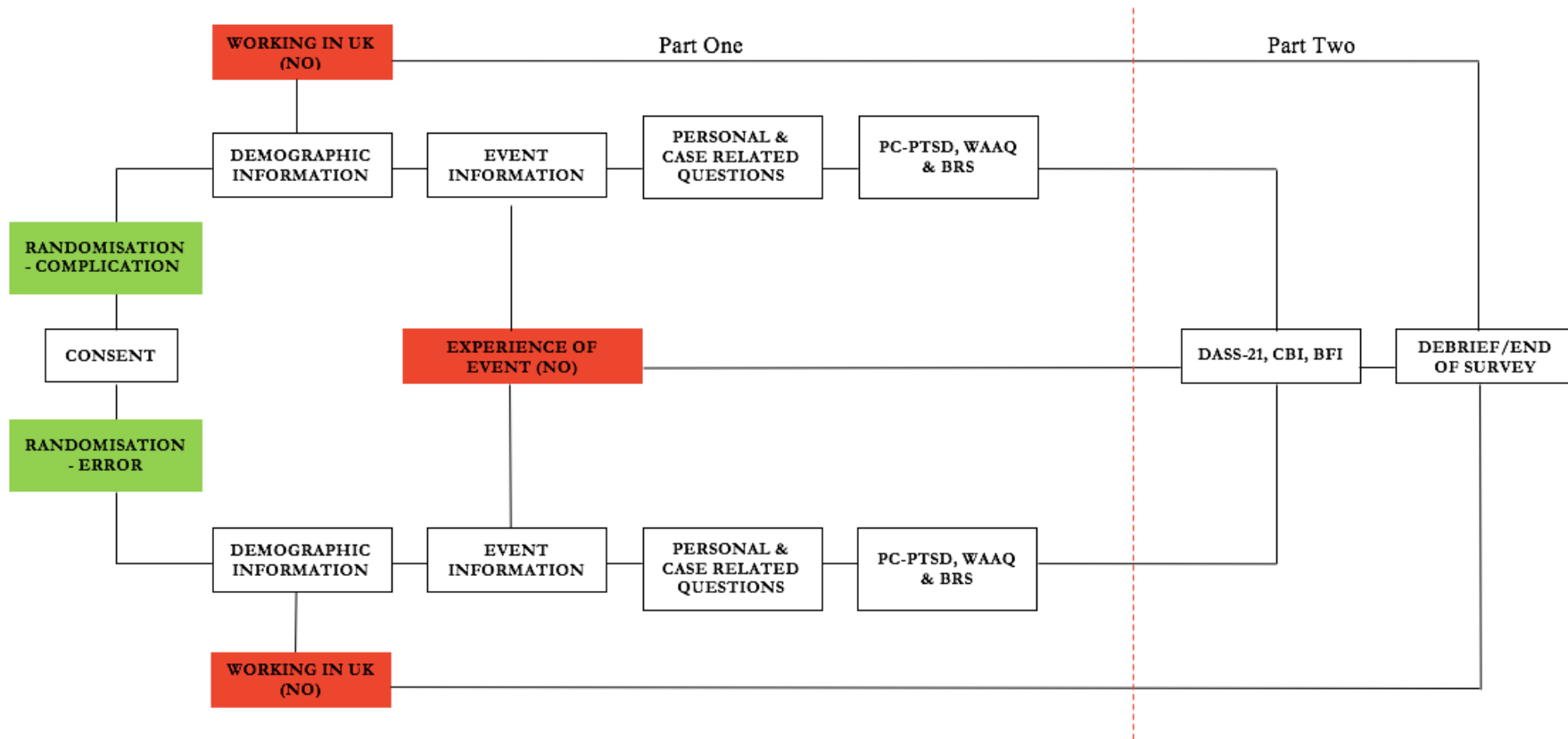
Those participants who had never experienced either type of adverse event within their assigned condition were automatically routed to the second section of the survey so that demographic and psychometric results could be obtained. Those who did not complete this conditional question were, by nature of the online survey, also automatically redirected to the second part of the survey.

Further conditional questions within the survey, such as ‘Did you speak to anyone following the complication/error?’ led to branches appearing to the participants dependent on their response. Therefore, certain items within the survey show high levels of variance with regards to response rates. Because of this, response rate fluctuation will be highlighted and addressed within the analysis of each item. This will also address that nonresponses may not be missing data, but rather non-viable pathways for some participants within the survey.

An initial iteration of the survey was broken into two parts, with the aim of increasing participation by reducing the time a respondent would be committed to completing the survey in one sitting. Participants could complete both parts at once, only the first part and then withdraw from participation, or return later to complete the second part of the survey via means of an email link. Given the high rate of attrition between parts one and two during preliminary stages of data collection, it was decided to amalgamate both parts of the survey into one, this significantly increased the response rate of the second half of the survey. Measures contained within the second part (as outlined in Figure Y) were the 21 item Depression, Anxiety and Stress Scale (DASS-21) (Henry & Crawford, 2005), the Copenhagen Burnout Inventory (CBI) (Kristensen et al., 2005) and the Big Five Personality Inventory (BFI) (John et al., 1991).

Figure 4

Survey Design Overview



## Survey Content

The following section provides an overview of the survey content, including the rationale for the inclusion of specific standardised measures. An overview of the themes, measures and items contained within the survey can be seen in Table 1. The full survey can be found within the appendices of this thesis.

Table 1

Overview of measures used within survey

### The nature of the event

Recency  
Nature of event  
Severity of outcome for patient  
Adapted Clavien-Dindo Scale

### Individual Effects

Personal impact  
Physiological  
Cognitive  
Behavioural  
Social

### Case-related impact

Patient related  
Colleague related  
Professional consequences

### Support available/Efficacy of support

Informal support (family, friends, colleagues)  
Formal support (Mentoring, professional organisations)  
Training  
Barriers to support

### The nature of the individual

#### Tendency to burnout

Copenhagen Burnout Inventory (CBI)  
\*

#### Levels of resilience

Brief Resilience Scale (BRS) \*

#### Psychological flexibility

Work-related acceptance and action questionnaire (WAAQ) [Process measure] \*

#### Symptoms of psychological distress

Depression, Anxiety and Stress Scale (DASS-21) +\*  
Primary Care Post-Traumatic Stress scale (PC-PTSD) \*

#### Personality type

Big Five Personality Inventory (BFI)  
+\*

---

\* Signifies pre-existing standardised measures

+ Signifies measures contained within the second phase of survey

CBI – (Kristensen et al., 2005)

BRS – (Smith et al., 2008)

WAAQ – (Bond et al., 2013)

DASS – 21 – (Henry & Crawford, 2005)

PC-PTSD – (Prins et al., 2016)

BFI – (John et al., 1991)

### **The nature of the event**

Key questions within the survey highlighted grouping variables allowing for further categorisation of the adverse event by specifying; recency of the event, nature of the event (emergency/elective) and severity of the event. Analysis of the data using these variables will allow for further insight into the effect of the nature of the event on surgeon wellbeing. By gaining an understanding of the way that different types of events may have more or less of an effect on the wellbeing of the individual surgeon it will be possible to tailor future training and interventions to prepare and support those who have experienced the type of events that are more likely to inflict harm.

To investigate the impact of timescale on the impact experienced by surgeons, the recency of the event was included within the survey. Surgeons were specifically asked to refer to their most recent experience of either a complication or error, with the aim of reducing response bias created by recalling their most memorable or traumatic event.

To investigate the impact of the nature of the event, surgeons were asked whether their experience occurred during an elective or emergency surgery. Elective surgery is surgery with pre-operative diagnosis, in which patients have been investigated for operability, have had co-morbid physical pathologies treated and their risk for anaesthetic complications assessed through outpatients' department before being admitted to surgical wards (Latif, et al., 2017). Emergency surgery was defined as surgery on patients reporting in emergency with complaints of short duration, with uncertain diagnosis having not much time for treatment of co-morbid pathologies or pre-anaesthesia evaluation and optimisation and who underwent surgery within 24 hours of reporting to emergency department of hospital (Latif, et al., 2017).

To examine the impact of severity of event, an adapted Clavien-Dindo scale was included within the survey. The Clavien-Dindo Scale is an objective classification of surgical

complications based on patient outcome and is used to classify the severity of a complication (Table 2; Dindo et al., 2004). It has been included within this survey as a way of standardising responses from surgeons when describing the severity of the event they experienced. The published scale ranges from Grade 1 (minimal negative outcome for patient) to Grade 5 (Death of a patient). However, as outlined within Table X, it has been adapted for the purposes of this survey to include a ‘Grade 0’ in which the surgeon is able to register that there is no negative outcome for the patient. It was envisioned that this adaptation would be particularly necessary for surgeons asked to recollect their experience of error.

Table 2

The Adapted Clavien-Dindo Classification of Surgical Complications

<b>Grade</b>	<b>Grade descriptor</b>
Grade 0	No deviation from normal postoperative course
Grade I	Any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic, and radiological interventions.
Grade II	Requiring pharmacological treatment with drugs other than such allowed for grade I complications. Blood transfusions and total parenteral nutrition are also included.
Grade III a	Requiring surgical, endoscopic, or radiological intervention – not under general anaesthesia
Grade III b	Requiring surgical, endoscopic, or radiological intervention – under general anaesthesia
Grade IV a	Life-threatening complication (including CNS complications*) requiring IC/ICU-management - single organ dysfunction (including dialysis)
Grade IV b	Life-threatening complication (including CNS complications*) requiring IC/ICU-management - multi organ dysfunction
Grade V	Death of patient

\*brain haemorrhage, ischemic stroke, subarachnoidal bleeding, but excluding transient ischemic attacks (TIA); IC: Intermediate care; ICU: Intensive care unit.

### Individual Effects

The survey included single item non-validated measures to assess specific aspects of surgeon wellbeing following adverse events (e.g., How easy/difficult did you find this



outcome to deal with? 1 = Very easy, 7 = Very difficult. The full survey can be found within appendix B of this thesis). These items were created for the sole purpose of this research by the researcher. Most of these survey items were scored using 7-point Likert scales. 7-point scales were used due to their propensity to perform better compared to 5-point scale (Joshi et al., 2015). The 7-point scale has been found to have an increased probability of meeting the objective reality of participants, by providing more options from which they may respond.

Other individual effects were assessed using binary 'yes/no' answers which linked to survey branches as outlined above. As above, these questions were created by the researcher for the purpose of this survey. The inclusion of these items within the survey aims to get more understanding of the effects that these adverse events had on surgeons and allowed for the inclusion of event specific questions that were missing from other validated scales.

### **Case related impact**

Questions regarding the impact of the case on the participants' professional capacity were also included within the survey. As with the previous category, these questions did not rely on pre-published measures, but rather single item questions that give insight into the specific experience of the participants following an adverse event. Questions within this category related to the ways in which participants felt they had been affected professionally, in terms of their work ability, their relationship with patients, changes to their professional practice and the perceived impact on their relationship with colleagues.

### **Support available/efficacy of support**

As above, questions regarding the availability and efficacy of support for surgeons following their experience of an adverse event were single item in nature. They were written to examine key concepts that are currently gaps within the literature and be utilised as

grouping variables by which standardised measure responses may be categorised. For example, examining whether those who received support following the adverse event scored lower on the DASS-21 measure of psychiatric distress.

**The nature of the individual**

**Tendency to burnout**

There are several available Burnout measures that have been developed and validated. These tools fall into two categories (See Table 3). Firstly, tools that assess the general concept of burnout. These do not differentiate between different professional or personal settings. However, they all assess different constructs or domains of burnout, dependent on their specific theoretical underpinnings. The second are tools that assess burnout within a discrete context or occupation. These are specifically formulated to address the unique facets experienced by individuals within these settings. Table 3 outlines these two groups of tools.

Table 3

Measures for assessing Burnout

<b>Generic</b>	<b>Context specific</b>
Burnout Assessment Tool (BAT)	Brief Burnout Questionnaire Revised for nursing staff
Copenhagen Burnout Inventory (CBI)	Burnout Questionnaire for Athletes
Maslach Burnout Inventory (MBI)	Maslach Burnout Inventory-Human Services Survey (MBI-HSS)
Oldenburg Burnout Inventory	Parental Burnout Inventory
Burnout Clinical Subtypes Questionnaire (BCSQ-36/12)	Physician Burnout Questionnaire
Questionnaire for the Evaluation of Burnout Syndrome at Work (CESQT)	School Burnout Inventory
Shirom–Melamed Burnout Questionnaire (SMBQ)	Teacher Burnout Questionnaire
	Psychologist’s Burnout Inventory

Until recently the most used psychometric measure of burnout was the Maslach Burnout Inventory (MBI; Maslach et al., 1997), accounting for more than 90% of all empirical burnout studies in the world (Schaufeli, & Enzmann, 1998). The tool was

specifically designed to address the three components of burnout syndrome as established by Maslach. To complete the MBI respondents indicate on a 7-point scale (1 = never to 7 = every day) how frequently they experienced items within the scale. Example of items included are 'I feel emotionally drained from my work' and 'in my opinion, I am good at my job'. Due to the prevalent nature of the measure within the field of burnout Kristensen et al. (2005) argue that the MBI and the Maslach definition of burnout have become two sides of the same coin - effectively creating a cyclical argument, i.e., that the MBI measures what burnout is, and burnout is what the MBI measures. A systematic review of Burnout measures used between 1980 and 2018 (Shoman et al., 2021) states that although the MBI is the most widely used burnout measure and is still considered to be the gold standard within the field (West et al., 2012), there are significant issues regarding its validity. The systematic review highlights an innate bias within the wording of the measure, with negative wording used for domains of emotional exhaustion and depersonalisation, yet positive wording used for the domain of personal accomplishment. There are also academic concerns regarding the inclusion of the domains of depersonalisation and personal accomplishment within the construct of burnout, which brings the psychometric validity of the MBI into question.

An independent (and publicly available) measure of burnout was therefore created to assess different possible dimensions of burnout. This Copenhagen Burnout Inventory (CBI) (Kristensen et al., 2005) steers away from the traditional triumvirate components of burnout as established by Maslach (1997). Within the systematic review conducted by Shoman et al. (2021), the CBI demonstrated the highest levels of validity of the measures assessed. Rather than the domains within the MBI, the CBI places fatigue and exhaustion as the core process of burnout. The CBI is a 19-item, three-factor construct with sub-domains of personal burnout, work related burnout and client related burnout (Cronbach's  $\alpha = .81$ ) (Borritz & Kristensen, 1999). Within the self-report measure, respondents indicate on a 5-point scale (1 = never to 5 = always) how often they experience behaviours outlined within

the scale. The CBI is used in assessing burnout within healthcare related professions (Winwood & Winefield, 2004), and the literature suggests that it is a valid alternative to the MBI (Milfont et al., 2008) especially within clinical settings. The three domains of the CBI are now to be further explored:

### *Personal Burnout*

Personal burnout is the degree of physical and psychological fatigue and exhaustion experienced by the person (Kristensen et al., 2005). The personal burnout scale within the CBI is a generic measure of burnout that does not focus on occupational status. Unlike the MBI, which assumes that all participants work within a human service sector, the CBI gauges how fatigued an individual is, whilst also making no clear distinction between physical and psychological exhaustion. (e.g., “How often are you physically exhausted?”, 100 = always/ 0 = never).

### *Work related burnout*

This is the degree of physical and psychological fatigue and exhaustion that is perceived by the person as related to their work (Kristensen et al., 2005). The work-related burnout scale within the CBI - when compared with scores of personal burnout - allows for analysis of how much participants personally attribute their level of burnout to their work, or adversely attribute their fatigue to non-work factors. The inclusion of this measure within the CBI attempts to account for any confounding variables that may significantly impact levels of burnout that are not arising from the sphere of work, something the MBI is not able to do. (e.g., “Do you feel burnt out because of your work? 100 = to a very high degree/ 0 = to a very low degree)

### *Client related burnout*

The degree of physical and psychological fatigue and exhaustion that is perceived by the person as related to his/her work with clients (Kristensen et al., 2005). As with work related burnout, this measure allows for analysis for how much of the fatigue experienced by the participant is because of their work with clients. Differentiating between general physical and psychological exhaustion and that specifically associated with client related work. (e.g., “Do you find it hard to work with patients?”, 100 = to a very high degree/ 0 = to a very low degree).

The CBI focusses on fatigue and exhaustion as the core process of burnout, with a diminished role for depersonalisation and reduced feeling of accomplishment within a work environment. Kristensen et al. (2005) claim that depersonalisation and personal accomplishment should be measured and understood as distinct phenomena, which although important are not part of burnout.

Despite its rating as a highly valid measure, it must be recognised that the validation of the measure was completed internally by its creators in only one study. The measure was also originally published in Danish and has then been translated for use in different languages. The cross-cultural validity of the measure is however, lacking. Despite these concerns, this measure is deemed to be the best fit for this research, especially given the concerns raised previously regarding the psychometric validity of the MBI.

### **Levels of Resilience**

As explored within the literature review, there is currently no gold standard for the measurement of the psychological phenomena of resilience. In a review of resilience measurement scales the Brief Resilience Scale (BRS) had one of the best psychometric ratings of all measures analysed (Windle, et al, 2011) The BRS (Smith et al., 2008) is a unidimensional

construct related to personal characteristics, social relations, coping and health and was predominantly designed as an outcome measure to assess the ability to bounce back or recover from stress. The scale consists of 6 items and has high internal consistency (Cronbach's  $\alpha = .85$ ). Respondents indicate on a 5-point scale (1 = strongly disagree to 5 = strongly agree) how much they agreed with the items within the scale. Example of items included are 'I tend to bounce back quickly after hard times' and 'I tend to take a long time to get over set-backs in my life'. Given the brevity of the scale and the importance within this research of analysing the effect of resilience on surgeons, it is to be included in the main body of the survey. There is no cost associated with using this measure

### **Psychological flexibility**

Most of the research into psychological flexibility has been carried out using the Acceptance and Action Questionnaire (AAQ; Hayes et al., 2004), or its revised version, the AAQ-II (Bond et al., 2011), a concise general measure of psychological acceptance and willingness to experience unwanted private experiences. To complete the seven item AAQ-II questionnaire respondents indicate on a 7-point scale (1 = never true to 7 = always true) how much they agreed with the items within the scale. Example of items included are 'I am afraid of my feelings' and 'Emotions cause a problem in my life'. However, ACT theory suggests that psychological flexibility can fluctuate within different contexts and environments (Hayes et al., 1999), therefore, to enable the analysis of surgeons' psychological flexibility purely within a professional context, the online survey will utilise the Work-Related Acceptance and Action Questionnaire (WAAQ; Bond, Lloyd & Guenole, 2013) to provide a contextually specific overview of surgeons' level of psychological flexibility.

The WAAQ, unlike the AAQ-II, asks questions particularly tailored to the work environment. The seven item WAAQ questionnaire also utilises a 7-point scale (1 = never true to 7 = always true), however items are specific to a professional context. E.g., 'I can

admit to my mistakes and still be successful' and 'I can perform as required no matter how I feel'. By using the WAAQ the research will be able to report on the levels of psychological flexibility exhibited by surgeons within their professional capacity.

### **Symptoms of Psychological distress**

Measuring psychological distress, the DASS-21 (Lovibond & Lovibond, 1995) is a 21 item, four factor construct analysing psychological distress, depression, anxiety, and stress (Cronbach's  $\alpha = .82$ ; Henry & Crawford, 2005). In completing the DASS, the individual is required to indicate the presence of a symptom over the previous week. Each item is scored from 0 (did not apply to me at all over the last week) to 3 (applied to me very much or most of the time over the past week). Example of items include 'I found it difficult to relax' and 'I felt that I wasn't worth much as a person'. The themes emerging from the content of this scale were a good match with the aims of the survey. Given that the scale is frequently used it was decided that this would be included within the primary questionnaire.

The survey included a measure to assess the potential occurrence of Post-Traumatic Stress Disorder within participants following their experience of adverse events. The Primary Care Post Traumatic Stress screening tool (PC-PTSD) (Prins et al., 2016) is a 4-item clinical screening tool which asks participants, for example, whether within the last month they 'Have had nightmares about it or thought about it when you did not want to?'. Due to the nature of this study, this measure was adapted to specifically capture the impact of the adverse event on the surgeon. Rather than asking for feedback on their experience within the last month, participants were asked to reflect on whether they experienced nightmares, avoidance, or felt guarded or numb in the aftermath of their experience of an adverse event.

A response of 'yes' to 3 or 4 items within the scale gives a 'positive' result. A positive response to the screen does not necessarily indicate that a patient has post-traumatic stress

disorder. However, a positive response does indicate that a patient may have PTSD or trauma-related problems and further investigation of trauma symptoms by a mental-health professional may be warranted.

It must however be reflected that the measure was not worded in its published format and had been altered to meet the needs of this study. Rather than asking participants whether they have experienced PTS symptomology within the last month, the adapted measure asked them whether they had experienced symptoms 'since the event.' The aim of this adaptation was to ensure that any PTS symptoms could be determined as a direct effect of the event itself and not caused by other events within the life of the participant.

### **Personality Type**

Measuring personality, the Big Five Personality Inventory (BFI; John et al., 1991) is a 44-item, five-factor construct analysing Openness, Conscientiousness, Extraversion, Agreeableness, Neuroticism (Cronbach's  $\alpha = .83$ ). Respondents indicate on a 5-point scale (1 = disagree strongly to 5 = agree strongly) how much they agreed with the items within the scale. Example of items included are 'I see myself as someone who does a thorough job' and 'I see myself as someone who can be cold and aloof'. A measure of personality was included in the survey to measure the impact that individual personality differences may have on surgeons' ability to cope following an adverse event. Given the length of this measure it was located within the second phase of the survey, which surgeons can choose to complete at a later stage. Although there are shorter versions of personality measures (e.g., 10 item BFI: Rammstedt & John, 2007) the psychometric properties of such measures are somewhat diminished, with the use of very short measures substantially increasing the possibility of both the Type 1 and Type 2 error rates (Credé et al., 2012). It was therefore deemed appropriate to include the longer version of the personality measure within the survey.



## **Data Collection Method**

### **Participant recruitment**

A working relationship with the Royal College of Surgeons of England (RCSEng), the Royal College of Edinburgh (RCSEd) and the British Medical Association (BMA) was developed by the researcher as part of the surgical adverse events research team. As a result of this, the online survey was distributed to potential participants within the United Kingdom via these professional bodies, with links to the online survey appearing in newsletters going out from RCSEng, RCSEd and the BMA. Due to the nature of this recruitment process participants represent a wide range of experience and disciplines within the surgical profession.

### **Participant eligibility**

The eligibility criteria for participation in the survey was for participants to have obtained a basic medical degree as well as a specific surgical qualification, such as Membership of the Royal College of Surgeons (MRCS) or Fellowship of the Royal College of Surgeons (FRCS). To be eligible to take part in the study participants must also have been currently working within the United Kingdom, this excluded British surgeons working outside of the United Kingdom and those who have retired from clinical practice.

### **Ethics**

No participants were approached, nor data collected until Bournemouth University ethical approval was obtained (Appendix A). NHS Ethics approval was unnecessary as the participation process did not involve patients. Before completing the survey, informed consent was obtained from participants.

## **Piloting**

External piloting of the survey was conducted. The survey was administered to a small group of target participants (N=15) who were not included in the main survey dataset. The survey was also sent to representatives of the Royal Colleges of Surgeons of England and Edinburgh to ensure satisfaction with content of the survey before it was distributed to their members. The piloting focused on the comprehensibility, readability and relevance of the study and the included pre-validated scales, rather than their psychometric properties.

## **Survey Launch**

To ensure that maximum impact was attained, a comprehensive a launch plan was constructed with RCS England and RCS Edinburgh (and in collaboration with media teams from Bournemouth University and the Royal Bournemouth Hospital). The on-line link to the survey was sent out to all surgeons via RCS (England and Edinburgh) newsletters and emails to promote completion of the survey by surgeons, as well as sending press releases to newspapers, television, and radio stations to raise awareness of the research within the general population, with the aim of increasing the impact of the research as a whole. Prior to the launch date a review article examining the impact of adverse events on surgeons was published in the Bulletin of the Royal College of Surgeons with the aim of raising awareness of this issue (Turner at al., 2016).

## **Data Analysis Method**

### **Descriptive characterisation**

Initial analyses will follow the pattern of statistical analyses used in this field to date. Previous studies (Shanafelt, 2009; West, 2006) have reported descriptive statistics of their populations having conducted large scale studies of physicians of all specialities and medical trainees in North America, relying on these statistics rather than more detailed analysis. As a starting point for analysis this research will do the same, to allow comparison with these studies, especially as no large-scale studies have reported descriptive measures just for surgeons within the UK.

### **Examination of effect of event type**

The first stage of data analysis will examine the effect of the between-groups variable. Analysing whether there is a difference between the experience of a complication or an error on participants' reported outcomes.

**H1** – The following areas will be affected by type of adverse event:

- General physical health
- General mental health
- Feelings about event
- Perception of support available
- Perception of own capability
- Post-traumatic stress symptomology

## **Comparison of surgeons with the general population**

The dataset will be used to examine how surgeons compare with the general population with respect to personality traits, psychological flexibility, tendency to burnout or suffer from psychological distress and resilience. For example, are they more resilient as Pegrum and Pearce (2008) have suggested?

**H2** – The following scores will differ between surgeon participant scores and published population means:

- CBI
- DASS-21
- PC-PTSD
- BRS
- BFI
- WAAQ

To examine effect sizes within the populations, both Hedge's  $g$  and Cohen's  $d$  were utilised. Whilst the more ubiquitous measure in examining the effect size between two populations is Cohen's  $d$ , this does not weight standard deviations based on sample sizes and therefore Hedge's  $g$  has better properties to analyse means from different sample sizes (Enzmann, 2015) which is the case for some of the comparisons within this research.

## **Factor analysis and structural equation modelling (SEM)**

The final stage in the analysis uses a combination of exploratory and confirmatory factor analysis to extract the latent variables that most accurately characterise the data structure. Previous research examining the impact of adverse events (Pinto et al., 2013;

Shanafelt et al., 2009) has failed to examine such factors and has left a gap within the understanding of this research area, a gap which this modelling will aim to address.

The factor scores obtained for each participant on each of the factors identified will have interval properties. Interval data will also allow for the use of structural equation modelling to examine the associations between putative predictor latent variables (such as type and severity of adverse events) and outcome variables (such as depression and burnout), and to explore the role of potential moderating and mediating latent variables. A series of competing models will be tested for their fit to the observed data with the aim of providing a principled quantitative model of the impact of adverse events on surgeons. The model so constructed can then be used to guide further research.

**H3** – the relationship between adverse events and psychological distress will be affected by the following psychological and environmental factors:

- Personality type
- Resilience
- Psychological flexibility
- Severity of event/patient outcome
- Outcome for the surgeon (investigation/litigation)
- Efficacy of training received by surgeons
- Availability of support

### **Methodology Conclusion**

The positivist approach within this research will provide the research area with rigorous findings that will be applicable within the surgeon population in the UK. Based as it is within previous research done within this field, the study will use a deductive approach

to investigate the impact of adverse events within a surgeon population. Whilst the use of directionless hypotheses may lead some to consider this more of an inductive approach, the theoretical framework is robust enough within areas outside of surgery for this research to confidently take a deductive stance.

The multi-method quantitative approach will enable a descriptive overview of how surgeons are affected when things go wrong - like that conducted within other projects. However, the use of mediation/moderation analysis and structural equation modelling within this research will provide a depth of understanding that is currently lacking. The creation of a predictive model will support training to support surgeons to develop protective behaviours and characteristics, which mitigate against the harm caused by such events.

Whilst online surveys may have their limitations in terms of response rates and technical difficulties (Ready & Veague, 2014), the use of Qualtrics software to create, disseminate and store data will be supportive in the data collection process. The collaboration and support of gatekeepers from surgical colleges will enable access to participation and increase response rates.

The content of the survey has been carefully considered for both ease of use and its inherent scientific rigour. The use of piloting guaranteed the former, whilst the inclusion of validated measures within the survey has ensured that the survey content is valid and fit for purpose.

## **4. Results – Descriptive characterisation and main impact of adverse events**

### **Introduction**

This chapter presents the statistical findings pertaining to data collected from the respondents of the research study, providing the descriptive results of the quantitative data. For analysis, the data was first put into an excel file and transferred into SPSS version 26. Details of the data cleaning procedure can be found within Appendix C of this thesis. The sample size is taken for this study  $n=445$ . As participants for this study were contacted through gatekeepers within organisations it is not possible to give an accurate response rate.

The first set of statistical analyses outlined within this chapter are the sample demographics, followed by a section examining a comparison of variables to population norms. The aim is to give a clear overview of the sample, followed by insight into the ways in which surgeons are a discrete group, as hypothesised within previous research (Borges & Osmon, 2001; Pegrum & Pearce, 2015). This chapter will then go on to examine the impact of the type of event experienced by participants. It will investigate whether the nature of the event itself has a significant effect on the outcomes of the surgeon.

The analyses of relationships between the variables, including mediation and moderation analysis, and structural equation modelling will take place in subsequent chapters.

### **Descriptive characterisation**

#### **Participant information**

Most of the respondents were from University Teaching Hospitals within the United Kingdom (54.6%), specialised in general surgery (29.2%) and were surgical consultants (78.2%). The average number of years since participants qualified as surgeons was 22 (SD=9.6, Range=3-47), while the mean number of years in which consultants had worked

in their current clinical position was 12.1 (SD=7.8, Range 1-32). Most of the respondents were male (70.8%) and married (80%) with a mean age of 46.7 years (SD=9.6, Range 27-69).

Full demographic information is outlined in Table 4 below:

Table 4

Demographic Information

<b>Demographic</b>	<b>Whole sample</b>	<b>Error sub-sample</b>	<b>Complication sub-sample</b>
Age <sup>#</sup>	46.7 (27-69)	47.9 (28-68)	45.7 (27-69)
Gender (Male)	315 (70.8)	145(75.1)	170 (67.5)
Principal place of work			
District General Hospital	188 (42.2)	76 (39.4)	112 (44.4)
University Teaching Hospital	243 (54.6)	110 (57.0)	133 (52.8)
Private Practice	14 (3.1)	7 (3.6)	7 (2.8)
<b>Surgical Specialty</b>			
Academic surgery	20 (4.5)	9 (4.7)	11 (4.4)
Cardiothoracic surgery	3 (0.7)	3 (1.6)	0 (0.0)
General surgery	130 (29.2)	60 (31.1)	70 (27.8)
Neurosurgery	8 (1.8)	4 (2.1)	4 (1.6)
Oral and maxillofacial surgery	12 (2.7)	3 (1.6)	9 (3.6)
Ophthalmology	20 (4.5)	10 (5.2)	10 (4.0)
Otolaryngology	18 (4.0)	5 (2.6)	13 (5.2)
Paediatric surgery	34 (7.6)	12 (6.2)	22 (8.7)
Plastic surgery	18 (4.0)	11 (5.7)	7 (2.8)
Trauma and orthopaedic surgery	72 (16.2)	31 (16.1)	41 (16.3)
Urology	89 (20.0)	35 (18.1)	54 (21.4)
Vascular surgery	21 (4.7)	10 (5.2)	11 (4.4)
<b>Grade</b>			
ST3*	13 (2.9)	5 (3.1)	7 (2.8)
ST4	5 (1.1)	4 (2.1)	1 (0.4)
ST5	13 (2.9)	2 (1.0)	11 (4.4)
ST6	11 (2.5)	3 (1.6)	8 (3.2)
ST7/8	28 (6.3)	10 (5.2)	18 (7.1)
Staff grade/associate specialist	26 (5.8)	15 (7.8)	11 (4.4)
Consultant	348 (78.2)	152 (78.8)	196 (77.8)
<b>Number of years at current grade (for consultants and non-training grades)</b>			
0-5 years	95 (21.3)	38 (19.7)	57 (22.6)
6-10 years	91 (20.4)	39 (20.2)	52 (20.6)
11-20 years	118 (26.5)	49 (25.4)	69 (27.4)
21-30 years	56 (12.6)	35 (18.1)	21 (8.3)
Over 30 years	3 (0.7)	2 (1.0)	1 (0.4)

Values are number of participants (%) unless otherwise stated; # values are mean (range); \* The ST3 grade is the beginning of specialist surgical training in the UK. This continues for 5/6 years (i.e. to grade ST7/8), at which point trainees complete their training.



## **Comparison between surgeons and the general population**

The main aim of this section is to give a picture of the characteristics of the participant surgeons and compare these findings with the general population, provide a clarity regarding the specific nature of the ‘surgeon personality’ that is hitherto lacking within this research area. The comparison group data has been obtained from previous standardising studies, the reference for which will be signposted within each section. Where access to raw data was limited, published means, and estimated effect sizes have been utilised. Independent t-tests have been used to analyse differences between means within this section.

Based on previous research it is hypothesised that surgeon scores will differ from those of the general population. Whilst research suggests that certain scores, such as those for burnout, post-traumatic stress symptomology and psychiatric distress, will be higher within the sample than the general population, the direction of differences within measures such as resilience is at present unclear, given contradictory findings within previous research. Therefore, the findings from this sample will shed much needed light into this research area.

### **Psychiatric Distress**

Previous research suggests that doctors are particularly vulnerable to experiencing mental illness due to the nature of their work (Bright & Krahn, 2011; Leblanc, 2009; Mihailescu & Neiterman, 2019; Panagioti et al., 2018). It was therefore predicted that there would be a significant difference between the sample scores for psychiatric distress (all domains) and the general population. The following (table 5) outlines the main findings of these analyses:

Table 5

DASS-21 Results and comparisons: Published normative data(n=1794) & Surgeon mean scores(n=345)

	Normative Sample	Surgeon Sample	<i>t</i>	<i>p</i>	<i>g</i>
	$\bar{x}$ (SD)	$\bar{x}$ (SD)			
Depression	5.66 (7.74)	6.31 (7.24)	1.443	.149	-
Anxiety	3.76 (5.90)	3.05 (4.55)	2.117	.034	0.12
Stress	9.46 (8.40)	10.55 (7.20)	2.256	.024	0.31
Total Scale	18.86 (19.32)	19.92 (16.21)	0.956	.339	-

Severity limit for DASS\*

	Depression	Anxiety	Stress
Normal	0-9	0-7	0-14
Mild	10-13	8-9	15-18
Moderate	14-20	10-14	19-25
Severe	21-27	15-19	26-33
Extremely Severe	28+	20+	34+

\* (Henry & Crawford, 2005) Severity limits are for DASS (42 item), therefore DASS-21 scores are doubled

## Burnout

Shanafelt et al. (2009) found that 40% of their sample (n=7905) screened positively for burnout symptomology using the MBI. Their findings suggest that burnout is the single greatest predictor of career satisfaction among surgeons. Using a different screening tool for burnout (CBI) this research examined the impact of burnout within the domains of the sample’s personal, work related and client related experiences. It was hypothesised that, as in previous studies, the surgeon sample would score significantly higher within all domains of burnout than the general population.

Table 6

CBI scores within surgeon sample and general population (n=2391\*)

	General Population		Surgeon Sample		<i>t</i>	<i>p</i>	<i>g</i>
	$\bar{x}$ (SD)	% > 50	$\bar{x}$ (SD)	% > 50			
Personal (351)	35.9 (16.5)	22.2	37.9 (21.3)	31.7	2.214	.027	0.12
Work (432)	33 (17.7)	19.7	33.1 (21.6)	24.1	0.104	.959	-
Client (429)	30.9 (17.6)	16.6	24.8 (20.1)	14.2	6.666	<.001	0.34

\* (Kristensen et al., 2005)

Whilst there was no significant difference between work burnout scores, there was a significant difference between personal burnout scores found within the general population ( $\bar{x}$ =35.9, SD=16.5) and those within the surgeon sample from this study ( $\bar{x}$ =37.9, SD=21.3) ( $t(2824)=2.214$ ,  $p=.027$ ) Hedge's *g* was the preferred method of effect size measurement given the large disparity between sample sizes of the two groups. However, the effect size of the difference in this instance was negligible ( $g = 0.12$ ).

There was also a significant difference between client burnout scores found within the general population ( $\bar{x}$ =30.9, SD=17.6) and those within the surgeon sample ( $\bar{x}$ =24.8, SD=20.1) ( $t(2818)=6.666$ ,  $p<.001$ ) and a small effect was found ( $g = 0.34$ ). As a group, surgeons are therefore suffering significantly less from burnout within a client related domain than those within the normative sample.

### Post-Traumatic Stress Symptomology

A meta-analysis examining the prevalence of PTSD among healthcare workers reported a prevalence of 15 – 25% of doctors screening positive for PTSD (Jacob-Sendler et al., 2016) in comparison with 6-7% of those within the general population (Prins et al., 2016). It is therefore the prediction of this research that the sample surveyed will contain higher levels of positive screens for PTS symptomology than the general population. The findings from the analyses are outlined in table 7:

Table 7

PC-PTSD sample scores (n=445)

Number of items	Positive report total	Percentage of sample
0	152	34.1
1	118	26.6
2	84	19
3	66	14.8
4	24	5.4

Note: A response of 'yes' to 3 or 4 items within the scale gives a 'positive' result for PTSD symptomology. A positive response to the screen does not necessarily indicate that a patient has posttraumatic stress disorder. However, a positive response does indicate that a patient may have PTSD or trauma-related problems and further investigation of trauma symptoms by a mental-health professional may be warranted.

90 participants out of 445 yielded a positive result (20.22%), indicating that the prevalence of PTS symptomology within the surgeon sample is two to three times higher than that of the general population (6-7%) (Prins et al., 2016).

## Resilience

Resilience is predicted to reduce both the physiological and psychological impact of negative events (Davis et al., 1998; Folkman and Moskowitz, 2000; Tugade et al., 2004), and is now recognised in healthcare as a collection of features that can be learned by individual doctors (RCSEd, 2022). However, the levels of resilience possessed by surgeons is under researched, with opposing findings being portrayed within different research landscapes (Pegrum & Pearce, 2015; Wu, 2000). Given the current lack of clarity, no predictions have been made about the outcome of this analysis, with an exploratory approach being taken in its stead. The table below outlines the BRS results of the surgeon sample:

Table 8

BRS sample scores (n=324)

Standardised sample mean	3.98 (.68)
Surgeon mean	3.23 (.81)
Frequency 'Low' (1-2.99) *	114 (35.2%)
Frequency 'Normal' (3-4.3) *	186 (57.4%)
Frequency 'High' (4.31-6) *	24 (7.4%)

\*Established Resilience categorization scores for BRS (Smith et al., 2008)

Although most surgeons within the sample fall within the 'normal' category, 35.2% of the surgeon population within this sample fall within the category of low resilience. This will be an important point for mediation/moderation analysis and modelling moving forward.

An unpaired T-test was performed on the data and found that there was a significant difference between resilience scores found within the general population ( $\bar{x}=3.98$ ,  $SD=0.68$ ) (Smith et al., 2013) and those within the surgeon sample ( $\bar{x}=3.23$ ,  $SD=.81$ ) ( $t(598)=12.033$ ,  $p<.001$ ) and using Cohen's  $d$ , a large effect was found ( $d = 1.11$ ). This sample therefore suggests that, as a group, surgeons are significantly less resilient than the general population.

### **Psychological flexibility**

Research suggests that psychological flexibility is a key predictor of a wide range of outcomes. Higher levels of flexibility are likely to enhance the cognitive processing of difficult events and promote both productivity and emotional health in a work environment (Bond et al., 2013). However, there is no indication from previous research that surgeons scores for psychological flexibility should differ from those of the general population.

An unpaired T-test was performed between surgeon data and published population norms (Bond, Lloyd & Guenole, 2013). There was no significant difference between surgeon levels of psychological flexibility within the sample ( $n=224$ ,  $\bar{x}=33.37$ ,  $SD=6.68$ ) and scores from the general population ( $n=191$ ,  $\bar{x}=33.77$ ,  $SD=6.62$ ) ( $t(413)=0.611$ ,  $p=.542$ ).

### **Surgeon personality**

It is contested whether there is a specific personality type for surgeons, with current research presenting contradictory findings (Preece & Cope, 2016; Whitaker, 2017). However, there is a consensus within the research to expect higher scores within the domain of neuroticism for the surgeon sample. The following analysis explores the scores of the

surgeon sample from the BFI measure included within the second half of the survey, and compares these findings with those of the general population:

Table 9

BFI sample score (n=198) and normative comparisons (n=1135\*)

	<b>Normative Sample*</b>	<b>Surgeon Sample</b>			
	$\bar{x}$ (SD)	$\bar{x}$ (SD)	<i>t</i>	<i>p</i>	<i>g</i>
Extraversion	3.22 (.89)	3.30 (.90)	1.17	.244	-
Agreeableness	3.88 (.67)	3.84 (.65)	.78	.436	-
Conscientiousness	3.77 (.69)	4.17 (.62)	7.64	<.001	0.59
Neuroticism	3.10 (.87)	2.57 (.83)	7.96	<.001	0.61
Openness	3.90 (.70)	3.50 (.74)	7.36	<.001	0.57

\*(John et al., 1991)

As outlined within table 9, an unpaired T-test was performed on the data and found that was a significant difference between surgeon scores within the domain of conscientiousness ( $\bar{x}$ =4.17, SD=.62) and those of the comparison sample ( $\bar{x}$ =3.77, SD=.69) ( $t(1331)$ =7.64,  $p$ <.001) and a medium effect, measured using Hedge's  $g$ , was found ( $g = 0.59$ ). Hedge's  $g$  was the preferred method of effect size measurement given the large disparity between sample sizes of the two groups. It was also found that surgeons within the sample scored significantly lower within the domain of neuroticism ( $\bar{x}$ =2.57, SD=.83) than those within the comparison sample ( $\bar{x}$ =3.10, SD=.87) ( $t(1331)$ =7.96,  $p$ <.001) and a medium effect, measured using Hedge's  $g$ , was found ( $g = 0.61$ ). Finally, surgeons within the sample scored significantly lower within the domain of openness ( $\bar{x}$ =3.50, SD=.74) than those within the comparison sample ( $\bar{x}$ =3.90, SD=.70) ( $t(1331)$ =7.36,  $p$ <.001) and a medium effect, measured using Hedge's  $g$ , was found ( $g = 0.57$ ). No significant difference was found within the domains of extraversion and agreeableness.

## **Adverse Event information**

Table 10

### Adverse Event Information

<b>Event information</b>	<b>Whole sample (n = 445)</b>	<b>Error sub-sample (n = 193)</b>	<b>Complication sub-sample (n = 252)</b>	<b>Sub-sample statistical comparison<sup>Δ</sup></b>
<b>Nature of event</b>				
Elective	352 (79.1)	151 (78.2)	201 (79.8)	$\chi^2(1)=0.15$ , $p=.695$
Emergency	89 (20.0)	41 (21.2)	48 (19.0)	$\chi^2(1)=0.28$ , $p=.595$
<b>Severity rating*</b>				
Low (0-grade II)	139 (31.2)	78 (40.4)	61 (24.2)	$\chi^2(1)=13.37$ , $p<.001$
High ( $\geq$ grade III-a)	302 (67.9)	113 (58.5)	189 (75.0)	$\chi^2(1)=13.56$ , $p<.001$
Feelings about event <sup>#</sup>	2.3; 1.07 (1-7)	2.3 (1-6)	2.4 (1-7)	
<b>Contributing factors</b>				
Fatigue	52 (11.7)	40 (20.7)	12 (4.8)	
Lack of knowledge/experience	54 (12.1)	32 (16.6)	22 (8.7)	
Lack of resources	31 (7.0)	24 (12.4)	7 (2.8)	
Lapse in judgement by you	139 (31.2)	101 (52.3)	38 (15.1)	
Poor communication	44 (9.9)	31 (16.1)	13 (5.2)	
Stress/depression/burnout	27 (6.1)	18 (9.3)	9 (3.6)	
Recognised risk of procedure	228 (51.2)	61 (31.6)	167 (66.3)	
System issue outside of your control	55 (12.4)	30 (15.5)	25 (9.9)	
Other (not specified)	75 (16.9)	38 (19.7)	37 (14.7)	

<sup>Δ</sup>Sub-sample comparisons obtained using Chi Squared. Outcome variable comparisons addressed later within the results chapter.

Values are number of participants (%) unless otherwise stated; # values are mean; SD (range)

\* Severity rating defined using Clavien-Dindo Scale

The following section outlines the descriptive data pertaining to the type of adverse events reported by participants within the study. Categorisation of adverse events include whether the event was a complication or an error (controlled by the between groups grouping factor and survey type), was an elective or emergency surgery, the outcome for the patient

and the outcome of the surgeon (e.g. litigation). Also included within table 10 is an overview of the contributing factors to the occurrence of the event as reported by survey participants.

56.6% of adverse events reported within the survey fell within the complication condition (n=252). The Qualtrics algorithm pseudo randomised into a 50/50 split through the embedded online algorithm, however, this slight disparity still occurred due to incomplete survey responses and the subsequent listwise removal of data during the data cleaning procedures. 352 (79.1%) of cases were elective cases and most patient outcomes following the adverse events were classified as 'high'/graded at or above grade III-a on the Clavien-Dindo scale (67.9%).

### **Main contributing factors leading to different types of adverse events**

Given the lack of clarity stated previously regarding the distinction between complications and errors, it was deemed pertinent to include a measure within the questionnaire that analysed surgeon perceptions of factors leading to the occurrence of the event. Given that participants within each condition were clearly presented with the definitions of both complications and errors, the following speculative hypotheses were made:

1. H1 – Participants within the complication condition would select 'recognised risk of surgery' as sole contributing factor of the event.
2. H2 – Participants within the error condition would not select 'recognised risk of surgery' as a contributing factor of the event and would rather select factors that were within their control

Frequency data appears to suggest that these hypotheses were refuted, with many participants within the complication condition selecting contributors to the occurrence of the sequelae other than it being a recognised risk of the surgery and many participants within



the error condition reporting that the event was a recognised risk of the procedure (See Table 11).

Table 11

Chi Square analysis of participant perceived contributors to complications (n=252) and errors (n=193)

Contributors	Complication condition frequency	Error Condition frequency	X <sup>2</sup> *	X <sup>2</sup> grouped contributing factor
Fatigue**	12(4.5%)	40 (16%)	X <sup>2</sup> (1)=18.77, p<.001	
Lack of knowledge**	22(8.3%)	32(12.8%)	X <sup>2</sup> (1)=2.82, p=.113	
Psychological distress**	9(3.4%)	19(7.6%)	X <sup>2</sup> (1)=4.47, p=.05	X <sup>2</sup> (1)=66.32, p<.001
Lapse in judgement**	38(14.3%)	103(41.2%)	X <sup>2</sup> (1)=47.01, p<.001	
Poor communication**	15(5.6%)	31(12.4%)	X <sup>2</sup> (1)=7.26, p=.008	
Recognised risk**+	158(59.4%)	61(24.4%)	X <sup>2</sup> (1)=81.40, p<.001	X <sup>2</sup> (1)=17.77, p<.001
Lack of resources**+	9(3.4%)	25(10%)	X <sup>2</sup> (1)=9.17, p=.004	
System issue **+	27(10.2%)	30(12%)	X <sup>2</sup> (1)=.45, p=.575	

\* Chi squared test of independence

\*\* Surgeon controlled factor

\*\*+ External factor

A Chi-square test of independence was calculated comparing the frequency of reported 'surgeon controlled contributing factors' occurring in complications and errors. A significant relationship was found with surgeons who had reported an error being more likely to report a 'surgeon-controlled factor' than those who had experienced a complication.

A Chi-square test of independence was calculated comparing the frequency of reported external factors within both complication and error conditions. A significant relationship was found with surgeons who had experienced a complication being more likely to report contributors outside of surgeon control than those within the error condition.

## The impact of the adverse event on outcome measures

This section examines participant responses regarding the fallout/aftermath of the event. It examines the practical implications of experiencing an adverse event for those within the sample, such as psychological, physiological or substance use changes, involvement in litigation, support, and any changes that surgeons felt they had subsequently made to their professional practice.

Throughout the section, the analyses are conducted on data from the sample and the complication and error subsamples.

### Analysis of physiological, psychological and substance usage changes

The main question addressed within this section is the extent to which a surgeon who has experienced an adverse event is affected in terms of self-reported general measures of physiology, psychology, and substance usage by analysing categorical data obtained from the survey.

Table 12

Impact of adverse event on mental and physical health and substance use

Issues reported	Whole sample	Error	Complication	$p (X^2, \varphi)^*$
Cardiovascular**	18 (4.0)	8 (4.1)	10 (4.0)	0.925
Gastrointestinal**	36 (8.1)	21 (10.9)	15 (6.0)	0.059
Headaches**	42 (9.4)	18 (9.3)	24 (9.5)	0.944
Minor illnesses**	28 (6.3)	11 (5.7)	17 (6.7)	0.652
Sleep problems <sup>+</sup>	189 (42.5)	96 (49.7)	93 (36.9)	0.007 (7.37, 0.13)
Depression <sup>+</sup>	52 (11.7)	25 (13.0)	27 (10.7)	0.466
Anxiety <sup>+</sup>	215 (48.3)	104 (53.9)	111 (44.0)	0.040 (4.24, 0.10)
Anger/irritability <sup>+</sup>	143 (32.1)	68 (35.2)	75 (29.8)	0.221
Relationship issues <sup>+</sup>	65 (14.6)	33 (17.1)	32 (12.7)	0.193
Alcohol consumption* <sup>+</sup>	47 (10.6)	28 (14.5)	19 (7.5)	0.018 (5.62, 0.11)

\* for significant p-values, the chi-square value ( $X^2$ ) and effect size value ( $\varphi$ ) are contained within brackets

\*\* is categorised as a physiological change

<sup>+</sup> is categorised as a psychological change

\*<sup>+</sup> Is categorised as a substance use change

A Chi-square test of independence was calculated comparing the frequency of reported physiological, psychological & substance use either staying the same or increasing (Table 13). Surgeons were more likely to report an increase in psychological changes than any other changes following the adverse event.

Table 13

Frequencies of reported physiological, psychological & substance use changes (n=332)

	<b>Stayed the same</b>	<b>Increased</b>	<b>X<sup>2</sup></b>
<b>Physiological</b>	178 (890)	112 (560)	
<b>Psychological</b>	214 (856)	523 (2092)	X <sup>2</sup> (2)=1540.05, <i>p</i> <.001
<b>Substance Usage</b>	206 (2060)	47 (470)	

To allow for the data to be comparable the scale of each category was adapted. This is represented within the brackets. (Physiological 5:1, psychological 4:1, substance use 10:1)

When examining the differences between the two subsamples, following the recalled event, the error group was more likely to report sleep problems and anxiety than the complication group. Additionally, alcohol consumption was greater in the error group. However, the effect size for these associations, measured using Phi due to this being a chi-squared analysis, are small. There was no significant association between event type and depression, anger/irritability, or health difficulties.

## Support

Participants were asked the question ‘Did you talk to someone about your feelings following the complication/error?’. The results revealed that only 50.2% of participants responded positively that they had talked about their feelings post event, with 49.8% preferring to keep their feelings to themselves.

Of those who responded positively to talking with someone about their feelings after the adverse event 67 (62.04%) chose to speak to a spouse, partner or friend, 97 (89.81%)

talked to colleagues within their own hospital, 21 (19.44%) reached out to colleagues in another hospital or trust and 6 (5.56%) utilised local or national support services.

Those who talked about their feelings post event were asked to rate how useful they found the experience in the question 'How useful did you find the experience of speaking to others?' in which they responded using a 7-point Likert scale (1 – Extremely useful to 7 – Not useful at all). The mean score of this scale was 2.26 (SD=1.34), demonstrating that on average support seeking was deemed useful by the sample.

A Chi-squared test of independence revealed that there was no association between event type and likelihood of talking about the event ( $X^2(1)=3.72, p=0.054$ ).

### **Changes to professional practice**

Participants were asked to rate whether they thought that 'My surgical practice changed as a result of this complication/error' on a 7-point Likert scale (1 – Strongly Agree, 7 – Strongly Disagree). The mean score for this scale was 3.34 (SD=1.71), demonstrating that on average participant practice had been somewhat changed by their experience.

In an independent T-test examining the difference between complications and errors, it was revealed that surgeons reported significantly more of a perceived change to practice following an error ( $\bar{x}=2.75, SD=0.11$ ) than a complication ( $\bar{x}=3.66, SD=0.11$ ), ( $t(444)=5.72, p<.001$ ).

123 participants then specified ways in which they felt that their practice had changed following the adverse event (Table 14). Most responses fell into the category of improving own practice (58.5%) or sharing the experience with others (58.5%) rather than precautionary or avoidant behaviours.

Table 14

Frequency data regarding ways in which practice has changed (n=123)

<b>Type of change</b>	
Surgical practice has improved because of learning from this experience	72 (58.5%)
Able to advise others on similar complications because of my experience	72 (58.5%)
Conduct more investigations prior to surgery	10 (8.1%)
Made more referrals than previously	9 (7.3%)
Ask for more frequent observations than previously	5 (4.1%)
Carried out more tests than previously	4 (3.3%)
Avoided procedures	19 (15.4%)
Avoided surgical approaches	13 (10.6%)
Stopped doing aspects of your work	9 (7.3%)

Note: Conditionally formatted question. Eligibility criteria for question was scoring <4 on previous scale

### **Impact of event type on involvement in Litigation**

Participants were asked the question ‘Did the complication lead to a formal investigation?’. 14.16% of participants responded positively to this question, stating that they had been involved in a formal investigation following the event. Of those, 68.3% of participants were from the error condition.

Such differences between the two conditions may be contributing factors towards any differences between outcome measures for surgeons within the two different groups (complication/error). It is therefore important to examine the ways in which these two groups differ amongst outcome variables within the study to provide a clear picture of the ways in which the events experienced impact surgeons – this is particularly pertinent as complications and errors have been conflated within previous research within this area.

### **Impact of event conditions**

Previous research has failed to clearly examine how the specific nature of the event experienced may affect surgeon outcomes. Within this section of the specific conditions of the event, including event type (complication or error) and outcome for the patient (severity score) are analysed, providing insight into how surgeons are affected following specific events. It is speculatively hypothesised that surgeons would report feeling worse about an error than a complication, given the definition of an error placing the event within the

surgeon's own locus of control. It is also hypothesised that severity of outcome of the patient will affect surgeon outcomes, therefore severity has been included as a covariate within ANCOVA testing. The following analyses examine effects between the event and surgeon reported outcomes directly related to the event (e.g. "How did you feel following the event?").

### **Impact of adverse event type on surgeons' feelings regarding the event**

Surgeons were asked 'How did you feel about the event? (Please indicate how positive or negative your feelings were about your specified event)' using a 7-point Likert scale (1=extremely negative, 7=extremely positive). Given previous research findings associating negative outcomes for surgeons following adverse events, alongside the predictions of this research that errors will have more of a negative effect on surgeons, it is speculatively hypothesised based on intuition that surgeons will report more negative feelings associated with errors than complications.

An ANCOVA was run to determine the effect of event type on surgeon feelings about the event after controlling for severity. After adjustment for severity there was a statistically significant difference in surgeon feelings scores between the groups ( $F(1, 439)=26.62, p<.001, \text{partial } \eta^2=.057$ ). Post hoc analysis was performed with a Bonferroni adjustment. Surgeons within the error subsample reported significantly more negative feelings associated with the event ( $\bar{x}(\text{adjusted}) = 1.97, SE=.07, 95\%CI = 1.83 - 2.12$ ) than the complication subsample ( $\bar{x}(\text{adjusted})=2.48, SE=0.06, 95\%CI = 2.35 - 2.60$ ). Severity was a significant co-variate in the ANCOVA ( $F(1, 439)=34.97, p<.001, \text{partial } \eta^2=.074$ ), indicating that event severity influenced surgeon feelings about the event.

### **Impact of event type on perception of own capability**

Participants were asked to evaluate 'To what extent do you feel that you are a better or worse practitioner as a result of your experience with this complication/error?' by using a

7-point Likert scale (1=much poorer, 7=much better). It was speculatively hypothesised that errors would make surgeons feel less capable.

An ANCOVA was run to determine the effect of event type on surgeon perceptions of own capability after controlling for severity, however the covariate was not significant – meaning that severity did not affect the relationship between event type and surgeon perception of capabilities. Therefore, an independent T-test was performed on the data, revealing that surgeons within the sample felt that they were better practitioners following experience of an error ( $\bar{x}=4.87$ ,  $SD=0.80$ ) than experience of a complication ( $\bar{x}=4.57$ ,  $SD=0.58$ ), ( $t(444)=-3.16$ ,  $p=.002$ ).

### **Impact of event type on training preparedness**

Participants were asked to evaluate “To what extent do you think that your training prepared you for the **personal** impact of this complication/error?” by using a 7-point Likert scale (1=Not at all, 7=well prepared). Given complications being ‘recognised risks of surgery’, it was speculatively hypothesised that training would have better prepared them to deal with complications than errors.

An ANCOVA was run to determine the effect of event type on surgeon feelings of preparedness for the event when controlling for severity. After adjustment for severity there was a statistically significant difference in surgeon feelings of preparedness between the groups ( $F(1, 425)=7.90$ ,  $p=.005$ , partial  $\eta^2=.018$ ). Post hoc analysis was performed with a Bonferroni adjustment. Surgeons within the error subsample reported feeling significantly less prepared ( $\bar{x}$  (adjusted) = 2.56,  $SE=.13$ ,  $95\%CI = 2.29 - 2.82$ ) than the complication subsample ( $\bar{x}$  (adjusted)=3.06,  $SE=0.12$ ,  $95\%CI = 2.83 - 3.29$ ). Severity was a significant covariate in the ANCOVA ( $F(1, 425)=5.69$ ,  $p=.018$ , partial  $\eta^2=.013$ ), indicating that event severity influenced surgeon feelings of preparedness regarding the event.

## Impact of event type on Post-Traumatic Stress Symptomology

Participants completed an adapted version of the PC-PTSD scale in which they were asked to reflect on the occurrence of PTSD symptomology following on from their experience of the adverse event. Previous research has highlighted the prevalence of PTS symptomology within surgeons following adverse surgical events (Joseph et al., 2014). However, given the ubiquitous nature of complications within a surgical setting and the recognised risk of such events within surgery, it is tentatively hypothesised that surgeons within the sample would experience fewer PTS symptoms following a complication than an error.

An ANCOVA was run to determine the effect of event type on PTS symptomology when controlling for severity. After adjustment for severity there was a statistically significant difference in the prevalence of PTS symptomology between the groups ( $F(1, 442)=8.42$ ,  $p=.004$ , partial  $\eta^2=.019$ ). Scores were higher for the error group ( $\bar{x}=1.3$ ,  $SD=1.2$ ) than complication group ( $\bar{x}=1.0$ ,  $SD=1.1$ ). Post hoc analysis was performed with a Bonferroni adjustment. Surgeons within the error subsample reported significantly more symptoms ( $\bar{x}$  (adjusted) = 1.56,  $SE=0.10$ ,  $95\%CI = 1.37 - 1.75$ ) than the complication subsample ( $\bar{x}$  (adjusted)=1.19,  $SE=0.08$ ,  $95\%CI = 1.03 - 1.35$ ). Severity was a significant co-variate in the ANCOVA ( $F(1, 442)=51.91$ ,  $p<.001$ , partial  $\eta^2=.105$ ), indicating that event severity influenced the prevalence of surgeon PTS symptomology.

### Conclusion: Descriptive characterisation and main impact of adverse events results

In line with previous research (e.g., Pinto et al., 2013; Shanafelt et al., 2009) the findings contained within this chapter provide a descriptive picture of the impact of adverse events on the individual. However, further analysis is required to fully examine the relationship between factors which may exacerbate or protect against negative outcomes. The results pertaining to these relationships will be examined within the following chapters.



## **5. Results - Mediation and Moderation Analyses**

### **Introduction**

This chapter presents the mediation and moderation analyses conducted on the sample dataset. As outlined within the methods chapter, mediation and moderation analyses were used to find the association between independent and dependent variables and provide a greater understanding of how the variables within the survey are related to one another. It is expected this would provide deeper insight into the ways in which surgeons are affected when they experience adverse events.

### **Mediation and moderation analysis**

Using mediation analysis, it is possible to test a chain of events in which the relationship between two variables is affected by a third, intermediary variable. Conversely, moderation analysis does not examine causal links between variables, but rather the conditions under which an effect occurs. Moderators can affect the nature of relationships between variables (Blair, 2019). A diagram depicting the difference between mediation and moderation can be found in the appendices of this thesis (Appendix D).

Mediation and moderation analysis is a vital step within this research, examining the role of state and trait behaviours in how surgeons respond to adverse events. This analysis will provide greater understanding of the complex relationships between different variables and act as a stepping stone towards the creation of a predictive psychological model.

Relationships within the sample data were analysed using the PROCESS macro within SPSS 26 (Hayes, 2013). PROCESS is an unofficial SPSS add-on that conducts observed-variable mediation and moderation analysis. PROCESS uses ordinary least squares

regression to estimate the parameters of regression equations (Hayes et al., 2017). The mediation and moderation analysis will examine the relationship between observed variables only. The examination of the effect of latent variables will be included within the structural equation modelling chapter of this thesis.

Table 15 and Table 16 provide an overview of the mediating and moderating variables that have been found to have a relationship with surgeon wellbeing following an adverse event. Full results follow immediately after. These variables highlighted as potential moderators and mediators were hypothesis driven and confirmed through the implementation of correlation analysis. Although the following results are significant, not all will be fully explored, as some of the variables were not appropriate for this analysis.

Appropriate variables for inclusion within the moderation and mediation analysis are those that can be directly linked to the event itself. Whilst variables such as the DASS-21 (psychiatric distress) and CBI (burnout) are shown to have a significant relationship with direct effect variables (Table 15 and Table 16), this research has no way of demonstrating beyond reasonable doubt that there is any direct link between these constructs without other, confounding factors.

Table 15

Moderating variables from moderation analysis

<b>Direct effect variables</b>	<b>Moderator</b>	<b><i>p</i></b>
Event type – Feelings	Neuroticism	.030
Event type – Psychiatric Distress*	Gender	.026
Event Type – Depression*	Gender	.040
Event Type – Anxiety*	Formal Investigation	.023
Event Type – Client Related Burnout*	Severity	.008
Event Type – Work-related burnout*	Severity	.034
Severity – Psychiatric distress*	Support	.003
Severity – Depression*	Support	.005
Severity – Anxiety*	Support	.002
Severity – Client Related Burnout*	Extraversion	.027

Feelings – Psychiatric Distress*	Emergency or Elective	.014
Feelings – PTSD	Neuroticism	.027
Feelings – Stress*	Emergency or Elective	.008
Feelings – Stress*	Extraversion	.044
Feelings – Work-related burnout*	Neuroticism	.023

Table 15 shows the moderating relationships investigated using the survey data. In which key moderators affect the relationships between the direct effect variables.

\* denotes lack of causal link between direct effect variables – relationship analysis will not be taken forward

Table 16

Mediating variables from mediation analysis

Direct effect variables	Mediator	b	95% Bca CI	p
Event type – Feelings	Resilience	.043	-.106, -.005	.076
Event type – Psychiatric Distress*	Resilience	.561	.196, 1.162	.020
Event type – PC-PTSD Score	Resilience	.077	.010, .168	.054
Event Type – Depression*	Resilience	.428	.132, .946	.032
Event Type – Anxiety*	Resilience	.128	.037, .302	.058
Event Type – Stress*	Resilience	.217	.070, .461	.029
Event Type – Client Related Burnout*	Resilience	8.843	2.464, 17.167	.018
Event Type – Personal Burnout*	Resilience	7.211	2.019, 15.127	.024
Event Type – Work-related burnout*	Resilience	9.410	2.544, 18.730	.020
Severity – Feelings	Resilience	.016	-.036, -.004	.043
Severity – PTSD Score	Resilience	.030	.010, .056	.011
Feelings – Psychiatric Distress*	Resilience	.417	-.794, -.174	.006
Feelings – PTSD score	Resilience	-.062	-.075, -.023	<.001
Feelings – Depression*	Resilience	.150	-.304, -.051	.016
Feelings – Anxiety*	Resilience	.101	-.210, -.034	.022
Feelings – Stress*	Resilience	.148	-.297, -.050	.016
Feelings – Client related burnout*	Resilience	7.067	-11.972, -3.699	<.001
Feelings – Personal Burnout*	Resilience	5.649	-9.950, -2.605	.003
Feelings – Work-related burnout*	Resilience	7.488	-12.960, -3.647	.002

Table 16 shows the mediating relationships investigated using the survey data. In which key mediators affect the relationships between the direct effect variables.

\* denotes lack of causal link between direct effect variables – relationship analysis will not be taken forward

The following section will examine the mediating and moderating relationships on direct effects. As outlined previously, only relationships in which it is possible to claim a direct causal link will be examined.

### **Direct effect: Event type – Feelings**

#### *Neuroticism as a moderator of the effect of event type on feelings*

When neuroticism is low, there is a significant negative relationship between event type and feelings ( $b=-.481$ , 95% CI [-.801, -.161],  $t=-2.95$ ,  $p=.003$ ). At the mean value of neuroticism there is a non-significant negative relationship between event type and feelings ( $b=-.235$ , 95% CI [-.452, -.018],  $t=-2.95$ ,  $p=.942$ ). When neuroticism is high there is a significant positive relationship between event type and feelings ( $b=.011$ , 95% CI [-.290, .312],  $t=.073$ ,  $p=.003$ )

#### *Mediating effect of Resilience in the relationship between Event Type and Feelings following the adverse event*

In step one of the mediation model the regression of Event Type on Feelings, ignoring the mediator, was significant,  $b=-.37$ ,  $t(417)=-3.66$ ,  $p<.001$ . Step two showed that the regression of Event Type on the mediator of Resilience was also significant,  $b=-.96$ ,  $t(417)=-1.99$ ,  $p=.048$ . Step three of the mediation process showed that the mediator (Resilience) controlling for Event Type was significant  $b=.05$ ,  $t(417)=4.43$ ,  $p<.001$ . Step four of the analysis revealed that, controlling for the mediator (Resilience) Event Type was a significant predictor of Feelings,  $b=-.33$ ,  $t(417)=-3.29$ ,  $p=.001$ . A Sobel test was conducted and found full mediation in the model ( $z=-1.78$ ,  $p=.076$ ). It was found that Resilience fully mediated the relationship between Event Type and Feelings.

### **Direct effect: Event type – PC-PTSD Score**

#### *Mediating effect of Resilience (BRS score) in the relationship between Event Type (error or complication) and PC-PTSD Score*

Within this model the outcome variable of PC-PTSD Score refers to the participants' score out of 4 from their completion of the PTSD screening tool.

In step one of the mediation model the regression of Event Type on PC-PTSD Score, without the mediator, was non-significant,  $b=.19$ ,  $t(418)=1.15$ ,  $p=.157$ . Step two showed that the regression of Event Type on the mediator of Resilience was significant,  $b=-.99$ ,  $t(418)=-2.06$ ,  $p=.040$ . Step three of the mediation process showed that the mediator (Resilience) controlling for Event Type was significant  $b=-.08$ ,  $t(418)=-6.06$ ,  $p<.001$ . Step four of the analysis revealed that, controlling for the mediator (Resilience), Event Type was not a significant predictor of PC-PTSD Score,  $b=.11$ ,  $t(418)=.86$ ,  $p=.388$ . A Sobel test was conducted and found full mediation in the model ( $z=1.93$ ,  $p=.054$  –  $p$  values of greater than .05 were considered statistically significant if the bootstrapped confidence intervals did not breach the zero threshold). It was therefore found that Resilience fully mediated the relationship between Event Type and PC-PTSD.

#### **Direct effect: Severity – Feelings**

##### *Mediating effect of Resilience in the relationship between Severity and Feelings*

In step one of the mediation model the regression of Severity on Feelings, ignoring the mediator, was significant,  $b=-.17$ ,  $t(359)=-5.20$ ,  $p<.001$ . Step two showed that the regression of Severity on the mediator of Resilience was also significant,  $b=-.40$ ,  $t(359)=-2.53$ ,  $p=.012$ . Step three of the mediation process showed that the mediator (Resilience) controlling for Severity was significant  $b=.04$ ,  $t(359)=3.62$ ,  $p<.001$ . Step four of the analysis revealed that, controlling for the mediator (Resilience) Severity was a significant predictor of Feelings,  $b=-.16$ ,  $t(359)=-4.83$ ,  $p<.001$ . A Sobel test was conducted and found full mediation in the model ( $z=-2.04$ ,  $p=.043$ ). It was found that Resilience fully mediated the relationship between Severity and Feelings.

### **Direct effect: Severity – PTSD Score**

#### *Mediating effect of Resilience in the relationship between Severity and PC-PTSD score*

In step one of the mediation model the regression of Severity on PC-PTSD Score, ignoring the mediator, was significant,  $b=.21$ ,  $t(354)=4.74$ ,  $p<.001$ . Step two showed that the regression of Severity on the mediator of Resilience was also significant,  $b=-.43$ ,  $t(354)=-2.75$ ,  $p=.006$ . Step three of the mediation process showed that the mediator (Resilience) controlling for Severity was significant  $b=-.09$ ,  $t(354)=-7.00$ ,  $p<.001$ . Step four of the analysis revealed that, controlling for the mediator (Resilience) Severity was a significant predictor of PC-PTSD Score,  $b=-.17$ ,  $t(354)=-4.12$ ,  $p<.001$ . A Sobel test was conducted and found full mediation in the model ( $z=-2.54$ ,  $p=.011$ ). It was found that Resilience fully mediated the relationship between Severity and PC-PTSD.

### **Direct effect: Feelings – PTSD score**

#### *Neuroticism as a moderator of the effect of feelings on PTSD*

When neuroticism is low, there is a significant negative relationship between feelings and PTSD ( $b=-.40$ , 95% CI [-.57, -.23],  $t=-4.62$ ,  $p<.001$ ). At the mean value of neuroticism there is a significant negative relationship between feelings and PTSD ( $b=-.55$ , 95% CI [-.67, -.42],  $t=-8.89$ ,  $p<.001$ ). When neuroticism is high there is a significant negative relationship between feelings and PTSD ( $b=-.69$ , 95% CI [-.87, -.51],  $t=-7.44$ ,  $p<.001$ )

#### *Mediating effect of resilience in the relationship between feelings and PC-PTSD Score*

In step one of the mediation model the regression of feelings following the adverse event on PC-PTSD score, ignoring the mediator, was significant,  $b=-.42$ ,  $t(415)=-8.12$ ,  $p<.001$ . Step two showed that the regression of feelings on the mediator of resilience was also significant,  $b=1.05$ ,  $t(415)=4.88$ ,  $p<.001$ . Step three of the mediation process showed that the mediator (resilience) controlling for feelings was significant  $b=.01$ ,  $t(415)=-4.45$ ,  $p<.001$ . Step four of the analysis revealed that, controlling for the mediator (resilience)

feelings about the adverse event was a significant predictor of PC-PTSD score,  $b=-.42$ ,  $t(415)=-7.00$ ,  $p<.001$ . A Sobel test was conducted and found full mediation in the model ( $z=-3.25$ ,  $p=.001$ ). It was found that resilience fully mediated the relationship between feelings and PC-PTSD score.

### **Conclusion**

Whilst it is evident that there are significant relationships between the variables within the study, to accurately create a reliable predictive model of how surgeons will be affected when things go wrong further analysis is required. The current picture presented by this research through mediation and moderation analysis alone has given a good overview of the individual variables that may affect the way in which surgeons are affected when adverse events occur.

At this stage in the analysis, Neuroticism has been found to moderate the relationship between event type and feelings about the event - with high neuroticism having a significant relationship between errors and negative feelings about the event - as well as the relationship between feelings about the event and PTS symptomology – with all levels of neuroticism yielding a significant negative relationship between feelings and PTSD.

Resilience has been found to be a significant mediator within the analysis so far. Mediating the relationship between event type and feelings, and event type and PTS symptomology, as well as the relationship between severity of event and feelings, and severity of event and PTS symptomology.

However, more analysis is required to provide insight into the interplay between moderation and mediation variables. To further examine the data and provide more understanding regarding the impact of adverse events on surgeons, more detailed structural equation modelling is required.

## **6. Results - Structural Equation Modelling**

### **Introduction**

SEM is a statistical technique that is the result of the amalgamation of factor analysis and path analysis (Weston et al., 2008). In factor analysis, intercorrelations among measured variables are analysed to confirm the unobserved constructs (Weston et al., 2008). In contrast, path analysis is a method used by investigators to describe the correlations among a set of variables when no underlying constructs are assumed to exist (Weston et al., 2008). The model included within this research includes both observed and latent variables, making SEM the appropriate analysis technique in this instance. The two main aims of SEM are as follows:

- To understand the patterns of correlation/covariance among a set of variables.
- To explain as much of their variance as possible with the model specified.

To develop a reliable predictive model, a series of regressions are applied sequentially to the data. In contrast to a first-order Confirmatory Factor Analysis (CFA) model, which comprises only a measurement component, and a second-order CFA model for which the higher order level is represented by a reduced form of structural model, the full structural equation model comprises of both a measurement and structural model (Schrieber et al., 2006). In the full SEM model, certain latent variables are connected by one-way arrows, the directionality of which reflects hypotheses in the study influencing the causal structure of variables in the model.

SEM is therefore an extension of the general linear model. It is used to test a set of regression equations simultaneously. SEM techniques are based on multivariate statistical



procedures, extending conventional multivariate statistical analysis by accounting for measurement error and by more thoroughly examining goodness-of-fit (Karimi & Meyer, 2014). The advantages of SEM analysis are as follows:

- SEM provides overall tests of model fit and individual parameter estimate tests simultaneously.
- Regression coefficients, means and variances may be associated simultaneously.

SEM represents the relationship between dependent (observed) variables and independent (input) variables using path diagrams. If the hypothesised model has a good fit, it is accepted that the statistical test values should be in the following manner (Hair et al., 2006):

- Chi-square value should be less than 5
- GFI, AGFI and CFI values should be greater than 0.90
- RMR & RMSEA values should be less than 0.08

CFA and SEM models will be represented graphically using path diagrams, and through tables demonstrating the statistical goodness of fit within this chapter. Through both mediums the following terminology will be used and reported upon:

Table 17  
Terminology key for SEM

<b>Term in use</b>	<b>Term - expanded</b>	<b>Definition</b>
AG	Agreeableness	Agreeableness domain within BFI
AGFI	Adjusted goodness of fit index	The proportion of variance accounted for by the estimated population covariance
CFI	Comparative fit index	The improvement of the fit of the model over a more restricted model
CON	Conscientiousness	Conscientiousness domain within BFI
Event_Type	Event Type	Between group variable – Error or Complication
EX	Extraversion	Extraversion domain within BFI
Feelings	Feelings following adverse event	Single item within the survey ‘How did you feel about the event?’
FormInv	Formal Investigation	Whether or not the adverse event led to a formal investigation (2 conditions – yes/no)
GFI	Goodness of Fit Index	The variance accounted for within the entire model.
IFI	Incremental fit index	Adjusts the Normed Fit Index (NFI) for sample size and degrees of freedom
NatEvent	Nature of Event	Whether the adverse event participants are referring to be an elective or emergency case
NEUR	Neuroticism	Neuroticism domain within BFI
NFI	Normed Fit Index	Indicates whether the model of interest improves the fit
OP	Openness	Openness domain within BFI
Psychological_Flexibility	WAAQ score	Scores for psychological flexibility using the WAAQ
PTSD_Total	PC-PTSD score	Scores for PTSD symptomology using the PC-PTSD
Resilience	BRS score	Scores for resilience using the BRS
RMR	Root Mean Square Residuals	Square-root of the difference between the residuals of the sample covariance matrix and the hypothesised model
RMSEA	Root Mean Square Error of Approximation	Index to correct for the complexity of the model
Severity	Clavien-Dindo severity rating	The severity of the patient outcome using the Clavien-Dindo rating scale
Timeframe	Timeframe since event	The recency of the event from the timepoint of completing the survey
WorryCol	Worry about Colleagues	Single item within the survey ‘As a result of this complication I worry more about what my colleagues think of my practice.’

## First Stage - Confirmatory Factor Analysis

To examine the theoretical interdependence between five factors (event type, nature of event, severity, timeframe, and formal investigation), confirmatory factor analysis was used (Fig. 5). This analysis agrees to test all the relevant paths and measurements errors and feedbacks are included directly in the model. The fit indices reveal a model is a good fit as the factors are found to be significant at the level of  $p < 0.05$  (Table 18). The model, which was assessed using global fit and 'r' to identify the degree to which the hypothesised model is reliable with the data in hand and the sample covariance matrix, based on data seems to fit (Bollen, 1989).

Figure 5

CFA Model – Input Variables

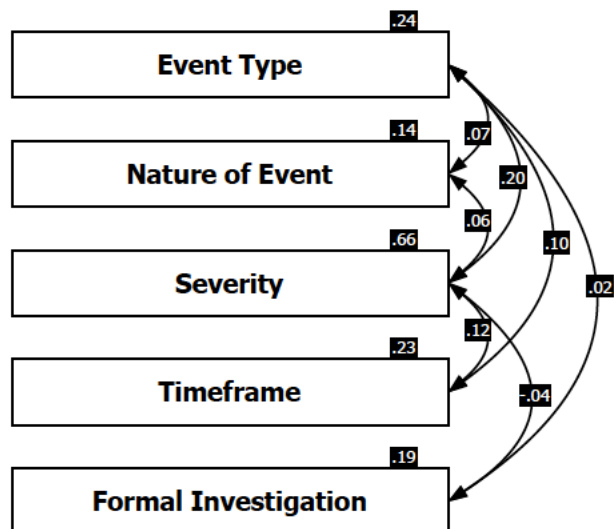


Table 18

## CFA Model – Input Variables

			<b>Unstandardized coefficient</b>	<b>S.E.</b>	<b>Standardized coefficient</b>	<b>p-value</b>
Formal Investigation	↔	Event Type	-0.020	0.009	-0.092	<b>0.020*</b>
Formal Investigation	↔	Severity	-0.043	0.016	-0.122	<b>0.007**</b>
Event Type	↔	Timeframe	0.102	0.012	0.435	<b>&lt;0.001***</b>
Event Type	↔	Nature of Event	0.067	0.009	0.363	<b>&lt;0.001***</b>
Severity	↔	Timeframe	0.121	0.019	0.314	<b>&lt;0.001***</b>
Event Type	↔	Severity	0.196	0.021	0.492	<b>&lt;0.001***</b>
Severity	↔	Nature of Event	0.060	0.014	0.198	<b>&lt;0.001***</b>

\*\*\*p<0.001, \*\*p<0.01, \*p<0.05

In terms of the structural model, the quality of fit was acceptable illustration of the sample data  $\chi^2(3) = 2.192$ , GFI = 0.998, AGFI = 0.990, CFI = 0.999, IFI = 0.999, NFI = 0.993, which are greater than the 0.90 criteria (Hu & Bentler, 1999; Joreskog & Sorbom, 1981). Similarly, RMSEA = 0.001 and RMR = 0.005 are lower than 0.08 critical value (Steiger, 1989).

## Direct effect analyses

The following section will examine the direct effect variables, analysing the significance of the relationships between unobserved and observed variables for the purposes of model building. As outlined within the CFA model above, the input variables are event type (complication/error), nature of event (emergency/elective), severity (adapted Clavien-Dindo scale), timeframe (length of time since reported event) and the incidence of a formal investigation. The observed (dependent) variables within the following analyses are surgeon feelings about the event, the reported levels of post-traumatic stress symptomology and worry about the perception of colleagues. The following three models examine the quality of fit of these direct effects.

### **Impact of event type, nature of event, severity, timeframe, and formal investigation on feelings**

Figure 6 depicts the impact of the input variables on the observed variable of feelings:

Figure 6

Impact of event type, nature of event, severity, timeframe, and formal investigation on feelings

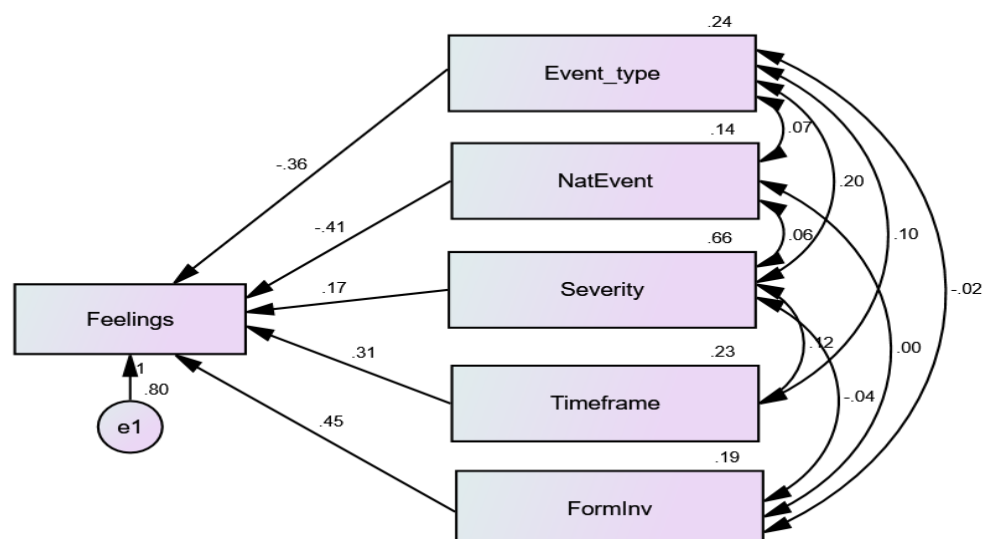


Table 19

Impact of event type, nature of event, severity, timeframe, and formal investigation on feelings

		Standardized coefficient	S.E	R Square	p-value
Feelings ↔	Event Type	0.159	0.126		<0.001***
Feelings ↔	Nature of Event	0.147	0.062		0.005**
Feelings ↔	Severity	0.156	0.103	0.122	<0.001***
Feelings ↔	Timeframe	0.205	0.100		<0.001***
Feelings ↔	Formal Investigation	0.184	0.115		<0.001***

\*\*\*p<0.001, \*\*p<0.01, \*p<0.05

Table 19 depicts the SEM of the impact of event type, nature of event, severity, timeframe, and formal investigation on feelings. The fit indices reveal a good fit, with factors significant at the  $p<0.05$  level. The above results reveal that there is a significant impact of event type, nature of event, severity, timeframe, and formal investigation on feelings. The factors which lead to more **negative feelings** were the event type being an error, the nature of the event being an emergency, the severity of outcome for the patient scoring higher on the Clavien-Dindo scale, the event taking place more recently and the event leading to a formal investigation.

Within the structural model, the quality of fit was acceptable illustration of the sample data  $\chi^2(2) = 2.180$ , GFI = 0.989, AGFI = 0.982, CFI = 0.999, IFI = 0.999, NFI = 0.994, which are greater than the 0.90 criteria. Similarly, RMSEA = 0.014 and RMR = 0.005 are lower than 0.08 critical value.

## Impact of event type, nature of event, severity, timeframe, and formal investigation on PTS symptomology

Figure 7 depicts the impact of the input variables on the observed variable of PTS symptomology:

Figure 7

Impact of event type, nature of event, severity, timeframe, and formal investigation on PTS

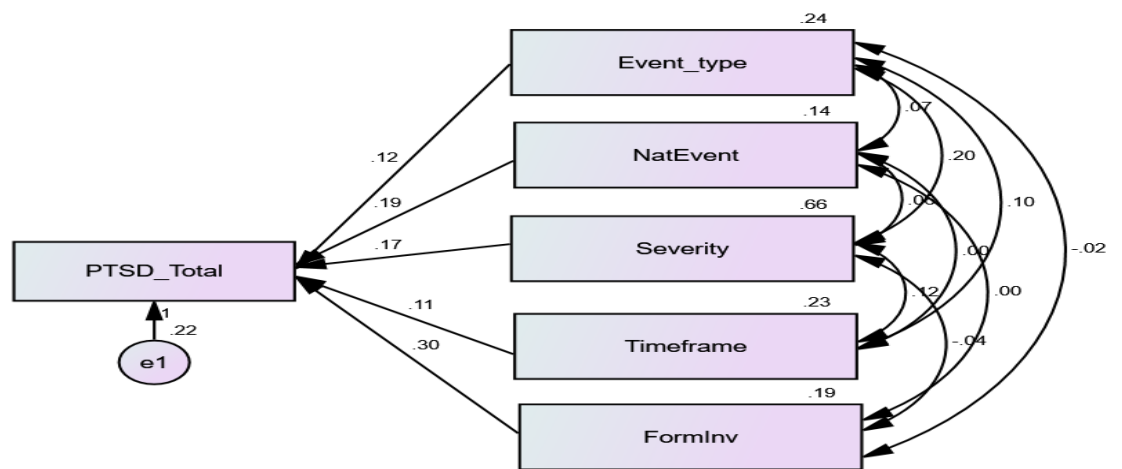


Table 20

Impact of event type, nature of event, severity, timeframe, and formal investigation on PTS

			Standardized coefficient	S.E	R Square	p-value
PTSD Total	↔	Event Type	.114	.061		<b>0.041*</b>
PTSD Total	↔	Nature of Event	.130	.067		<b>&lt;0.005**</b>
PTSD Total	↔	Severity	.256	.033	0.135	<b>&lt;0.001***</b>
PTSD Total	↔	Timeframe	.101	.054		<b>0.036*</b>
PTSD Total	↔	Formal Investigation	.244	.053		<b>&lt;0.001***</b>

\*\*\*p<0.001, \*\*p<0.01, \*p<0.05

Table 20 shows the impact of event type, nature of event, severity, timeframe, and formal investigation on PTS, in which a SEM was used. The above results reveal that there is a significant impact of event type, nature of event, severity, timeframe, and formal investigation on PTS symptomology. The factors which **increased** the prevalence of PTS symptomology were the event type being an error, the nature of the event being an emergency, the severity of outcome for the patient scoring higher on the Clavien-Dindo scale, the event taking place more recently and the event leading to a formal investigation.

Within the structural model, the quality of fit was acceptable illustration of the sample data  $\chi^2(1) = 2.015$ , GFI=0.998, AGFI = 0.968, CFI =0.998, IFI = 0.998, NFI = 0.995, which are greater than the 0.90 criteria. Similarly, RMSEA =0.048 and RMR =0.004 are lower than 0.08 critical value.

**Impact of event type, nature of event, severity, timeframe, and formal investigation on worry about colleagues**

Figure 8 depicts the impact of the input variables on the observed variable of worry about colleagues:

Figure 8

Impact of event type, nature of event, severity, timeframe, and formal investigation on worry about colleagues

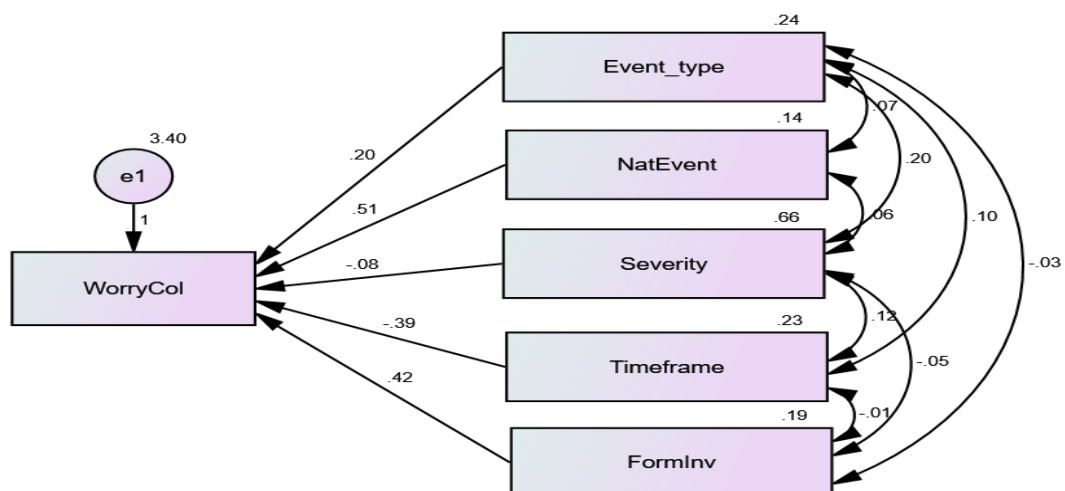




Table 21

Impact of event type, nature of event, severity, timeframe, and formal investigation on worry about colleagues

			Standardized coefficient	S.E	R Square	p-value
Worry about colleagues	↔	Event Type	0.052	0.236		<b>0.011*</b>
Worry about colleagues	↔	Nature of Event	0.101	0.259		<b>0.041*</b>
Worry about colleagues	↔	Severity	-0.033	0.127	0.133	<b>&lt;0.001***</b>
Worry about colleagues	↔	Timeframe	-0.099	0.212		<b>&lt;0.001***</b>
Worry about colleagues	↔	Formal Investigation	0.099	0.206		<b>0.039*</b>

\*\*\*p<0.001, \*\*p<0.01, \*p<0.05

Table 21 depicts the impact of event type, nature of event, severity, timeframe, and formal investigation on worry about colleagues, in which a structural equation model was used. The above results reveal that there is a significant impact of event type, nature of event, severity, timeframe, and formal investigation on worry about colleagues. The factors which **increased** levels of worry about the perception of colleagues were: the event type being a complication, the nature of the event being an elective surgery, the severity of outcome for the patient scoring higher on the Clavien-Dindo scale, the event taking place more recently and the event leading to a formal investigation.

Within the structural model, the quality of fit was acceptable illustration of the sample data  $\chi^2(2) = 0.177$ , GFI = 0.999, AGFI = 0.999, CFI = 0.999, IFI = 0.999, NFI = 0.999, which are greater than the 0.90 criteria. Similarly, RMSEA=0.001 and RMR =0.001 are lower than 0.08 critical value.

## Mediated main effects

The following analyses will examine the role of the mediators within the model. The mediators highlighted within the previous mediation analysis were resilience and psychological flexibility. These factors will now be loaded into the model to examine model fit.

### The mediating effect of resilience

#### **Impact of event type, nature of event, severity, timeframe, and formal investigation on feelings when mediated by resilience**

Figure 9 depicts the impact of the input variables on the observed variable of feelings when mediated by resilience:

Figure 9

Impact of event type, nature of event, severity, timeframe, and formal investigation on feelings when mediated by resilience

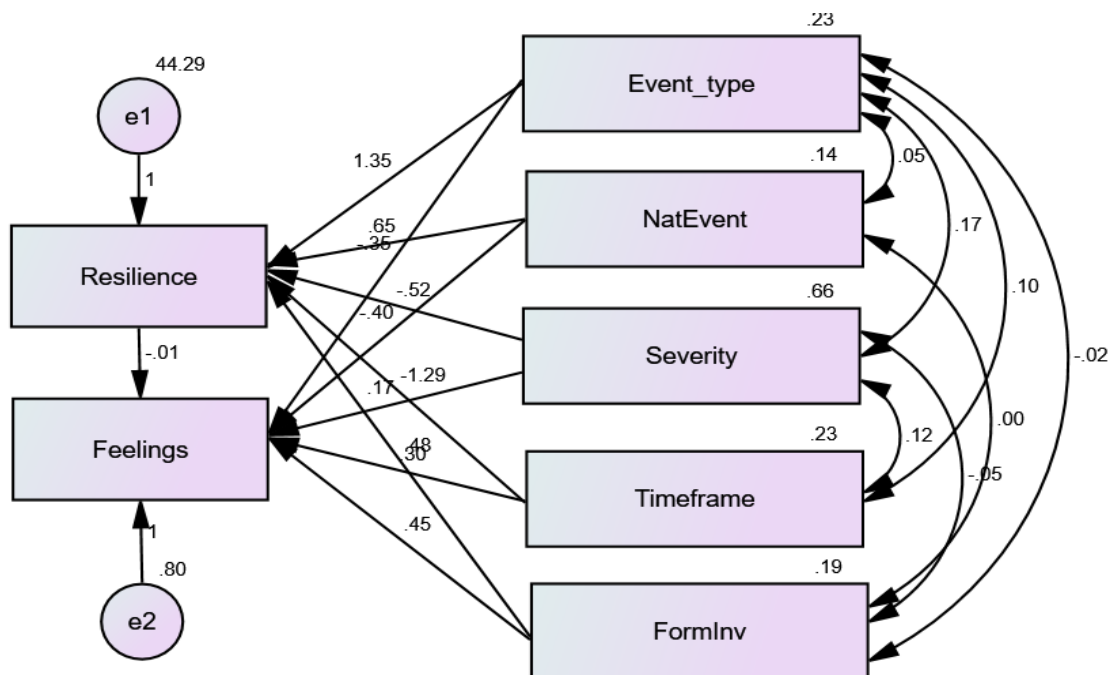


Table 22

Impact of event type, nature of event, severity, timeframe, and formal investigation on feelings when mediated by resilience

			Standardized Coefficients		R Square	P value
			Beta	SE		
Resilience	←	Event Type	0.097	0.851		<b>0.012*</b>
Resilience	←	Nature of Event	0.036	0.919		<b>0.039*</b>
Resilience	←	Severity	-0.063	0.450	0.017	<b>0.003**</b>
Resilience	←	Timeframe	-0.091	0.764		<b>0.015*</b>
Resilience	←	Formal Investigation	0.031	0.741		<b>0.047*</b>
Feelings	←	Resilience	-0.056	0.006		<b>0.018*</b>
Feelings	←	Severity	0.143	0.061		<b>0.005**</b>
Feelings	←	Timeframe	0.151	0.103		<b>0.003**</b>
Feelings	←	Formal Investigation	0.206	0.100	0.129	<b>&lt;0.001***</b>
Feelings	←	Event Type	-0.175	0.115		<b>0.002**</b>
Feelings	←	Nature of Event	-0.156	0.123		<b>0.001**</b>

\*\*\*p<0.001, \*\*p<0.01, \*p<0.05

Table 22 demonstrates the impact of event type, nature of event, severity, timeframe, and formal investigation on feelings when mediated by resilience. The model shows a significant effect of event type, nature of event, severity, timeframe, and formal investigation on feelings and resilience. Resilience also has a significant impact on feelings, with the mediating effect of resilience **reducing** the negative impact of input variables on feelings.

Within the structural model, the quality of fit was acceptable illustration of the sample data  $\chi^2(3) = 21.652$ , GFI = 0.986, CFI = 0.948, IFI = 0.951, NFI = 0.941, which are greater than the 0.90 criteria, although within this mediated model the AGFI = 0.871, falling slightly short of the established criteria, but still indicating a model of acceptable fit when examined in conjunction with the other fit indices within the model (Hair et al., 2006). RMSEA = 0.020 and RMR = 0.022 and are therefore lower than 0.08 critical value.

**Impact of event type, nature of event, severity, timeframe, and formal investigation on PTS symptomology when mediated by resilience**

Figure 10 depicts the impact of the input variables on the observed variable of PTS symptomology when mediated by resilience:

Figure 10

Impact of event type, nature of event, severity, timeframe, and formal investigation on PTS symptomology when mediated by resilience

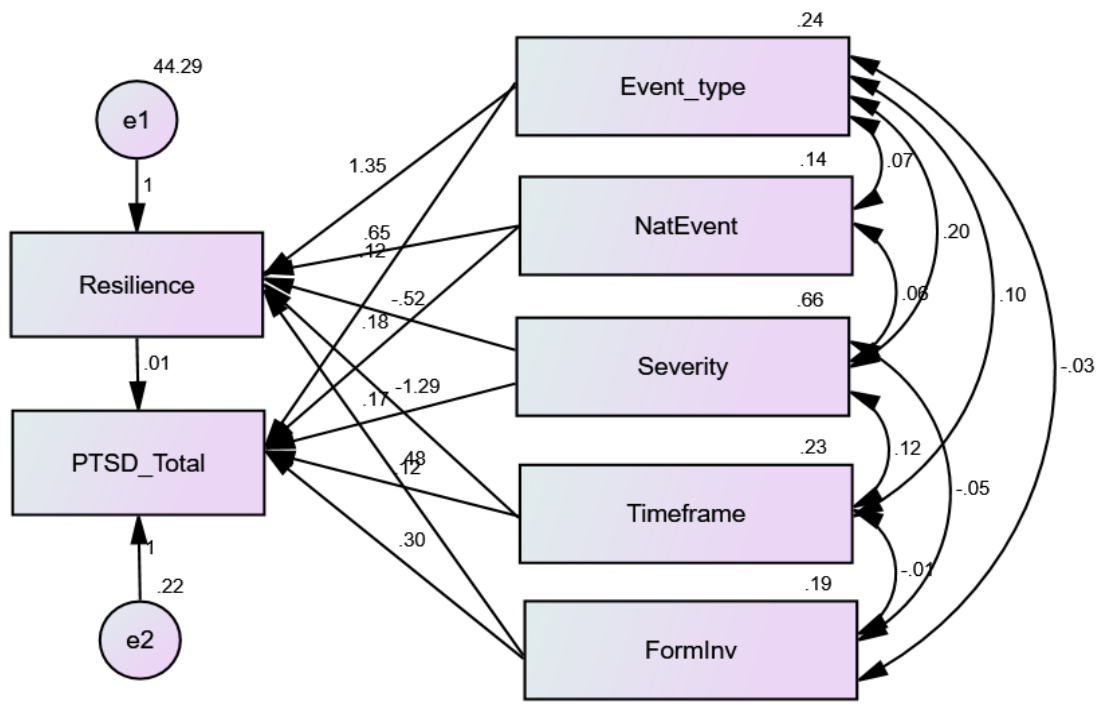


Table 23

Impact of event type, nature of event, severity, timeframe, and formal investigation on PTS symptomology when mediated by resilience

			Standardized Coefficients		R Square	P value
			Beta	SE		
Resilience	←	Event Type	0.100	0.851		<b>0.012*</b>
Resilience	←	Nature of Event	0.036	0.937		<b>0.007**</b>
Resilience	←	Severity	-0.063	0.459	0.152	<b>0.046*</b>
Resilience	←	Timeframe	-0.092	0.766		<b>0.093</b>
Resilience	←	Formal Investigation	0.031	0.743		<b>0.015*</b>
PTSD Total	←	Resilience	0.073	0.003		<b>0.006**</b>
PTSD Total	←	Severity	0.262	0.033		<b>&lt;0.001***</b>
PTSD Total	←	Timeframe	0.108	0.054		<b>0.026*</b>
PTSD Total	←	Formal Investigation	0.243	0.053	0.280	<b>&lt;0.001***</b>
PTSD Total	←	Event Type	0.107	0.061		<b>0.044*</b>
PTSD Total	←	Nature of Event	0.128	0.066		<b>0.006**</b>

\*\*\*p<0.001, \*\*p<0.01, \*p<0.05

Table 23 displays the impact of event type, nature of event, severity, timeframe, and formal investigation on PTS symptomology when mediated by resilience. The above results reveal that there is a significant impact of event type, nature of event, severity, and formal investigation on PTS symptomology and resilience. Resilience has a significant impact on PTS symptomology, with the mediating effect of resilience **reducing** the prevalence of PTS symptomology.

Within the structural model, the quality of fit was acceptable illustration of the sample data  $\chi^2(2) = 0.177$ , GFI=0.999, AGFI = 0.998, CFI =0.999, IFI = 0.999, NFI = 0.999, which are greater than the 0.90 criteria. Similarly, RMSEA =0.001 and RMR =0.002 are lower than 0.08 critical value.

**Impact of event type, nature of event, severity, timeframe, and formal investigation on worry about colleagues when mediated by resilience**

Figure 11 depicts the impact of the input variables on the observed variable of worry about colleagues when mediated by resilience:

Figure 11

Impact of event type, nature of event, severity, timeframe, and formal investigation on worry about colleagues when mediated by resilience

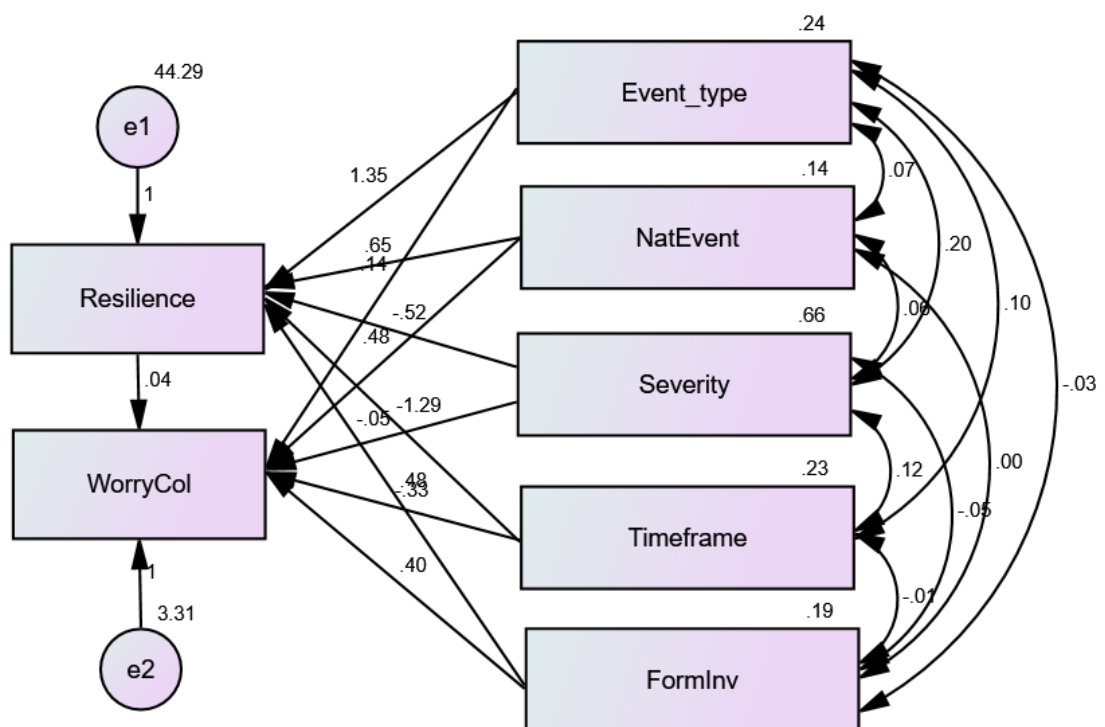


Table 24

Impact of event type, nature of event, severity, timeframe, and formal investigation on worry about colleagues when mediated by resilience

			Standardized Coefficients		R Square	P value
			Beta	SE		
Resilience	←	Event Type	0.100	0.851		<b>0.012*</b>
Resilience	←	Nature of Event	0.036	0.937		<b>0.007**</b>
Resilience	←	Severity	-0.063	0.459	0.016	<b>0.046*</b>
Resilience	←	Timeframe	-0.092	0.766		<b>0.093</b>
Resilience	←	Formal Investigation	0.031	0.743		<b>0.015*</b>
Worry about colleagues	←	Resilience	0.156	0.013		<b>&lt;0.001***</b>
Worry about colleagues	←	Severity	-0.023	0.126		<b>0.008**</b>
Worry about colleagues	←	Timeframe	-0.084	0.210		0.115
Worry about colleagues	←	Formal Investigation	0.094	0.203	0.057	<b>0.047*</b>
Worry about colleagues	←	Event Type	0.037	0.233		<b>0.052*</b>
Worry about colleagues	←	Nature of Event	0.095	0.256		<b>0.022*</b>

\*\*\*p<0.001, \*\*p<0.01, \*p<0.05

Table 24 outlines the SEM of the effect of event type, nature of event, severity, timeframe, and formal investigation on worry about colleagues when mediated by resilience. Whilst Timeframe was found to be not significant, these results demonstrate a significant effect of event type, nature of event, severity, and formal investigation on worry about colleagues and resilience. Similarly, resilience has a significant impact on worry about colleagues, with the mediating effect of resilience **reducing** the levels of worry about colleagues reported by the sample.

Within the structural model, the quality of fit was an acceptable illustration of the sample data ( $\chi^2(1) = 0.107$ , GFI=0.999, AGFI = 0.997, CFI = 0.999, IFI = 0.999, NFI = 0.999, which are greater than the 0.90 criteria. Similarly, RMSEA = 0.001 and RMR=0.002 are lower than 0.08 critical value.

## The mediating effect of psychological flexibility

### Impact of event type, nature of event, severity, timeframe, and formal investigation on feelings when mediated by psychological flexibility

Figure 12 depicts the impact of the input variables on the observed variable of feelings when mediated by psychological flexibility:

Figure 12

Impact of event type, nature of event, severity, timeframe, and formal investigation on feelings when mediated by psychological flexibility

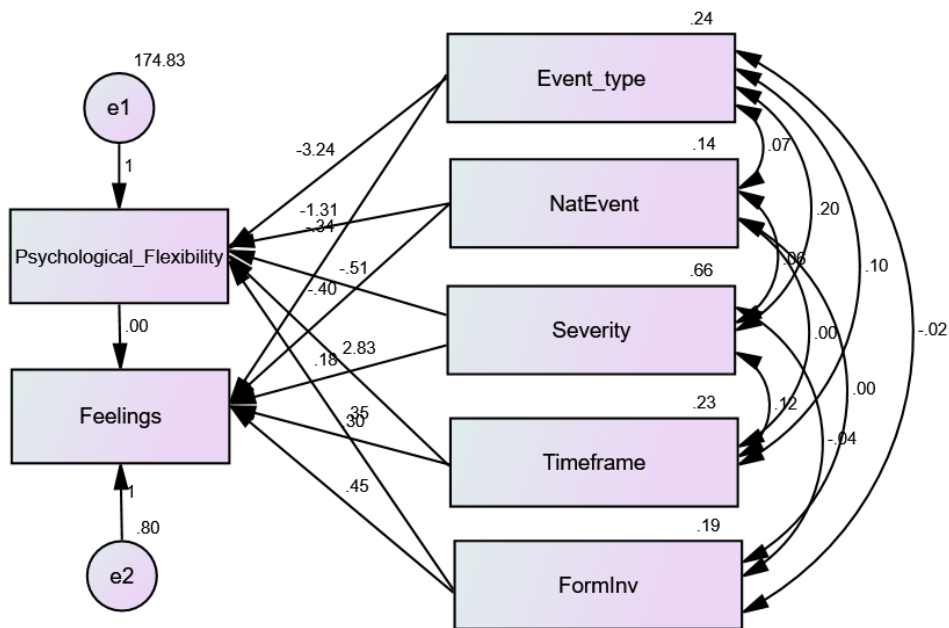




Table 25

Impact of event type, nature of event, severity, timeframe, and formal investigation on feelings when mediated by psychological flexibility

			Standardized Coefficients		R Square	P value
			Beta	SE		
Psychological Flexibility	←	Event Type	-.119	1.691		<b>0.036*</b>
Psychological Flexibility	←	Nature of Event	-.037	1.861		<b>0.003**</b>
Psychological Flexibility	←	Severity	-.031	.912	0.031	<b>0.043*</b>
Psychological Flexibility	←	Timeframe	.101	1.520		<b>0.010*</b>
Psychological Flexibility	←	Formal Investigation	.012	1.472		<b>0.007**</b>
Feelings	←	Psychological Flexibility	.057	.003		<b>0.006**</b>
Feelings	←	Severity	.149	.062		<b>0.004**</b>
Feelings	←	Timeframe	.150	.103	0.124	<b>0.004**</b>
Feelings	←	Formal Investigation	.204	.100		<b>&lt;0.001***</b>
Feelings	←	Event Type	-.178	.115		<b>0.003**</b>
Feelings	←	Nature of Event	-.157	.126		<b>&lt;0.001***</b>

\*\*\*p<0.001, \*\*p<0.01, \*p<0.05

Table 25 displays the impact of event type, nature of event, severity, timeframe, and formal investigation on feelings when mediated by psychological flexibility. The fit indices reveal a model of good fit. The above results reveal that there is a significant impact of event type, nature of event, severity, timeframe, and formal investigation on feelings and psychological flexibility. Similarly, psychological flexibility has a significant effect on feelings. Hence, there is a significant association between event type, nature of event, severity, timeframe, and formal investigation on feelings when mediated by psychological flexibility, with the mediating effect of psychological flexibility **reducing** the negative impact of input variables on feelings.

Within the structural model, the quality of fit was acceptable illustration of the sample data ( $\chi^2(1) = 2.015$ , GFI = 0.999, AGFI = 0.963, CFI = 0.997, IFI = 0.997, NFI = 0.995), which are greater than the 0.90 criteria. Similarly, RMSEA = 0.048 and RMR = 0.007 are lower than 0.08 critical value.

**Impact of event type, nature of event, severity, timeframe, and formal investigation on PTS symptomology when mediated by psychological flexibility**

Figure 13 depicts the impact of the input variables on the observed variable of PTS symptomology when mediated by psychological flexibility:

Figure 13

Impact of event type, nature of event, severity, timeframe, and formal investigation on PTS symptomology when mediated by psychological flexibility

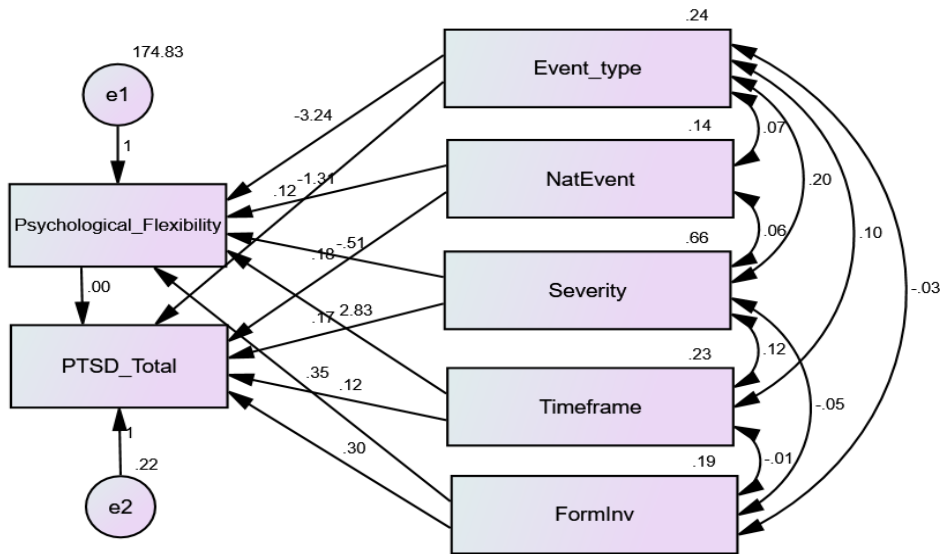


Table 26

Impact of event type, nature of event, severity, timeframe, and formal investigation on PTS symptomology when mediated by psychological flexibility

			Standardized Coefficients		R Square	P value
			Beta	SE		
Psychological Flexibility	←	Event Type	-0.121	1.691		<b>0.036*</b>
Psychological Flexibility	←	Nature of Event	-0.143	1.861		<b>0.011*</b>
Psychological Flexibility	←	Severity	0.440	.912	0.122	<b>0.025*</b>
Psychological Flexibility	←	Timeframe	0.363	1.522		<b>0.043*</b>
Psychological Flexibility	←	Formal Investigation	0.321	1.475		<b>0.010*</b>
PTSD Total	←	Psychological Flexibility	0.495	0.002		<b>0.002**</b>
PTSD Total	←	Severity	0.198	0.033		<b>&lt;0.001***</b>
PTSD Total	←	Timeframe	-0.068	0.055	0.222	<b>0.028*</b>
PTSD Total	←	Formal Investigation	-0.121	0.053		<b>&lt;0.001***</b>
PTSD Total	←	Event Type	-0.143	0.061		<b>0.044*</b>
PTSD Total	←	Nature of Event	0.440	0.067		<b>0.006**</b>

\*\*\*p<0.001, \*\*p<0.01, \*p<0.05

Table 26 displays the impact of event type, nature of event, severity, timeframe, and formal investigation on PTS symptomology when mediated by psychological flexibility. The fit indices reveal that the model is a good fit. There is a significant effect of event type, nature of event, severity, timeframe, and formal investigation on PTS symptomology and psychological flexibility. Similarly, psychological flexibility is significant impact on PTS symptomology. Hence, there is a significant association between event type, nature of event, severity, timeframe, and formal investigation on PTS symptomology when mediated by psychological flexibility, with the mediating effect of psychological flexibility **reducing** the prevalence of PTS symptomology reported by the sample.

Within the structural model, the quality of fit was an acceptable illustration of the sample data  $\chi^2(2) = 0.177$ , GFI = 0.999, AGFI = 0.998, CFI = 0.999, IFI = 0.999, NFI = 0.999,

which are greater than the 0.90 criteria. Similarly, RMSEA =0.001 and RMR=0.005 are lower than 0.08 critical value.

**Impact of event type, nature of event, severity, timeframe, and formal investigation on worry about colleagues when mediated by psychological flexibility**

Figure 14 depicts the impact of the input variables on the observed variable of worry about colleagues when mediated by psychological flexibility:

Figure 14

Impact of event type, nature of event, severity, timeframe, and formal investigation on worry about colleagues when mediated by psychological flexibility

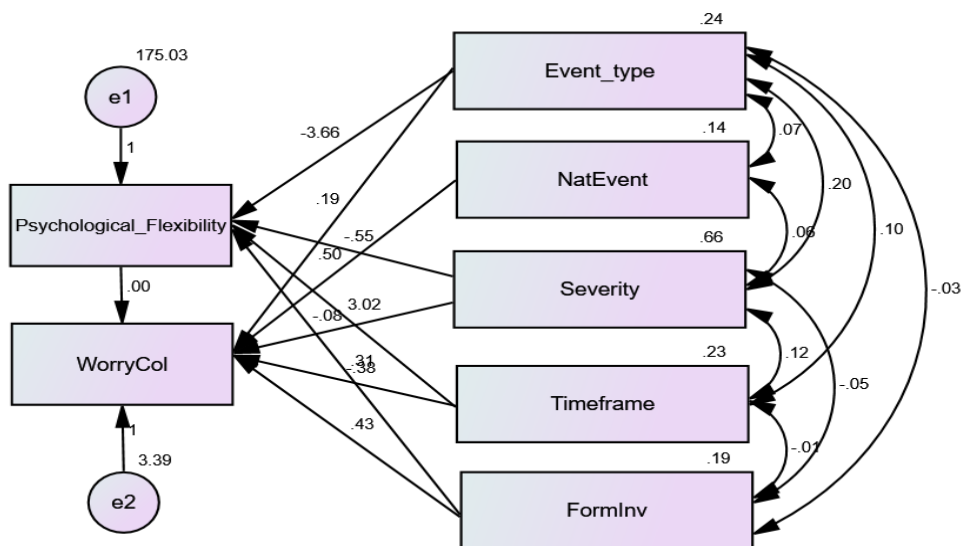


Table 27

Impact of event type, nature of event, severity, timeframe, and formal investigation on worry about colleagues when mediated by psychological flexibility

		Standardized Coefficients		R Square	P value
		Beta	SE		
Psychological Flexibility	← Event Type	-0.135	1.580	0.018	<b>0.020*</b>
Psychological Flexibility	← Severity	-0.033	0.911		<b>0.049*</b>
Psychological Flexibility	← Timeframe	0.108	1.494		<b>0.043*</b>
Psychological Flexibility	← Formal Investigation	0.010	1.474		<b>0.036*</b>
Worry about colleagues	← Psychological Flexibility	-0.027	0.007	0.117	<b>0.006**</b>
Worry about colleagues	← Severity	-0.034	0.127		<b>0.036*</b>
Worry about colleagues	← Timeframe	-0.096	0.213		<b>0.047*</b>
Worry about colleagues	← Formal Investigation	0.099	0.206		<b>0.038*</b>
Worry about colleagues	← Event Type	0.049	0.237		<b>0.034*</b>
Worry about colleagues	← Nature of Event	0.100	0.259		<b>0.023*</b>

\*\*\*p<0.001, \*\*p<0.01, \*p<0.05

Table 27 displays the effect of event type, nature of event, severity, timeframe, and formal investigation on worry about colleagues when mediated by psychological flexibility. The fit indices reveal a model of good fit. The above results reveal that there is a significant effect of event type, nature of event, severity, timeframe, and formal investigation on worry about colleagues and flexibility. Similarly, psychological flexibility has a significant effect on worry about colleagues. Hence, there is a significant association between event type, nature of event, severity, timeframe, and formal investigation on worry about colleagues when mediated by psychological flexibility, with the mediating effect of psychological flexibility **reducing** the levels of worry about colleagues reported by the sample.

Within the structural model, the quality of fit was an acceptable illustration of the sample data  $\chi^2(3) = 0.672$ , GFI = 0.999, AGFI = 0.996, CFI = 0.999, IFI = 0.999, NFI = 0.998, which are greater than the 0.90 criteria. Similarly, RMSEA = 0.001 and RMR = 0.031 are lower than 0.08 critical value.

## Mediation model

Figure 15 depicts the fully mediated model in which the impact of the input variables on the observed variables when mediated by resilience and psychological flexibility is presented. Until this point, the individual mediators have been assessed discretely. This model examines the goodness of fit of both mediators concurrently within the model.

Figure 15

Mediation SEM

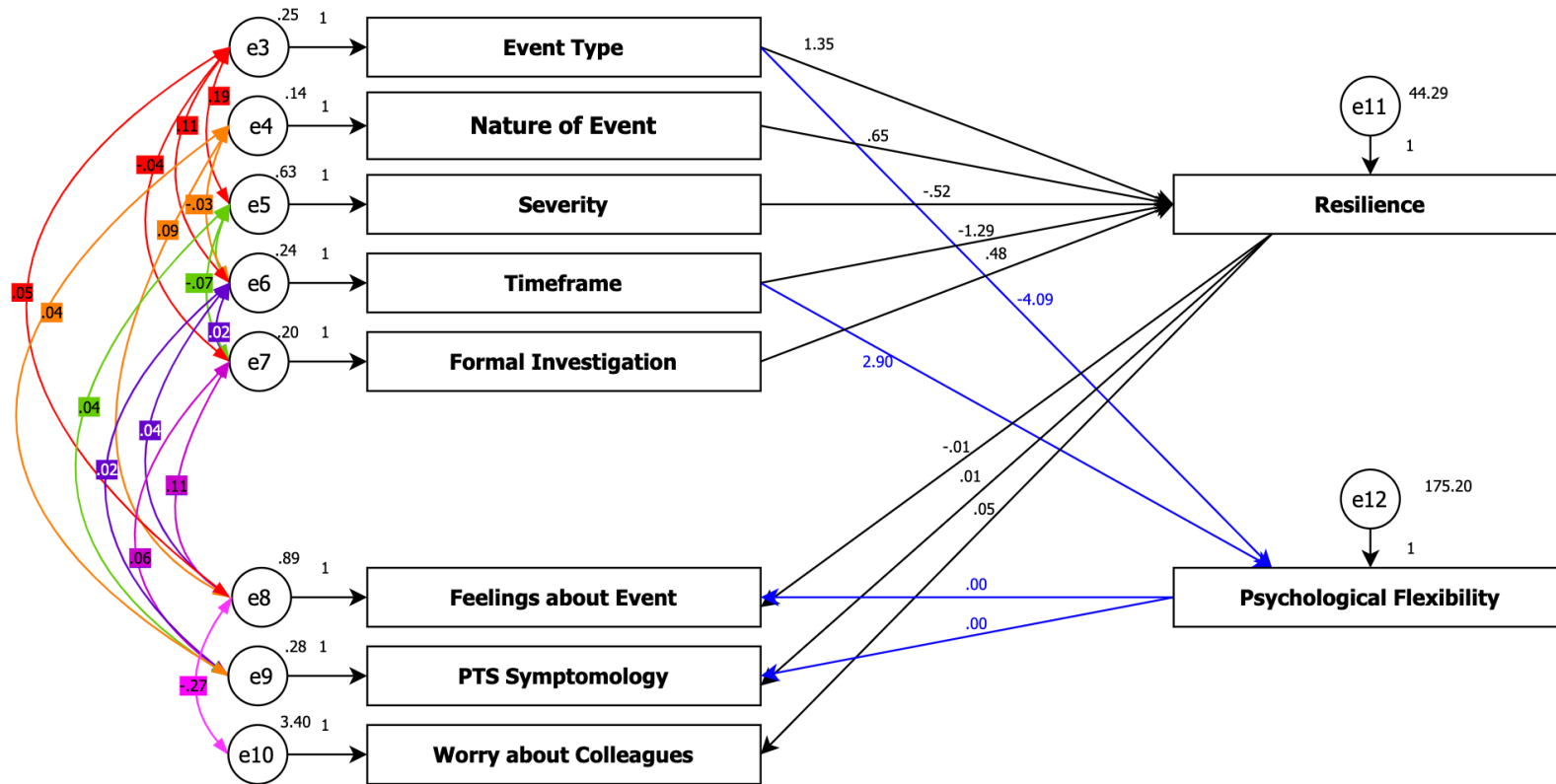


Table 28

## Mediation SEM

			Standardized Coefficients		P value
			Beta	SE	
Resilience	←	Event Type	0.100	0.795	<b>0.028*</b>
Resilience	←	Severity	0.062	0.461	<b>&lt;0.001***</b>
Resilience	←	Timeframe	0.093	0.765	<b>0.033*</b>
Psychological Flexibility	←	Event Type	0.152	1.448	<b>0.005*</b>
Psychological Flexibility	←	Timeframe	0.105	1.482	0.051
Resilience	←	Nature of Event	0.036	0.873	<b>0.034*</b>
Resilience	←	Formal Investigation	0.032	0.736	<b>0.011*</b>
Feelings	←	Resilience	-0.064	0.006	0.160
PTSD Total	←	Resilience	0.080	0.003	<b>0.029*</b>
Worry about colleagues	←	Resilience	0.173	0.013	<b>&lt;0.001***</b>
Feelings	←	Psychological Flexibility	0.051	0.003	<b>&lt;0.001***</b>
PTSD Total	←	Psychological Flexibility	-0.075	0.002	<b>0.008*</b>

\*\*\*p<0.001, \*\*p<0.01, \*p<0.05

Table 28 outlines the full mediation model, assessing the impact of event type, nature of event, severity, timeframe, and formal investigation on Feelings, PTS symptomology and worry about colleagues when mediated by Resilience and Psychological Flexibility, in which a structural equation model was used. The fit indices reveal that the model is a good fit.

The model fit was estimated using global fit and the sample covariance matrix and, based on data, it appears to fit (Bollen, 1989). The above results expose that there is a significant effect of event type, nature of event, severity, timeframe, and formal investigation on surgeon feelings, PTS symptomology and worry about colleagues when mediated by their Resilience and Psychological Flexibility. Hence, there is a significant association between event type, nature of event, severity, timeframe, and formal investigation on Feelings, PTS symptomology and worry about colleagues and Resilience and Psychological Flexibility.

Within the structural model, the quality of fit was acceptable illustration of the sample data  $\chi^2(21) = 121.761$ , GFI = 0.959, AGFI = 0.947, CFI = 0.915, NFI = 0.918 and IFI = 0.918, which are greater than the 0.90 criteria. Likewise, RMSEA = 0.005 and RMR = 0.026, are lower than 0.08 critical value.

## Moderated main effects

The following analyses will examine the role of the moderators within the model. The moderators highlighted within the previous moderation analysis were the extent to which participants felt that their training had prepared them to deal with the adverse event and personality factors. These factors will now be loaded into the model as moderators to examine model fit. Within both the path diagrams and tables, variables are represented as both discrete variables (Z) and as interactions between input and moderator variables (Int\_).

### The moderating effect of training

#### **Impact of event type, nature of event, severity, timeframe, and formal investigation on feelings when moderated by training**

Figure 16 depicts the impact of the input variables on the observed variable of feelings when moderated by training.

Figure 16

Impact of event type, nature of event, severity, timeframe, and formal investigation on feelings when moderated by training.

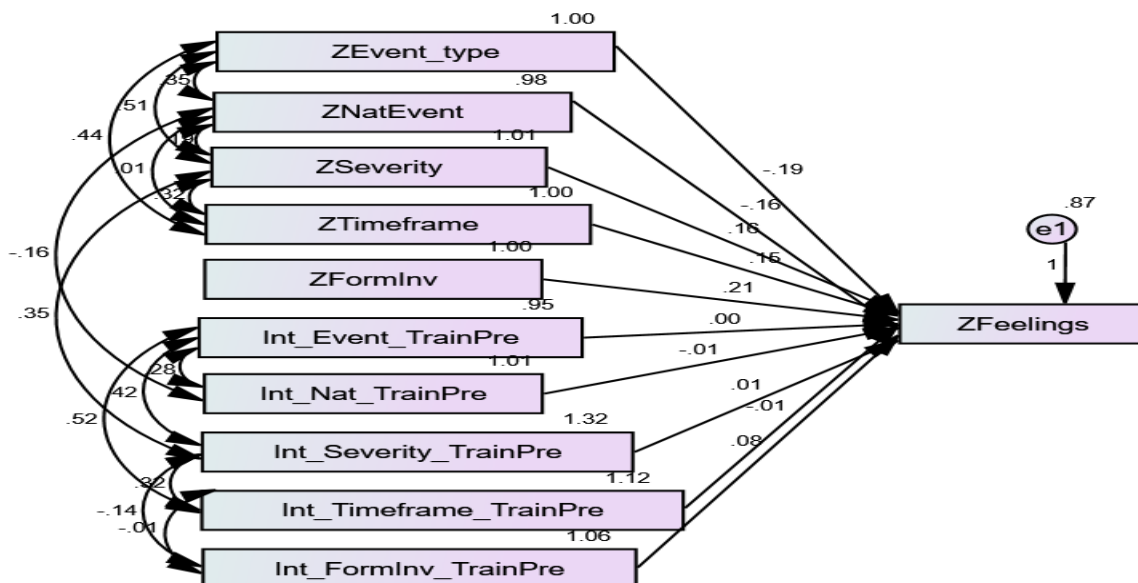




Table 29

Impact of event type, nature of event, severity, timeframe, and formal investigation on feelings when moderated by training

		Standardized Coefficients		R Square	P value
		Beta	SE		
ZFeelings	← ZSeverity	.157	.057		<b>0.006**</b>
ZFeelings	← ZTimeframe	.147	.051		<b>0.004**</b>
ZFeelings	← ZFormal Investigation	.211	.045		<b>&lt;0.001***</b>
ZFeelings	← Int_Event_TrainPre	.003	.060		0.054
ZFeelings	← Int_Nat_TrainPre	-.008	.049		<b>&lt;0.001***</b>
ZFeelings	← Int_Severity_TrainPre	.007	.046	0.431	0.894
ZFeelings	← ZEvent Type	-.191	.060		<b>0.001**</b>
ZFeelings	← ZNature of Event	-.163	.050		<b>0.001**</b>
ZFeelings	← Int_Timeframe_TrainPre	-.010	.050		<b>0.046*</b>
ZFeelings	← Int_Formal Investigation_TrainPre	.083	.044		<b>0.027*</b>

\*\*\*p<0.001, \*\*p<0.01, \*p<0.05

Table 29 outlines the impact of event type, nature of event, severity, timeframe, and formal investigation on feelings when moderated by training. The fit indices reveal a model of good fit. There is a significant impact of event type, nature of event, timeframe, and formal investigation on feelings when moderated by training. Hence, there is a significant association between event type, nature of event, timeframe, and formal investigation on feelings and training, with the moderating effect of training leading to a **reduction** in the negative impact of input variables on feelings. Those who reported receiving effective training to prepare them for the occurrence of adverse events are less likely to report negative feelings about their experience of adverse events.

Within the structural model, the quality of fit was acceptable illustration of the sample data  $\chi^2(31) = 64.887$ , GFI = 0.974, AGFI = 0.945, CFI = 0.954, NFI = 0.918 and IFI = 0.955, which are greater than the 0.90 criteria. Likewise, RMSEA = 0.050 and RMR = 0.054 are lower than 0.08 critical value.

## Impact of event type, nature of event, severity, timeframe, and formal investigation on PTS symptomology when moderated by training

Figure 17 depicts the impact of the input variables on the observed variable of PTS symptomology when moderated by training:

Figure 17

Impact of event type, nature of event, severity, timeframe, and formal investigation on PTS symptomology when moderated by training

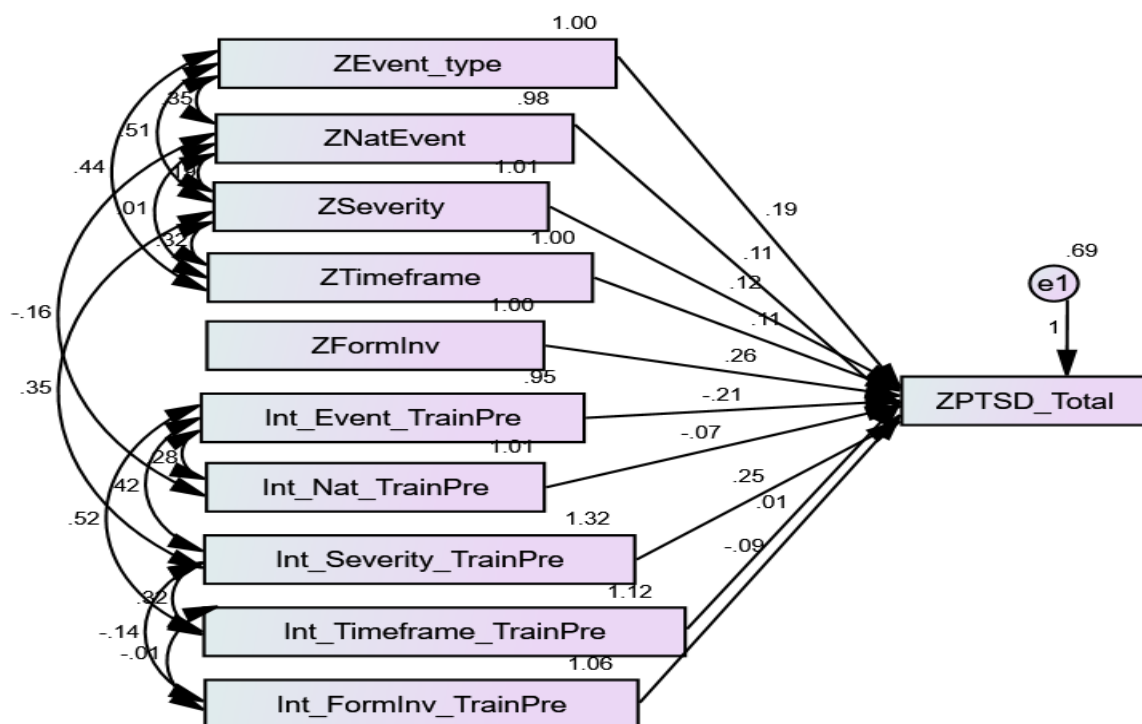


Table 30

Impact of event type, nature of event, severity, timeframe, and formal investigation on PTS symptomology when moderated by training

	Standardized Coefficients	R Square	P value
ZPTSD Total ← ZSeverity	0.119	0.050	<b>0.016*</b>
ZPTSD Total ← ZTimeframe	0.112	0.046	<b>0.012*</b>
ZPTSD Total ← ZFormal Investigation	0.257	0.040	<b>&lt;0.001***</b>
ZPTSD Total ← Int_Event_TrainPre	-0.202	0.053	<b>&lt;0.001***</b>
ZPTSD Total ← Int_Nat_TrainPre	-0.065	0.043	<b>0.026*</b>
ZPTSD Total ← Int_Severity_TrainPre	0.279	0.041	<b>&lt;0.001***</b>
ZPTSD Total ← ZEvent Type	0.189	0.053	<b>&lt;0.001***</b>
ZPTSD Total ← ZNature of Event	0.110	0.044	<b>0.011*</b>
ZPTSD Total ← Int_Timeframe_TrainPre	0.012	0.045	0.790
ZPTSD Total ← Int_Formal Investigation_TrainPre	-0.087	0.039	<b>0.028*</b>

\*\*\*p<0.001, \*\*p<0.01, \*p<0.05

Table 30 outlines the impact of event type, nature of event, severity, timeframe, and formal investigation on PTS symptomology when moderated by training. The fit indices reveal that the model is a good fit. There is a significant effect of event type, nature of event, severity, and formal investigation on PTS symptomology when moderated by training. Hence, there is a significant association between event type, nature of event, severity, and formal investigation on PTS symptomology and training, with the moderating effect of training **reducing** the prevalence of PTS symptomology reported by the sample.

Within the structural model, the quality of fit was acceptable illustration of the sample data  $\chi^2(31) = 64.887$ , GFI = 0.974, AGFI = 0.945, CFI = 0.959, NFI = 0.927 and IFI = 0.961, which are greater than the 0.90 criteria. Likewise, RMSEA = 0.055 and RMR = 0.050 are lower than 0.08 critical value.

## Impact of event type, nature of event, severity, timeframe and formal investigation on worry about colleagues when moderated by training

Figure 18 depicts the impact of the input variables on the observed variable of worry about colleagues when moderated by training:

Figure 18

Impact of event type, nature of event, severity, timeframe and formal investigation on worry about colleagues when moderated by training

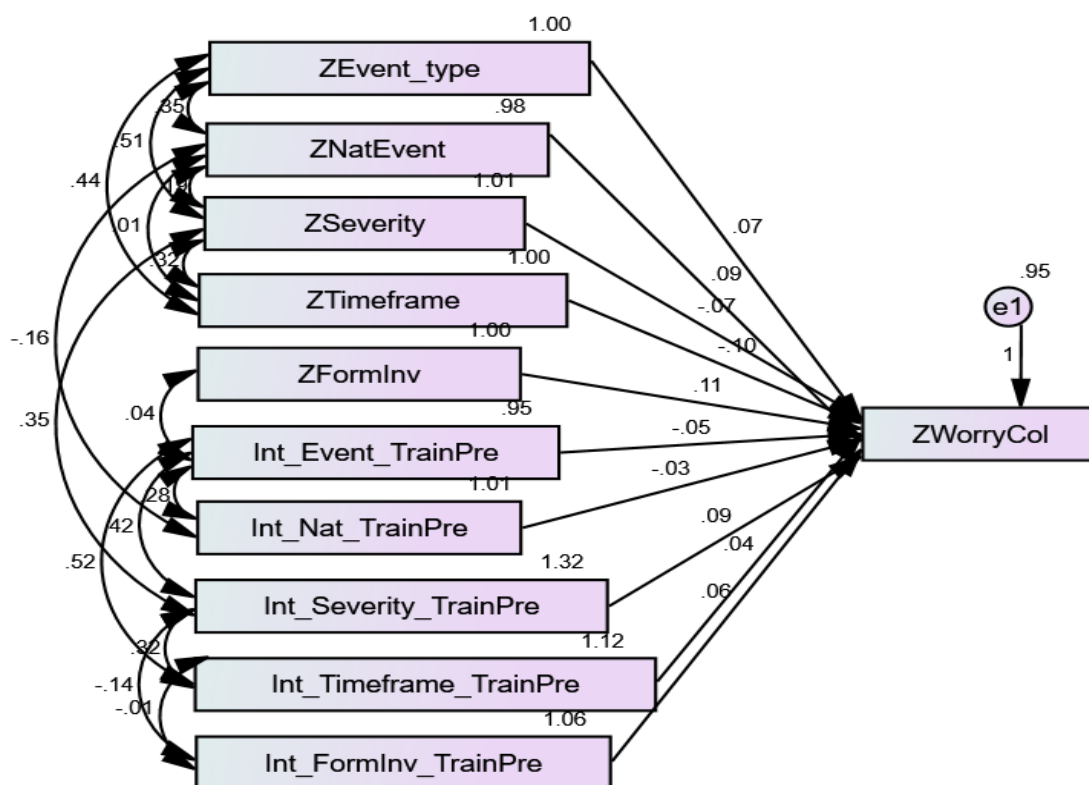


Table 31

Impact of event type, nature of event, severity, timeframe and formal investigation on worry about colleagues when moderated by training

		Standardized Coefficients		R Square	P value
		Beta	SE		
ZWorry about colleagues	← ZSeverity	-0.074	0.059		<b>0.016*</b>
ZWorry about colleagues	← ZTimeframe	-0.096	0.054		<b>0.043*</b>
ZWorry about colleagues	← ZFormal Investigation	0.106	0.047		<b>0.024*</b>
ZWorry about colleagues	← Int_Event_TrainPre	-0.044	0.063		<b>0.009**</b>
ZWorry about colleagues	← Int_Nat_TrainPre	-0.035	0.051		<b>0.034*</b>
ZWorry about colleagues	← Int_Severity_TrainPre	0.109	0.049	0.146	0.051
ZWorry about colleagues	← ZEvent Type	0.072	0.063		0.052
ZWorry about colleagues	← ZNature of Event	0.093	0.052		0.073
ZWorry about colleagues	← Int_Timeframe_TrainPre	0.038	0.052		0.087
ZWorry about colleagues	← Int_Formal Investigation_TrainPre	0.057	0.046		<b>0.027*</b>

\*\*\*p<0.001, \*\*p<0.01, \*p<0.05

Table 31 outlines the impact of event type, nature of event, severity, timeframe, and formal investigation on worry about colleagues when moderated by training. The fit indices demonstrate that model is a good fit. There is a significant impact of nature of event, severity, and formal investigation on worry about colleagues when moderated by training. Hence, there is a significant association between event type, nature of event, severity, and formal investigation on worry about colleagues and training, with the moderating effect of training **reducing** the levels of worry about colleagues reported by the sample.

Within the structural model, the quality of fit was acceptable illustration of the sample data  $\chi^2(30) = 63.772$ , GFI = 0.975, AGFI = 0.944, CFI = 0.953, NFI = 0.915 and IFI = 0.953, which are greater than the 0.90 criteria. Likewise, RMSEA = 0.051 and RMR = 0.053 are lower than 0.08 critical value.

## The moderating effect of personality factors

Unlike training, a one factor variable within the study, the variable of personality contains five factors within the construct – grouped together as ‘personality factors’. This makes the presentation of such findings lengthy and incongruent with the brevity required within this thesis. Therefore, the below table (Table. 32) provides an overview of the significant moderating effects of the different factors of personality within the model. The full analysis for this may be found within the appendices of this thesis (Appendix E).

Table 32

Overview of personality factors moderation effects

<b>Input</b>		<b>Observed</b>	<b>Significant* Factors**</b>	<b>(non sig.)</b>
Event Type	→	Feelings	O,C,E,A,N	-
		PTS symptomology	O,E,A,N	C
		Worry about colleagues	C,E,A,N	O
Nature of Event	→	Feelings	O,C,E,N	A
		PTS symptomology	O,C,N	E,A
		Worry about colleagues	C,E,A	O,N
Severity	→	Feelings	O,C,E,N	A
		PTS symptomology	O,C,A,N	E
		Worry about colleagues	O,C,E,N	A
Timeframe	→	Feelings	O,C,E,A,N	-
		PTS symptomology	O,A,N	C,E
		Worry about colleagues	O,C,A,N	E
Formal Investigation	→	Feelings	O,C,A,N	E
		PTS symptomology	O,C,E,A	N
		Worry about colleagues	O,E,A,N	E

\* Significance level -  $p < .05$

\*\* The labelling of the factors is also referred to as follows:

3. Openness (inventive/curious vs. consistent/cautious)
4. Conscientiousness (efficient/organised vs. extravagant/careless)
5. Extraversion (outgoing/energetic vs. solitary/reserved)
6. Agreeableness (friendly/compassionate vs. critical/rational)
7. Neuroticism (sensitive/nervous vs. resilient/confident)

At the  $p < .05$  significance level, personality factors moderate the relationship between input and observed variables, with the exceptions for each relationship noted above. Hence, there is a significant association between input variables (event type, nature of event,

severity, timeframe, and formal investigation) on observed variables (feelings, PTS symptomology and worry about colleagues) and personality factors. With the moderating effect of the factors: openness, conscientiousness, extraversion, and agreeableness **reducing** negative outcomes, and with the moderating effect of neuroticism **increasing** negative outcomes.

## **SEM overview**

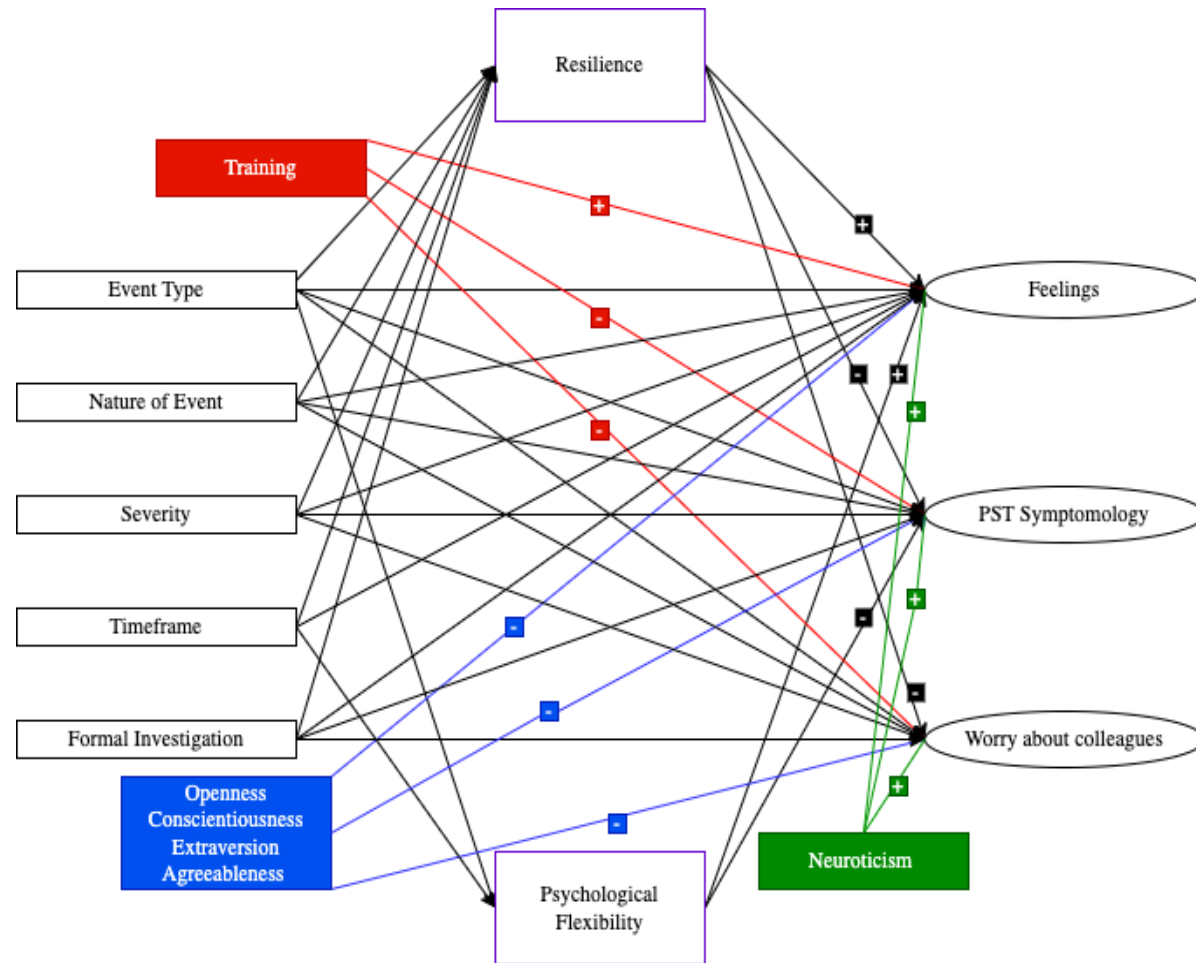
This completion of the moderation analysis allows for the presentation of a full model in which the key mediators and moderators are included concurrently. Given the complexity of the results – especially those within the domain of personality – a revised model has been generated that gives an overview of the key relationships without reiterating the statistics presented within this chapter.

Rather than presenting the full statistical path diagram as done previously for the mediation model (Figure 19) the following model provides an overview of the relationships, giving an insight into the direction of such relationships for the ease of discussion within the following chapter. An alternative version of the model may be found within the appendices of this thesis (Appendix F).



Figure 19

SEM overview



Note: Colour coded boxes within the diagram indicate the direction of the relationship between the mediating and moderating variables: Black relating to the mediating relationships, red the moderating effect of training, blue the moderating effect of protective personality factors and green the moderating effect of vulnerable personality factors on observed variables.

## **Summary of key findings by thesis aim**

The following section contains a brief overview of key findings from within the research outlined within this thesis, as broken down by the research aims. Each key finding will then be explored in relation to the thesis hypotheses, in terms of its interpretations and implications, later within the next chapter.

### **Aim 1**

**Understanding the range of surgeons' psychological reactions to different types of adverse events within surgery and how this may impact upon their mental health and wellbeing.**

#### *Surgeon results compared with normative data*

Surgeons were more likely to report:

- Lower levels of anxiety
- Higher levels of stress
- Higher levels of personal burnout
- Lower levels of client burnout
- Higher prevalence of PTS symptomology
- Lower levels of resilience
- Higher levels of conscientious
- Lower levels of neuroticism
- Lower levels of openness

#### *Complications vs Errors*

Participants within the error subsample were more likely to report:

- More sleep problems
- More anxiety
- Higher alcohol consumption
- More changes to professional practice
- More negative feelings about the event
- More improvement to practice

- Lack of training to prepare for the personal impact of the event
- Higher prevalence of PTS symptomology

### *Impact of severity*

Higher severity outcomes were associated with:

- More negative feelings about the event
- Lack of training to prepare for the personal impact of the event
- Higher prevalence of PTS symptomology

## **Aim 2**

### **Identifying the psychological factors that potentially moderate or mediate surgeons' psychological reactions to adverse events within surgery.**

The mediation and moderation analysis within the survey was significantly affected by the ability to determine a causal relationship between direct effect variables. Although standardised measures were included within the survey to examine the psychological phenomena experienced by surgeons, to maintain the validity of such measures, the wording remained generic and did not make direct links to the event experienced by the participants. Therefore, it is not possible to conclude whether other, confounding variables did not exist when interpreting results of the direct effects between experience of event and outcome measures such as the 21 item Depression, Anxiety and Stress Scale (DASS-21; Henry & Crawford, 2005), and the Copenhagen Burnout Inventory (CBI; Kristensen et al., 2005).

However, the analysis of variables with proven direct effects highlighted interactions within the data that were useful steppingstones in confirming theoretical connection and were used to inform further examination of the data through regression analysis and structural equation modelling. Such relationships were supported by the literature and

included the psychological construct of resilience as a key mediator, and personality traits as a moderator of outcomes.

### **Aim 3**

#### **Developing a statistical model that explains variance in outcome measures for surgeons following an adverse event.**

Factor analysis confirmed a model of good fit for five unobserved variables within the model. These were event type (complication or error), nature of event (emergency or elective), severity of patient outcome (categorised by Clavien-Dindo score), timeframe of event occurring, and whether the event led to a formal investigation.

The modelling also identified three observed variables; feelings, PTS symptomology and worry about colleagues. The relationships between the unobserved and observed variables were found to be moderated by training and personality factors and were mediated by resilience and psychological flexibility.

## 7. Discussion

### Introduction

This thesis set out to explore the psychological impact of surgical complications and errors on surgeons and establish a quantified model to provide insight into the key predictive factors associated with surgeon wellbeing. Whilst there is existing evidence of the negative impact of adverse events (e.g., Pinto, 2013; Shanafelt, 2009), most of it is based outside of the United Kingdom and/or conflates errors and complications. This research set out to establish a clear picture of the impact of both complications and errors within an NHS setting. By taking a quantitative approach to this analysis, this research transcends the descriptive analysis previously conducted within this field, and generates a predictive model, using structural equation modelling (SEM), which allows for the in-depth exploration of key moderators and mediators which predict negative outcomes within surgeons following adverse surgical events.

The outcomes of this research have provided insight into the impact of complications and errors on surgeons within the UK. This chapter provides a reflection on the research process. The key strengths and limitations of the design are discussed, as well as the implications for the interpretations of the results. This chapter ends with several recommendations for future research, as well as recommendations for professional practice, changes to training and support for surgeons.

The main research question addressed within this research was **‘How do complications and errors effect surgeons?’**. However, to successfully answer this question, layers of considerations were required to examine the key issues faced by surgeons and the impact that these may or may not have on surgeon wellbeing. As outlined within the literature review chapter, previous research gave insight into various aspects of this research area, yet to date

there was no comprehensive research that provided a clear, national picture (UK) of how surgeons are affected when they experience adverse events within surgery.

To bridge the present gaps within the literature, this research provides baseline data and analysis of UK surgeons' experiences of both **complications** and **errors**, a between groups condition was established within the survey to accurately analyse the impact of event type which has so far been missing from the literature.

The inclusion of pre-validated measures within the survey provided insight into how surgeons across all specialties are affected when things go wrong. Providing more generalisable data than previous UK research studies. The use of validated measures allowed for surgeon data to be comparable with general population means, and therefore generating a detailed comparative picture to settle debates regarding surgeon wellbeing, resilience, and personality - relative to the general public.

More than anything, this research aimed to add depth to the understanding of the mechanisms by which surgeons are affected by negative events. Rather than conducting correlational studies that add little to the understanding, this data generated a quantified model to provide insight into the key predictive factors associated with surgeon wellbeing. Through the use of structural equation modelling this research significantly contributes to the understanding of contentious issues presently within the literature. These include the role of the exact nature of the event experienced by the surgeon in predicting outcomes; the mediating effect of resilience and thereby the benefit of its role within training; possible interactions between a range of negative outcomes and protective factors such as psychological flexibility; and the role of the surgical personality in dealing with adverse events.

The following section explores the study findings for each of the three hypotheses, examining the impact of complications and errors on surgeons within the UK, and explores the theoretical implications of the study findings in the context of existing research and relevant literature.

## **Main findings**

The findings will now be discussed in relation to both the study's established hypotheses and the findings of previous research within this field.

### **Hypothesis 1**

The first hypotheses were based upon the findings of previous research (e.g., Brookes et al., 2011; Pinto et al., 2013; Shanafelt et al., 2009), and predicted that surgeons would be negatively affected by adverse events. However, due to the ambiguity of findings within previous research, including the conflation of complications and errors, the hypotheses were non-directional. However, it was tentatively predicted through anecdotal evidence, such as conversations with surgeons, that experience of error would lead to more negative outcomes, due to the occurrence of such events being caused by factors within the surgeon's locus of control, or at least perceived by the surgeon to be within their control.

**H1** – The following areas will be affected by type of adverse event:

- General physical health
- General mental health
- Feelings about event
- Perception of support available
- Perception of own capability
- Post-traumatic stress symptomology

### **How does the type of event effect surgeon outcomes?**

*The event type will have an impact on surgeon feelings about the event*

The results demonstrate a notable impact of event type on surgeon feelings, with participants within the error subsample reporting significantly more negative feelings than those who experienced a complication – especially when controlling for severity of patient



outcome. Whilst these results originate from one single item within the study, the results provide a powerful insight into how the event directly affected the participants. The question asked for a direct reflection of how the event made them feel at the time that it happened, minimising the impact of other confounding variables and accounting for the range of timeframes since the occurrence of the event included within the study. It is however important to note that both conditions resulted in negative affect for surgeons, demonstrating that adverse events in general are having a negative impact on wellbeing, with errors having an even more detrimental effect.

The finding that surgeons feel differently about errors and complications is significant within this research as it highlights that these events are typically perceived differently by surgeons and it is therefore important to treat these as two, distinct phenomena. As highlighted within the literature review, there is an inconsistency within the agreed definitions and use of key terminology within this research area, with previous literature having either conflated these events (e.g., Pinto et al., 2013) or failed to define the parameters of the terminology leading to confusion regarding the exact nature of the adverse events experienced by surgeons (Chung & Kotsis, 2012). This finding would suggest that the type of event experienced by surgeons is a key determinant of their feelings about the event itself. Therefore, event type should be considered when conducting research into adverse events, but also when designing support systems and interventions in the aftermath of adverse events. Previous literature that fails to delineate between the two may not fully represent the experience of surgeons and so have limited utility, with such findings therefore being generalised with caution.

*The event type will have an impact on general mental and physical health.*

The results demonstrate that surgeons were more likely to report the experience of psychological changes than physiological changes in the aftermath of an adverse event. The

psychological changes reported within the survey included problems with sleeping, feelings of depression and anxiety, anger and irritability, and relationship issues. This supports findings from as far back as 1989 in which Pilowski and O'Sullivan reported that medical professionals, in general, have better physical than mental health. However, with mental health issues regularly going underreported (Bharadwaj et al., 2017), with individuals being reluctant to seek support (Clement et al., 2011), this raises concerns about the number of surgeons who are seeking help for psychological distress experienced following the experience of an adverse event. Many of the questions raised by gaps within the literature stem from the underlying query as to whether surgeons are different from other medical professionals, as previous research has mostly examined them as one homogenous group (For example, Brunsberg et al., 2019; Fahrenkopf et al., 2008; Waterman et al., 2007; West et al., 2006). It would seem, in this instance at least, that surgeon outcomes conform to the generic (rather than surgeon specific) professional norms.

When the data was examined by event type, those within the error subsample were more likely to report sleep problems and increased anxiety than those within the complication subsample. Given the wording of the item within the survey ('As a result of the event...'), it is possible to relate these issues directly to the event and therefore conclude that this change was as a direct result of their experience. Again, this difference highlights the importance of treating complications and errors as discrete event types, with each type having its own associated psychological issues. Failure to delineate may mean that supportive interventions do not offer the correct kind of targeted support to maximise the efficacy of any provisions made.

*The event type will have an impact on post-traumatic stress symptomology*

The results demonstrate that factors relating to the nature of the adverse events have a significant influence over the prevalence of surgeon post-traumatic stress (PTS)

symptomology. The factors associated with a higher level of PTS symptomology were the event being an error, with a patient outcome of higher severity. Previous research into the prevalence of PTS symptomology within a surgical population (Jacob-Sendler et al., 2016) identified four distinct stressors which led to higher levels of PTS symptoms in surgeons. The stressors identified were 1) general training related stress, 2) treating trauma, 3) working in a conflict zone, and 4) working in a rural environment. However, these findings allude to there being a fifth stressor that is directly linked to a higher prevalence of PTS symptomology, that of making an error, especially one that causes patient harm. The Jacob-Sendler study went on to highlight the importance of protective interventions to mitigate the effect of such stressors on surgeon wellbeing. The findings of this present research highlight the need for interventions such as training and support - with a specific focus on errors in surgery – to be available to all surgeons throughout their careers, with the aim of reducing the prevalence of PTS symptoms within the surgical workforce.

*The event type will have an impact on surgeon perceptions of support available*

Data analysis demonstrated that there was no significant difference between the two subsamples when it came to the perceived utility of support. Within the whole sample, support was deemed to be useful. However, only half the participants (50.2%) sought support after their experience of an adverse event, raising the question of what possible blockers could be stopping support seeking. Also, despite high reported levels of mental health symptomology, participants reported very little engagement with formal support services (5.6%).

It is therefore important to highlight that almost half of participants (48.2%) talked to no one after their experience of an adverse event, so they were effectively isolated and perhaps significantly suffering. This is a key consideration that needs to be made following this research, to support surgeons to seek support and removing any blockers, such as stigma,

to support seeking behaviours. The finding that people are reluctant to seek support is supported by prior research, in which avoidant behaviours were observed due to the stigma regarding mental illness and the negative impact that this then had on individuals' propensity to seek help (Clement et al., 2011). This previous research was not conducted on a surgical sample but demonstrates the pervasive nature of the reticence to seek support within general society.

Given that support was deemed to have high levels of utility for those who did seek it, removing the blockers to support seeking could have an impact on the outcome and wellbeing of surgeons following adverse events. Bharadwaj et al. (2017) claim that fear of repercussion and lack of anonymity/confidentiality stops medical professionals from seeking help regarding mental health concerns. Therefore, more confidential, and official support systems (such as inter-deanery support and surgeon specific confidential services like that of the Practitioner Health Programme) could be of benefit to surgeons in the aftermath of adverse events to ensure that they get the support they need in a psychologically safe and stigma free environment that is guaranteed not to interfere with their own work environment.

However, the most oft sought form of support reported within the survey was support from a colleague within the surgeon's own hospital (89.8%). The informal nature of this support could highlight the need for systemic changes to aid surgeons to have consistent and candid working relationships with colleagues, so that they may have access to more continuous sources of support and advice. This could be buddy systems, WhatsApp groups or drop-in support sessions such as Schwartz rounds. The current structure of the NHS surgical training pathway does not necessarily foster a supportive environment, as trainees move jobs every 6 months, are often ranked against their colleagues for training placements and are subject to a hierarchical system in which some may find it difficult to admit to mistakes or ask for support when it is needed (Rose & Aruparayil, 2022). It is only when

surgeons settle into more permanent roles (typically later in their careers as a consultant, staff grade or associate specialist) that they can develop the network required to foster such support within their own hospital setting. This could suggest that informal support pathways within the hospital setting may be lacking for less experienced surgeons and that interventional systems, such as informal mentoring relationships, could be required to ensure that they have access to the support that they need. However, one of the main outcomes within the model established within this research was ‘worry about colleagues’. Surgeons are concerned about the perceptions of others, especially when it comes to involvement in adverse events, and therefore this could act as a blocker to support seeking. It is hoped that initiatives such as the Surgical First Responder training (RCSEng, 2020), will enable those in need to find well-structured and signposted support from people who have been specifically trained to deliver it in these circumstances.

*The event type will have an impact on surgeon perceptions of own capability*

Data analysis revealed that surgeons within the sample were significantly more inclined to report being a better practitioner following the experience of an error than a complication. This finding may seem contradictory to findings related to surgeon feelings about the event, however, it offers insight into the surgical attitude towards continued professional development and the reframing of negative events as learning opportunities. For those who experienced a complication – a recognised risk of the operation with no real link to surgical expertise – there was no need to reflect on their performance and make changes for future surgeries. However, for those who made an avoidable error, it seems as though reflection and change to practice is required to ensure that this does not happen again within future operations. This finding therefore potentially demonstrates a growth mindset present within the surgical workforce; something that could be utilised within training opportunities and standard setting for ongoing reflective practice. However, research suggests that surgeons are more likely to be of a fixed mindset than those in other

professions, or other medical specialties (Callahan et al., 2020), therefore more research is required into the adaptability potential of surgeons and how this can be maximised to support their development.

Whilst comparisons between the aviation industry and surgery are often overused and unpopular, (Randell, 2003), this finding does support the introduction of a system into healthcare that is based on aviation's approach to 'just culture' (Kapur et al., 2015). The aim of a just culture is to promote continuous learning from previous mistakes and encourage pilots to share essential safety related information. Given how much surgical practice is perceived to be improved by experience of errors, it could be argued that surgeons would benefit from being exposed to other people's mistakes – learning from the actions of others, rather than learning through their own experience and negatively impacting the safety of their own patients. However, there are concerns within the aviation industry that this type of error reporting is already being used for ends other than training and safety monitoring (Van Dam, 2009), with many pilots experiencing the negative ramifications of reporting errors under the auspices of 'just culture' – especially when such reports are made available or leaked to the public and the media. It would not be inconceivable to imagine the same issue arising within healthcare should such an incident reporting mandate be enforced. Therefore, it is vital that a careful balance is made between supporting surgeon development, sharing best practice, and learning from the mistakes of others, whilst continuing to ensure that surgeons remain protected from condemnation should an event be reported. To achieve this, such a system would need to be totally anonymous (unlike current reporting structures), must be established into a culture within healthcare of sharing information for the benefit of patient safety, and would need to be accepted by a no-blame society at large, where human error is tolerated not punished. Therefore, a total paradigm shift would be required before this type of approach could be implemented within the NHS.

## **Hypothesis 1 ~ Key considerations**

Although the data from this survey represents the first step towards providing insight into complications and errors as discrete entities, examination of the key contributing factors demonstrates that some participants reported on events that did not exclusively fall within the parameters of the event type to which they were assigned. The definitions included within this research established clarity regarding the type of events to be reported by each subgroup. Surgeons reporting an error were significantly more likely to report surgeon-controlled factors as key contributing factors, and surgeons within the complication subgroup were significantly more likely to report contributors outside of surgeon control. However, some participants within the complication condition reported events with contributing factors that fall outside the parameters of the definition of such an event. For example, 14.3% of participants within the complication subsample reported ‘lapse in judgement’ as a key contributor to the occurrence of the event. This highlights how the conflation between the two event types is not constrained to within the literature (Patel et al., 2010; Pinto et al., 2013; Waterman et al., 2007; West et al., 2006) but is ingrained within the culture of surgery itself. If surgeons feel better about complications than they do about errors, then are some surgeons self-determining errors as complications for self-preservation? Or is there a systemic influence to view some errors as complications due to their ubiquity within certain domains? If an error is so commonly made that it becomes a recognised risk of the surgery, does that change its classification of adverse event? For example, there is a mistake in terms of misidentifying anatomy that happens regularly within one surgery (For example, Common Bile Duct injuries – Reinsoo et al., 2023). If this could be avoided through procedural rigour or surgeon skill, is the occurrence of the event a complication or an error? Does it change the way that patient harm is viewed should the event occur? Would it reduce the propensity for litigation if the patient had consented to this as an acknowledged risk of surgery? Does the label of ‘complication’ act as a protective factor against negative outcomes for the surgeon? Future research may wish to consider these questions when investigating the impact

of terminology in the aftermath of adverse events. It must also be considered within future research that complications and errors may not happen in isolation. It is possible that different classifications of adverse events could co-occur within the same operation. This would therefore further explain the lack of clear delineation between the two types of adverse events.



## Hypothesis 2

Previous research findings (Campbell et al., 2001, Dimou et al., 2016; Gerada & Jones, 2014; Jacob Sandler et al., 2016; Mousa et al., 2016; Shanafelt et al., 2009; Whitaker, 2017) led to the hypothesis that surgeons will be more negatively affected than the general population within outcome measures relating to mental health and wellbeing, and that their trait characteristics will differ from those of the general population.

**H2** – The following scores will differ between surgeon participant scores and published population means:

- CBI
- DASS-21
- PC-PTSD
- BRS
- BFI
- WAAQ

## Surgeons and the general population

### *Surgeon burnout compared with the general population*

Previous studies found that surgeons are significantly more burnt out than the general population (e.g., Shanafelt et al., 2009). However, the results of this study indicate that surgeons are more burnt out within the domain of personal burnout, however they have no difference within the domain of work-related burnout and significantly lower reported levels of client-related burnout.

The domain of personal burnout is the generic component assessing burnout within the Copenhagen Burnout Inventory (CBI; Kristensen et al., 2005). This domain gives a general measure of how tired/exhausted surgeons are. The findings within this domain are important as they demonstrate that surgeons, generally, are suffering from burnout. However, the reduced scores within the domain of client-related burnout are leading to a lower overall score. This indicates that whilst working directly with patients may function as a protective factor when it comes to levels of burnout, there are indications that surgeons are suffering from general burnout more than the general population. This would support the findings of previous studies, such as Shanafelt et al. (2009), however the use of the CBI as opposed to the Maslach Burnout Inventory (MBI) gives more insight into the domains in which surgeons are affected in terms of global burnout and potential protective factors. The findings of this study do however raise questions about the degree to which surgeons are burnt out and whether burnout is as prevalent within the surgical population as the findings of Shanafelt et al. suggest. However, the research conducted by Shanafelt et al. - which found a 40% prevalence of burnout - was conducted using the MBI within the American healthcare system. Therefore, the findings of this present study provides new clarity into burnout within UK healthcare.

The reduction in burnout caused by client related factors indicates that patients may not be the leading cause of burnout symptomology, but that dealing with patients potentially reduces the prevalence of burnout within surgeons. Intuitively it seems that patient interactions represent the core drive of what surgeons joined the profession to achieve – to help people. Whereas, both work-related and personal burnout encompass the wider aspects of the profession, including the systemic stressors and the difficulty of maintaining a work life balance, which is potentially why these domains are scoring more highly within this sample. This theory is supported by research that examines the difficulties faced by surgeons

to achieve a balance between work and life outside of work (Brown et al., 2021), in which 57% of surgeons surveyed were dissatisfied with their work life balance (n=291).

### *Surgeon psychiatric distress compared with the general population*

The results of this study indicate that surgeons are less anxious, but more stressed than the general population. The nature of the measure used to ascertain levels of psychiatric distress was a general standardised measure, and not a measure for targeted assessment of the impact of adverse events on the mental wellbeing of surgeons. Therefore, these findings can be used as a general comparison between surgeons and the general public.

The findings regarding depression and overall psychiatric distress demonstrated no significant difference between the two groups, with both groups falling within the 'mild' category (Henry & Crawford, 2005). However, the 'mild' total score for surgeons ( $\bar{x}=19.92$ ) could be a result of the contrast between low anxiety and high stress scores, and therefore may not accurately depict that surgeons and the general population are homogenous in nature. This disparity between the component scores gives insight into key differences between the two groups. The findings relating to depression goes against the findings of similar studies (e.g. Ding et al., 2017; Mousa et al., 2016) and contribute towards an ever growing lack of consistency when it comes to findings relating to depression in healthcare. However, this study utilised a valid and commonly used screening tool (DASS-21; Henry & Crawford, 2005) and therefore provides more reliable findings than previous studies examining this highly contested issue.

Anxiety – the DASS-21 scores found a significant difference between two samples within the domain of anxiety. Surgeons were found to have an average anxiety score of 3.05, placing the mean score within the 'normal' category. Whilst the average score of the general population ( $\bar{x}=3.76$ ) places them within the category of 'mild'. This is a surprising finding

given that anxiety disorders are the most prevalent mental health disorder within society (Tolin et al., 2010) and indicates that surgeons may have some protective factors against anxiety. This finding potentially indicates that surgeons already utilise coping mechanisms to minimise the effect of their work on their levels of anxiety and that this protective factor could be used to support other facets of their working life. What cannot be determined by this finding is whether surgeons have an innate aptitude for dealing with anxiety, or whether this is something that has been learned through their surgical training. However, surgeons within this sample have lower levels of neuroticism than the general population, which will be discussed in more detail later within this chapter. High neuroticism is a risk factor for a range of mental health issues, including anxiety (Jardine et al., 1984) and therefore this trait characteristic could be protective against anxiety for the surgical population.

When examining the content of the DASS-21 in terms of anxiety, the questions, although generic, would be applicable to the surgical environment and therefore this measure would still be a valid tool for assessing surgeon anxiety. However, items such as 'I felt scared for no good reason' or 'I felt close to panic' are both emotive in nature and – it could be argued - linked to concepts that are stigmatised within the surgical domain – that of panic and fear. Therefore, there may be some reluctance for participants to report the full extent of their feelings regarding these items, which may lead to skewed/unreliable results.

Stress - the DASS-21 scores found a significant difference between two samples within the domain of stress. Surgeons were found to have an average stress score of 10.55, placing the mean score within the 'moderate' category. Whilst the average general population score ( $\bar{x} = 9.46$ ) places them within the category of 'mild'. Surgery is a high stress job (Green et al., 1990), with the demands of the job seeming to outweigh the amount of control an individual has in meeting those demands (Lambert & Lambert, 2008). Though higher than the general population, the findings of this study are not as high as the levels found within

Tan et al. (2022). Demonstrating both the impact of the pandemic on individuals working within a healthcare environment, and the utility of the data gathered within this study as a pre-pandemic marker, to help evaluate the impact of Covid-19 on the mental health and wellbeing of surgeons.

A surprising finding within this sample is that there is no relationship between anxiety and stress, as previous studies have shown a significant relationship between stress and higher levels of anxiety (Fan et al., 2015). The role of stress and anxiety within a predictive model would provide insight into the nature of this relationship within a surgical population. Given the use of an unaltered, standardised measure of general psychiatric distress within this survey, there is no way to make a valid link between surgeon experiences of adverse events and the findings of the DASS-21 – the measure asked for temporally restricted (within the last month), general measures of psychiatric distress, not those specifically linked to the occurrence of the adverse event. Future studies should examine this relationship by making use of event specific measures (E.g., Following the event did you feel...).

It is also pertinent to consider that not all stress is inherently negative (Kupriyanov & Zhdanov, 2014), and that the level of stress experienced by surgeons could be the necessary motivation required to fully comprehend the enormity of the tasks they face. Surgeons deal with people on the worst days of their lives and can be responsible for life altering and even life ending decisions. It could be argued that such tasks are stressful, and that optimal surgical performance is linked to these domain specific stressors. The levels of reported burnout within the surgeon sample may indicate that the levels of stress experienced by surgeons are close to optimum levels, as levels of work-related burnout are low. The established relationship between stress and burnout (Tsai et al., 2009) would mean that if stress levels were high to a detrimental degree, that we would expect to see this reflected within burnout scores. The lack of burnout within the sample therefore leads to the

conclusion that the levels of stress experienced by the majority of surgeons – although higher than the general population – is not necessarily having a negative impact on their mental health.

#### *Surgeon post-traumatic stress symptomology compared with the general population*

There has been found to be a 6-7% prevalence of post-traumatic stress (PTS) symptomology within the general population (Prins et al., 2016). However, the findings of this present study reveal that 20.22% of surgeons screened positively on the Primary Care Post Traumatic Stress Disorder screening tool (PC-PTSD; Prins et al., 2016). These findings are in line with research findings indicating that 15-25% of doctors screen positively for PTS symptomology (Jacob-Sendler, 2016), with post-pandemic findings demonstrating an even higher prevalence of PTS symptoms within the surgical population (24%; Tan et al., 2022).

Not only do these findings highlight the need for supportive interventions for those working within healthcare, they also support the changes made to the DSM 5 to include the manifestation of PTS symptomology through professional duties and experiences (APA, 2013). Surgeons are experiencing trauma through their everyday work experiences that is affecting them to a potentially clinical degree. Although it is important to highlight that the screening tool is not a clinical diagnosis, it is however a commonly used and well validated screen tool to ascertain the degree of traumatic events experienced by surgeons within their working lives.

65.9% of the surgeon sample within this study reported at least one symptom of PTS following their experience of an adverse event, highlighting a real need for supportive interventions to better care for surgeons both pre-emptively and in the aftermath of traumatic events. However, as the measure was amended to relate specifically to the recalled event, the findings may not be reflective of surgeons' current wellbeing, rather a recollection

of how they were affected at the time of the event. Future studies may wish to include a comparable measure of current PTS symptomology to analyse current levels of PTS symptomology and the need for interventions to support surgeons within the continued practice.

### *Surgeon personality compared with the general population*

The results of this study indicate that surgeon personalities may differ from the general population in relation to some personality variables. On average, surgeons were found to be less open, less neurotic, and more conscientious than the normative data. No statistically significant difference was found within the domains of agreeableness and extraversion.

The findings of several studies - including the present one - suggest that surgeons' personalities may differ somewhat from the general population (Stienen et al., 2018; Whitaker, 2017), however, the nature of these differences tends to vary from study to study. These present findings, taken from within a UK/NHS setting and from participants of all surgical specialties, helps to provide a picture of the surgical personality which has been previously lacking. Surgeons generally scored lower than the general population within the domain of openness, indicating that they are more likely to demonstrate personality traits such as consistency and cautiousness. Surgeons generally scored higher within the domain of conscientiousness, indicating that they are more efficient and organised. Surgeons generally scored lower within the domain of neuroticism, indicating that they are more confident and are less prone to worry and negative emotions. Low neuroticism is a protective factor that reduces the risk of mental health problems (Roelofs et al., 2008).

The above findings generate a picture of a surgeon within the context of the UK healthcare that is unsurprising and will enable them to flourish given the specific demands

of the role. However, what must be considered is whether the surgeon specific personality is enough to protect surgeons from the negative impact of adverse events. It was therefore vital that the effect of personality be considered within the predictive model, which will be examined in more detail later within this chapter.

However, following this research it remains unclear as to whether there is a specific personality type for surgeons, or whether the difference in personality can be attributed to physicians in general. The lack of comparison against other groups within healthcare means that the finding of a ‘surgical personality’ must remain tentative and should be examined within future research. It also remains unclear as to whether the phenomena of personality differences is top-down or bottom-up – do individuals become surgeons because they have certain dominant personality traits, or is this something that is brought out in people through the process of medical education? Given the cross-sectional and temporal limitations of this study these questions cannot be addressed by the data presented within this thesis, however it is a gap to consider addressing within future longitudinal research.

#### *Surgeon resilience compared with the general population*

The results of this study indicate that surgeons are significantly less resilient than the general population. Whilst very few studies have examined the levels of resilience within UK based surgeons, it is suggested that high levels of resilience are required for surgeons to function effectively within an NHS setting (Arnold-Forster, 2020).

The finding of ‘low resilience’ if taken in isolation has the potential to be a contentious finding within the surgical community. The concept of resilience is so often weaponised (Bolderston et al., 2020), with individuals challenged to ‘be more resilient’ in the face of situations and systems that are potentially professionally or psychologically harmful



to the individual. Therefore, it is vital to consider this finding within the context of resilience as a specific psychological construct that enables individuals to overcome adverse events.

The finding of low resilience within surgeons was not an expected outcome within this research. The hypothesised finding was that surgeons would exhibit higher levels of resilience than the general population. This hypothesis was based upon the surgeons' ability to manage high workplace demand and continued high performance whilst demonstrating adaptability to changing circumstances. However, the results indicate that there is a significant difference between surgeons and the general population when it comes to resilience and therefore the cause of this difference must be explored.

It is worth considering that surgeons are people with no more resilience than the general population, and perhaps less resilient in some cases, but, despite this, they are doing extremely demanding jobs, with perpetually high expectations. As such, the gap between the demand and their levels of resilience may lead to increased risk of some mental health issues including PTS symptomology, but individuals may possess other factors which might also act as protective.

It is however possible that the lower levels of resilience exhibited within this surgical sample are a result of surgeons having a higher tolerance for normal day-to-day stressors than that of the general population. The concept of resilience is based upon an individual's ability to 'bounce-back' to their baseline following acute or chronic stressors. It could therefore be argued that surgeons have a significantly higher baseline than the general population, meaning that the distance between their day-to-day normality and their maximum stress experiences is significantly smaller than those who do not work within such a high demand environment. An analogy to explain this would be that of aerobic fitness. It might take the average person one month to reduce their personal best kilometre pace by 30 seconds.

However, for an elite athlete to achieve the same goal it may take many months or not be achievable at all. This is not because the athlete is not as fit as the average person, does not work as hard nor train as effectively, it is purely because they are already training with maximum efficacy and therefore do not have the capacity to significantly reduce their personal best time. Whilst the average person has the capacity to improve their time by minutes, the athlete may only be able to improve by points of a second. This small variance from their baseline does not indicate that they are less good or have lower levels of potential than the general population, but rather that they are already working at the edge of human capacity. Just like athletes, surgeons are working at the upper levels of human capacity in terms of workplace demand. Therefore, they do not have as much 'distance' between their normality and the extremes of stressful events - which is reflected within their resilience scores. The resilience score is a measure of bouncing back to baseline – surgeons bounce back less, not because they are less resilience, but because their baseline is so much higher than those who do not work within a surgical environment.

## **Hypothesis 2 – Key considerations**

The findings reported within this section provide a clearer picture of the ways in which surgeons differ from the general population. However, it is important to reiterate that the scores reported within this section are means, they purely represent what is going on with this sample of surgeons on average. It is therefore important for any future research or changes to practice to consider the individual differences within this sample and offer support and interventions that will also cater for such variance within the surgical population.

Significant differences between surgeons and the general population in terms of resilience, stress, burnout, and PTS symptomology should be used to inform future interventions. The strength and nature of the relationships between some of these variables following an adverse event will be discussed in detail within the next section.

### **Hypothesis 3**

The following relationships were tentatively predicted based on general population research into moderating and mediating effects of measures such as resilience and psychological flexibility (Kashdan & Rottenberg, 2010, Shaffer & Postlethwaite, 2012).

**H3** – the relationship between adverse events and psychological distress will be affected by the following psychological and environmental factors:

- Severity of event/patient outcome
- Outcome for the surgeon (investigation/litigation)
- Personality type
- Resilience
- Psychological flexibility
- Efficacy of training received by surgeons

### **Psychological and environmental factors affecting surgeon outcomes**

#### *Severity of event and surgeon outcomes*

The severity of the event was found to have a direct effect on the observed outcomes of surgeons following an adverse event (feelings, PTS symptoms and worry about colleagues). The direct relationship between severity of adverse events had been established within previous research (Shanafelt et al., 2009; 2011). However, further analysis through SEM demonstrated that this relationship is also both mediated and moderated by other factors. The relationship between severity of event and observed variables (PTS symptoms and worry about colleagues) was found to be reduced by both resilience (mediator) and training (moderator). With higher levels of resilience and more training reducing the negative outcomes for a surgeon following a severe adverse event. The relationship between severity

of event and observed variables (PTS symptoms, worry about colleagues and feelings) was also moderated by personality factors. However, whilst the moderating effect of the factors: openness, conscientiousness, extraversion, and agreeableness reduced negative outcomes, conversely, the moderating effect of neuroticism increased negative outcomes.

These findings demonstrate that two of the factors responsible for mitigating against the negative impact of severe adverse events have the potential to be influenced and changed. By developing personal resilience in individuals through training and interventions and developing more resilient systems within healthcare (Johal et al., 2021) the levels of resilience within surgeons could be improved, meaning that they could be less negatively affected following a severe adverse event. Similarly, surgical training should include training which has a specific and transparent focus on how to deal with an adverse event to help surgeons deal with the situation when it happens to them. The inclusion of these interventions within surgical training could significantly impact the wellbeing of surgeons following an adverse event.

#### *Formal investigation and surgeon outcomes*

Questions regarding causality and the attribution of blame following an adverse event in healthcare is a common process, with doctors often facing litigation following the occurrence of a surgical adverse event (Ford & Cooper, 2016). In the current research, the formal investigation of an adverse event was found to have a direct effect on the observed outcomes of surgeons (feelings, PTS symptoms and worry about colleagues). However, further analysis demonstrated that this relationship is also mediated and moderated by other factors. The relationship between formal investigation and observed variables (feelings, PTS symptoms and worry about colleagues) is mediated by resilience, with higher levels of resilience leading to a reduction in negative psychological outcomes following a formal investigation. The relationship is moderated by both training and personality. With surgeons

who felt more prepared for the event by training being less negatively affected and personality factors of openness, conscientiousness, extraversion, and agreeableness reducing negative outcomes, and neuroticism increasing negative outcomes.

As above, both training and resilience are factors that can be considered throughout surgical training to allow surgeons to develop a set of protective tools to allow them flourish, despite the ubiquity of complications and errors within the surgical work environment.

### *Personality type and surgeon outcomes*

The results from the SEM demonstrated that personality factors moderate the relationship between the adverse event and surgeon outcomes, as examined by the inclusion of the BFI within the survey. Personality factors were found to moderate the relationship between input and observed variables, with some exceptions as outlined within the results chapter. Hence, there is a significant association between input variables (event type, nature of event, severity, timeframe, and formal investigation) on observed variables (feelings, PTS symptomology and worry about colleagues) and personality factors. With the moderating effect of the factors: openness, conscientiousness, extraversion, and agreeableness reducing negative outcomes, and with the moderating effect of neuroticism increasing negative outcomes.

Neuroticism is a well-established risk factor for a range of mental health problems within the general population (Roelofs et al., 2008), so it is not a surprising finding that neuroticism increases negative outcomes within the SEM. However, as a group, surgeons are less neurotic than the general population. Therefore, it is hoped that the negative impact of neuroticism would be less within the surgical population as a whole. However, those individuals who do score highly within the domain of neuroticism may be facing detrimental psychological effects.

The role of personality factors as a moderator potentially raises some ethical considerations. It would be concerning, for example, if personality factors were used to select who would be successful within the surgical workforce – with those with less ‘desirable’ characteristics being denied acceptance. Despite this, individuals having an awareness of and insight into their personality traits, and the potential strengths and blind spots that these may bring, could be a useful tool for any surgeon as they navigate their way through their career. Therefore, there is a role for future psychological research examining protective/desirable personality characteristics to help educate surgeons as a community, to proactively support surgeons to develop and thrive regardless of their predominant personality traits.

#### *Resilience and surgeon outcomes*

The results indicated that the psychological phenomenon of resilience has a mediating relationship between adverse events and surgeons’ outcomes. Resilience was found to mediate the relationship between input variables (Event type, Nature of Event, Severity, Timeframe and Formal Investigation) and observed variables (feelings, PTS symptomology and worry about colleagues). With the mediating effect of resilience reducing the negative aspects of these outcomes. Surgeons with higher levels of resilience felt better about the event, have fewer PTS symptoms, and worried less about the opinions of their colleagues.

This supports previous research findings in which higher resilience is found to be associated with lower levels of PTS symptomology (Warrant et al., 2013) and the surgeon experience of psychiatric distress (West et al., 2020). Given the widespread mediation effect of resilience throughout the model, supporting the development of resilience – whether individual or systemic - should be a primary focus of any training or interventions designed to protect surgeon wellbeing following an adverse event.

### *Psychological flexibility and surgeon outcomes*

The results indicated that psychological flexibility plays a mediating role between the adverse event and surgeon outcomes. Psychological flexibility was found to mediate the relationship between input variables (event type and recency of event) and observed variables (feelings and PTS symptoms). With the mediating effect of psychological flexibility reducing the negative aspects of these outcomes. For more severe events, higher levels of psychological flexibility reduce negative feelings following the event and the prevalence of PTS symptoms. For more recent events, lower levels of PTS symptoms were reported and less negative feelings if participants scored higher within the psychological flexibility measure.

As with resilience, the positive impact of psychological flexibility on wellbeing following an adverse event suggests that it should be included within the intervention and training pathways of surgical training and continued professional development. Bolderston et al. (2020) suggest that one possible source of training that would be suitable for surgeons that would support the development of psychological flexibility and support the development of individual resilience is Acceptance and Commitment Therapy (ACT) training. ACT as an intervention was designed specifically to increase psychological flexibility, so there's an existing, well-tested intervention that should deliver desired outcomes in terms of increasing psychological flexibility (Bond et al., 2016). The pilot phase of Bolderston's intervention is reported to have found similarly encouraging results within a surgical population (Bolderston et al., 2020).

### *Training and surgeon outcomes*

The results demonstrated that training is a moderator between adverse event and surgeon outcomes. Training was found to moderate the relationship between input variables (Event type, nature of event, severity, timeframe and formal investigation) and observed

variables (Feelings, PTS symptoms and worry about colleagues), with the moderating effect of training reducing the negative aspects of these outcomes. Effective training to prepare surgeons for adverse events was found to improve feelings about the event and reduce PTS symptoms and feelings of worry about colleagues.

Since the onset of the Covid-19 pandemic, surgical training has been affected in a range of domains, including a reduction in operative and clinical exposure, the use of blended learning modalities, the reduction of face-to-face training and outsourcing of training to external agencies (Doulias et al., 2022). The negative impact on surgical training during and since the pandemic include limitations to operative and clinical experiences, as well as significant negative effects on the mental health and wellbeing of trainees (Hope et al., 2021). Because of this, the content and modality of delivery of surgical training will need to move away from traditional models of learning to ensure trainees are surgically competent, as well as being well supported and fully equipped to deal with their current working environment. The findings of this research indicate that training to prepare surgeons for experiencing an adverse event would be a vital consideration for inclusion within any new or reviewed training curriculum, given the moderating effect such training has on reducing negative outcomes.

### **Hypothesis 3 – Key considerations**

The SEM clearly demonstrated the interplay of some of the variables affecting surgeons following an adverse event. This model includes the most theoretically relevant factors that will exacerbate or mitigate against the effects of adverse events. However, this is not an exhaustive model, and it is anticipated that the inclusion of other outcome measures for mental health and wellbeing (such as depression, anxiety, stress, and burnout) would provide even more clarity regarding how surgeons are affected by surgical complications and errors.



### **Key strengths**

This study is the first of its kind within the surgical context to delineate between different types of adverse events. The differences found between complications and errors demonstrate that these event types should not be conflated and should be treated as two discrete phenomena. The findings from this research therefore provide novel insight into these different types of events and their impact on surgeons.

Previous studies within this field (e.g., Pinto, 2013; Shanafelt et al., 2009; Shanafelt et al., 2011) have examined surgeons' experiences in a quantitative manner. However, their statistical examination has not exceeded a descriptive overview of the effect of adverse events on outcome measures. The current study scrutinised the impact of adverse events in a previously unexamined way. By utilising SEM to generate a predictive model, this study has added a depth of understanding surrounding the psychological effect of adverse events and the factors that mediate and moderate their impact, providing insight into this research area that has been hitherto lacking.

Unlike other studies conducted within this field (e.g., Patel et al., 2010; Pinto et al., 2013; Shanafelt et al., 2009) this study presents findings from a range of surgical specialities (12 specialities), geographical locations within the UK, hospital settings (District General Hospital, University Teaching Hospital or Private Practice) and levels of experience (ST3 – Consultant, including staff and associate specialist grades), all within a larger sample size than other studies within this area. The findings represented within this thesis are therefore more generalisable than any previous study of its kind and provide data which future studies can use as a baseline for further examination of the mental health and wellbeing of surgeons across the UK (especially those examining pre- and post-Covid19 differences, as the data from this thesis was obtained prior to the onset of the pandemic).

## **Limitations**

Several limitations must be weighed against the strengths reviewed above. As with most research that uses a survey methodology, the obtaining of data was reliant on self-report measures. Whilst it was the judgement of the researcher that the inclusion of such validated measures within the survey outweigh any potential risk of bias, it must be considered that their inclusion could have carried the risk of participant fatigue, demand bias and inaccurate memory of experiences.

Another limitation of this study is that although the measures used have been shown to be valid indicators of clinically relevant mental health disorder symptomology (such as burnout, PTS symptomology and psychiatric distress), some of the response formats were altered to ask participants to report on different time frames (e.g., 'since the adverse event...'). Therefore, these measures provide an indication of recalled symptom severity rather than having any current clinical diagnostic value (Kupfer, 2015).

Finally, and conversely, the use of the DASS-21 and CBI measures using their original wording meant that the findings were comparable with the general population and remained a valid psychometric measure. However, the results from such measures could not be included within the SEM as there was no direct link between the two. If the wording of the measures had been changed to ask participants to recall their feelings following the event, then the analysis within the model would have been possible. However, the potential for recall bias was considered too high for this method to have been implemented within this study.

## **Implications and recommendations for future research and changes to professional practice**

This section presents the implications of this present research and recommendations in terms of future avenues of research. This section will also examine potential changes to professional practice and the culture within the surgical profession, as well as avenues of support to be considered, and recommendations for training that should be routinely available to surgeons.

### **Implications of this research**

This research provides the first quantitative model of the impact of complications and errors on surgeons within the UK. Due to the distinct way in which the type of event was examined within this research, it has been demonstrated that complications and errors can have significantly different impacts on a range of important factors and so they should not be conflated in future research. Analysis of the impact of these different event types revealed that experience of error led to higher likelihood of reporting negative outcomes and behaviours, such as sleep problems, higher prevalence of PTS symptomology and more negative feelings about the event. However, surgeons also felt as though they were better practitioners following an error than a complication, demonstrating that errors are also an opportunity for growth and professional development. Regardless of these specific findings, the significant differences found between both conditions in a range of domains demonstrates that these events are distinct phenomena, and that any future study that conflates these would be misinformed and at risk of arriving at conclusions that neither help surgeons nor the surgical profession. As well as influencing future research it is hoped that the distinction between different types of events will also inform targeted interventions and training events to allow surgeons to cope and flourish despite the ubiquitous nature of many different types of adverse events.

The structural model implicates the role of key moderators and mediators within the mechanism of psychologically managing the impact of adverse events. These variables are key factors in making meaningful change for surgeons in terms of improving their wellbeing and psychological outcomes. As well as informing future research into the specific nature of the roles of such variables, it is hoped that the development of understanding that this generates will also inform the training methods and intervention strategies utilised within the surgical profession, as well as reducing cultural stigma around these areas.

### **Recommendations for future research**

Further research is required into the nature of surgical errors and complications. Surgeons can be differentially impacted by surgical events they view as errors or complications, the distinction between the two therefore appears to be important. However, there remain grey areas in which an adverse event in surgery could be viewed as either a complication or error, as was seen within the data relating to factors contributing to the occurrence of complications and errors within this present research. Therefore, there may be some utility in research that scrutinises the distinction and the overlap in more detail, and the psychological ramifications of such distinctions.

Future research in this area should also examine the role of psychological constructs such as depression, anxiety, stress, and burnout within the newly established structural model, both as observed and potentially moderating factors. Given the nature of the measures used within this present research, it was not possible to accurately ascertain the roles of such constructs. However, by establishing the right temporal restrictions within the development of the measure, the impact of these could be captured in relation to an adverse event.

Future research will also need to consider the content and efficacy of training, support and interventions recommended based on the findings of this research. A cross-sequential study that examines the longitudinal and cross-sectional effect of these would provide an insightful overview of the application of this structural model and the benefits of developing content to support surgeons within these particular areas of development. Whilst ACT based interventions seem to be a good candidate for this context there are a range of other modalities of supportive interventions (e.g., CBT based, mindfulness etc.) that could be beneficial. The ‘dose’ of such interventions will also be an important factor to be examined in future research. Scrutinising the requirements in terms of sessions/hours/content to ensure maximum effect, whilst – pragmatically - ensuring brevity, to promote engagement and reduce participant attrition.

### **Recommendations for changes to professional practice and culture**

The concept of resilience is not embraced within the surgical community due, in part, to the weaponization of the term within many healthcare settings. To allow surgeons to see the benefits of resilience as a distinct psychological phenomenon, the way in which the mediating properties of the construct are shared with stakeholders will need to be carefully addressed and managed. A cultural shift around resilience as a concept will be required before surgeons engage meaningfully with any training or interventions related to its development. There is a need to address the systemic and organisational issues that are currently limiting individual resilience, so that institutions may support individual surgeons to develop resilience and remove potential blockers to resilience maintenance and development.

Surgeons who experienced an error reported that they became better practitioners as a result of their experience. This research supports the development of a community of practice in which surgeons can share their experiences and learn from the mistakes of others to minimise patient harm. With some similarities to the aviation industry’s ‘just culture’, the

surgical workforce needs to feel empowered to share their experiences of both complications and errors to help others develop strategies – both practically and emotionally – to cope with their occurrence. A range of factors may currently contribute to the reticence exhibited by surgeons when it comes to sharing their experiences of adverse events. Not only does openly admitting to mistakes leave a surgeon open to potential litigation or disciplinary action, but it also leaves them professionally and personally vulnerable and exposed. The sharing of such experiences should therefore be role modelled within surgery in an attempt to change the culture. Within the hierarchical structures of surgery, a top-down exhibition of such behaviours could have a significant and pervasive impact on the culture of surgery.

Following the experience of a complication or an error, fewer than half of the surgeons surveyed sought any form of support to help them process or deal with their experience. Not only that, but their worry of colleagues' perceptions of them was a significant negative outcome within the findings of this research. This reluctance to seek help and advice, which is somewhat amplified by a fear of reputational damage, requires systemic changes to ensure that all surgeons feel safe to access the support they need. This could also relate to the flattening of hierarchical structures within institutional settings, such as the implementation of Schwartz Rounds and mentoring systems, including reverse mentoring. To encourage support seeking, the process of reflecting, debriefing, and talking to others about negative work experiences should be encouraged and modelled from early medical training, embedding such practises into the norms of surgical culture. This may help reduce stigma associated with support seeking and help those with more serious mental health concerns feel safe and able to reach out for the supportive interventions they require.

### **Recommendations for training**

Training to support surgeons deal with the aftermath of complications and errors should focus on the key moderators and mediators that can be manipulated through

educational and psychological interventions. Therefore, it is recommended that training explicitly focusses on the practical management of complications and errors, so that all surgeons know what needs to happen in the event of an adverse event and are aware of the protocols in place for reporting such incidents and when dealing with patients and their families. Training institutions should consider incorporating explicit support seeking practices, such as overtly signposting towards support pathways, into their curriculum from as early as medical school to normalise such behaviours throughout medicine. Surgeons should be encouraged to develop an understanding of their own unique character traits, so that they may maximise the strengths associated with their disposition, as well as be explicitly aware of any potential blind spots or vulnerabilities. Finally, to maximise the impact of key mediators within the structural model, targeted training interventions based on Acceptance and Commitment Training should be incorporated by deaneries and trusts throughout the surgical workforce, to support the development of both resilience and psychological flexibility within surgeons and thereby reduce the prevalence of negative outcomes when adverse events occur.

## **Conclusion**

The aim of this thesis was to examine the impact of complications and errors on surgeons within the United Kingdom. Previous research failed to delineate between types of adverse events leading to findings that failed to provide a clear picture of how surgeons were affected when they experienced either a complication or an error. This research, although just the first of many studies required to ensure that surgeons are adequately supported before, during and after an adverse event, provides the first comprehensive overview of the mechanisms by which surgeons are protected from negative outcomes when they experience complications and errors.

This study paves the way for future research examining complications and errors as distinct entities, allowing for this field of study to be freed from the current confusion surrounding the use of such terminology. The structural model created within this study provides a template with which future researchers may scrutinise the mechanisms behind surgeon outcomes, rather than examining such psychological phenomena in a purely descriptive manner.

This research was born out of a desire to understand in more detail the detrimental effect of complications and errors on surgeons and examine the ways that they may be better protected from negative outcomes. If this research does anything however, it suggests the extent to which surgeons are negatively affected by their experience of complications and errors and that more work needs to be done to ensure that they are enabled to thrive and flourish within their occupational environment.



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## 9. Appendices

### Appendix A: Ethics Checklist



# Research Ethics Checklist

Reference Id	12443
Status	Approved
Date Approved	27/09/2016

## Researcher Details

Name	Catherine Johnson
School	Faculty of Science & Technology
Status	Postgraduate Research (MRes, MPhil, PhD, DProf, DEng)
Course	Postgraduate Research
Have you received external funding to support this research project?	Yes
RED ID	8936
Funding Body	Nuffield Health Bournemouth Hospital (Match-funded PhD Studentship)
Please list any persons or institutions that you will be conducting joint research with, both internal to BU as well as external collaborators.	Professor Siné McDougall, Dr Kevin Thomas and Dr Helen Bolderston (Psychology Department, SciTech Faculty, BU); Mr Kevin Turner (Royal Bournemouth Hospital)

## Project Details

Title	The impact of complications and errors on surgeons: National Survey
Proposed Start Date of Data Collection	01/09/2016
Proposed End Date of Project	01/01/2017

<b>Original Supervisor</b>	Sine McDougall
<b>Approver</b>	Sine McDougall

<b>Summary - no more than 500 words (including detail on background methodology, sample, outcomes, etc.)</b>
<p>There is a high likelihood that surgeons will experience adverse outcomes due to patient complications following surgery (e.g., death) sometime during their careers (Patel et al., 2010). Such adverse events can have undesirable effects on the surgeon in terms of quality of life and mental well-being (e.g., anxiety, feelings of regret) and lowered professional confidence and impaired perceptions of professional competence. Given the important practical benefits of understanding how surgeons deal with both complications and errors, it is surprising that this subject has received little empirical scrutiny to date (cf. Patel et al., 2010). The proposed study seeks to begin to address this omission by gauging how surgeons perceive complications and errors and the impact of such adverse events on their mental well-being and professional practice. The methodology for this study will be an online Qualtrics survey. The survey will be distributed electronically to over 10,000 surgeons thanks to the good offices of the Royal Colleges of Surgeons within the UK. Findings from the survey will generate a quantifiable description of the impact of adverse events on surgeons to enable us to compare their effects and to isolate the factors that are associated with impact. Results from the survey will provide us with a national picture that is currently lacking and will be able to inform decision making and provide quantifiable leverage for influencing policy change as well as help to guide the development of better targeted education and support for surgeons.</p>

## External Ethics Review

<b>Does your research require external review through the NHS National Research Ethics Service (NRES) or through another external Ethics Committee?</b>	No
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## Research Literature

<b>Is your research solely literature based?</b>	No
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## Human Participants

<b>Will your research project involve interaction with human participants as primary sources of data (e.g. interview, observation, original survey)?</b>	Yes
<b>Does your research specifically involve participants who are considered vulnerable (i.e. children, those with cognitive impairment, those in unequal relationships—such as your own students, prison inmates, etc.)?</b>	No
<b>Does the study involve participants age 16 or over who are unable to give informed consent (i.e. people with learning disabilities)? NOTE: All research that falls under the auspices of the Mental Capacity Act 2005 must be reviewed by NHS NRES.</b>	No
<b>Will the study require the co-operation of a gatekeeper for initial access to the groups or individuals to be recruited? (i.e. students at school, members of self-help group, residents of Nursing home?)</b>	No

Will it be necessary for participants to take part in your study without their knowledge and consent at the time (i.e. covert observation of people in non-public places)?	No
Will the study involve discussion of sensitive topics (i.e. sexual activity, drug use, criminal activity)?	No

Are drugs, placebos or other substances (i.e. food substances, vitamins) to be administered to the study participants or will the study involve invasive, intrusive or potentially harmful procedures of any kind?	No
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Will tissue samples (including blood) be obtained from participants? Note: If the answer to this question is 'yes' you will need to be aware of obligations under the Human Tissue Act 2004.	No
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Could your research induce psychological stress or anxiety, cause harm or have negative consequences for the participant or researcher (beyond the risks encountered in normal life)?	No
Will your research involve prolonged or repetitive testing?	No
Will the research involve the collection of audio materials?	No
Will your research involve the collection of photographic or video materials?	No
Will financial or other inducements (other than reasonable expenses and compensation for time) be offered to participants?	No

<p>Please give a summary of the ethical issues and any action that will be taken to address these. Explain how you will obtain informed consent (and from whom) and how you will inform the participant about the research project (i.e. participant information sheet).</p> <p>Although it is not anticipated that this survey will induce psychological stress or anxiety, cause harm or have negative consequences for the participant or researcher beyond the risks encountered in normal life, it is recognised that this survey may cause surgeons to re-examine stressful events that they have encountered within their work environment. Therefore, as a safeguard, the debrief at the end of the survey will include signposts towards information and support for participants to access if by any chance the content of the survey has caused any form of psychological distress. Survey data will be stored by Qualtrics in an externally located secure server, as well as securely and anonymously by the researcher for SPSS data analysis.</p>
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## Final Review

Will you have access to personal data that allows you to identify individuals OR access to confidential corporate or company data (that is not covered by confidentiality terms within an agreement or by a separate confidentiality agreement)?	No
Will your research involve experimentation on any of the following: animals, animal tissue, genetically modified organisms?	No

Will your research take place outside the UK (including any and all stages of research: collection, storage, analysis, etc.)?	Yes
Does the country in which you are conducting research require that you obtain internal ethical approval (i.e. beyond that required by Bournemouth University)?	No
Could conflicts of interest arise between the source of funding and the potential outcomes of the research?	No

Please use the below text box to highlight any other ethical concerns or risks that may arise during your research that have not been covered in this form.

## **Appendix B: Survey Content**

The following is the paper version of the survey for reference. The following example is that of the **complication** condition.

### **The impact of complications and errors on surgeons**

#### **The purpose of this research**

This survey is being carried out to find out more about how the complications and errors which arise in surgical practice affect the way in which surgeons think, feel, and behave.

This research is supported by the BMA, the Royal College of Surgeons of England and the Royal College of Surgeons of Edinburgh and is being conducted by researchers at Royal Bournemouth & Christchurch Hospitals NHS Foundation Trust and Bournemouth University.

#### **Why you have been asked to take part**

You are being invited to complete this survey because you are a currently practising surgeon within the United Kingdom and this is the first national survey of its kind. We hope that the results of the survey will provide greater insights into the impact of complications and errors with a view to fostering effective support for surgeons.

#### **What it will involve**

Taking part in the survey involves answering questions about your surgical experiences as well as providing information about your background and professional experience.

#### **Confidentiality and data storage**

The information you supply is anonymous and confidential and is used only for the purposes of this research and nothing else. The research team only has access to your anonymised responses and all data is kept in accordance with the Data Protection Act (1998).

If you are affected by any of the content of the survey, information regarding existing support is available at the end of the survey or on the research team's website <http://www.surgeonwellbeing.co.uk>.

For further information regarding this research study, please contact Catherine Johnson, (email: [johnsonc@bournemouth.ac.uk](mailto:johnsonc@bournemouth.ac.uk)) or Professor Sine McDougall ([smcdougall@bournemouth.ac.uk](mailto:smcdougall@bournemouth.ac.uk)), Faculty of Science & Technology, Bournemouth University. Should you have any complaints regarding this research study, please contact Professor Keith Phalp, Dean, Faculty of Science & Technology via email: [KPhalp@bournemouth.ac.uk](mailto:KPhalp@bournemouth.ac.uk).

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Before you start the survey can you please confirm that you are happy to take part. Please read each of the following statements below carefully and tick to confirm ALL of them to indicate you are happy to take part.

- I understand that my participation is voluntary and that I can withdraw at any time up to the point at which the survey is submitted.
- Should I not wish to answer any question, I am free to decline.
- I understand that the information I give is anonymous and confidential.
- I confirm I am happy to take part in this study.

We would be grateful if you could provide us with some information about yourself, your training, and your current post. This helps us to contextualise the information that you give us.

1.a. Age: \_\_\_\_\_

1.b. Gender:

- Male
- Female
- Non-Binary
- Prefer not to say

1.c. Marital Status:

- Single
- Co-habiting
- Married
- Widowed
- Divorced
- Separated
- Prefer not to say

1.d. Year of Qualification: \_\_\_\_\_

1.e. Are you currently practicing in the United Kingdom?

- Yes
- No\*

\*We regret that at this time we are only seeking participants who are practicing within the United Kingdom.

1.f. If you qualified outside of the U.K. in which year did you come to the U.K. to practice medicine?: \_\_\_\_\_

1.g. Where is your principal place of work?

- District General Hospital
- University Teaching Hospital
- Private Practice

1.h. What is your surgical specialty?:  
\_\_\_\_\_

1.i. What is your current grade? \_\_\_\_\_

1.j. For how long have you worked at this grade? \_\_\_\_\_

---

You have been randomly selected to answer questions related to your experience of SURGICAL COMPLICATIONS. Please note that this survey is NOT about SURGICAL ERRORS.

Complications: Adverse events which are an acknowledged risk of surgical care or procedures

Errors: Commissions or omissions with the potential for negative consequences independent of whether there were actually any negative outcomes

Please be sure to consider only COMPLICATIONS in your answers.

---

Ideally we would like to hear about a complication that you have had during the last 3 months.

2.a. Have you had a surgical complication within the last 3 months?  Yes  No

2.b. If No is selected above please recall a memorable complication:

- I have had a memorable surgical complication within the last year
- I have had a memorable surgical complication over a year ago  
(In years, please specify approximately how long ago the event took place)

I have never experienced a surgical complication\*

\*If you have never experienced a surgical complication then please proceed directly to section 9



2.c. Please briefly describe the nature of this complication:

2.d. Please state the nature of the operation:

- Elective
- Emergency

2.e. Please classify the severity of this complication by selecting the appropriate grade from the Clavien-Dindo scale:

- NO GRADE No deviation required from the normal postoperative course
- GRADE I Any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic and radiological interventions. Allowed therapeutic regimens are: drugs as antiemetics, antipyretics, analgetics, diuretics and electrolytes and physiotherapy. This grade also includes wound infections opened at the bedside.
- GRADE II Requiring pharmacological treatment with drugs other than such allowed for grade I complications. Blood transfusions and total parenteral nutrition are also included.
- GRADE III-a Requiring surgical, endoscopic or radiological intervention not under general anaesthesia
- GRADE III-b Requiring surgical, endoscopic or radiological intervention under general anaesthesia
- GRADE IV-a Life-threatening complication (including brain heamorrhage, ischemic stroke, subarrachnoidal bleeding, but excluding transient ischemic attacks) requiring IC/ICU-management - single organ dysfunction (including dialysis)
- GRADE IV-b Life-threatening complication (including brain heamorrhage, ischemic stroke, subarrachnoidal bleeding, but excluding transient ischemic attacks) requiring IC/ICU-management - multi organ dysfunction
- GRADE V Death of a patient

3.a. Did any of the following contribute to the occurrence of the complication? (Please select all applicable options.)

- Fatigue
- Lack of knowledge/experience
- Lack of resources
- Lapse in judgement by you
- Poor communication

- Recognised risk of procedure
  - Stress/depression/burnout
  - System issue outside of your control
  - Other (Please specify)
- 

3.b. How did you feel about the event? (please indicate how positive or negative your feelings were about your specified event)

Extremely negative			Neutral			Extremely positive
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

---

4.a. We are interested in finding out about the impact on you following this complication. Did you experience any of the following?

	Started	Stayed the same	Troubled me less	Troubled me more	Does not apply
Cardiovascular problems (e.g. hypertension, angina, MI)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gastrointestinal problems (e.g. gastritis, IBS)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Headaches	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Minor illnesses (e.g. colds)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sleep problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Depression	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Anxiety	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Anger or irritability	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Problems with relationships	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	Started	Stayed the same	Consumed less	Consumed more	Does not apply
Alcohol consumption	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Smoking	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

\*If 'other' please specify \_\_\_\_\_

4.b. Following the complication:

	Yes	No
Did you have nightmares about it or thought about it when you did not want to?	<input type="checkbox"/>	<input type="checkbox"/>
Did you try hard not to think about it or went out of your way to avoid situations that reminded you of it?	<input type="checkbox"/>	<input type="checkbox"/>

---

Were you constantly on guard, watchful, or easily startled?

Did you feel numb or detached from others, activities, or your surroundings?

---

5.a. Did you talk to someone about your feelings following the complication?  Yes  No\*

\*If you have answered 'no' please proceed directly to question 5.d.

5.b. Who did you speak to? (Please tick all applicable options)

- Spouse/partner/friends
  - Colleagues in my hospital
  - Colleagues in another hospital
  - A local or national support service
- (Please specify) \_\_\_\_\_
- Other  
(Please specify) \_\_\_\_\_
- 

5.c. How useful did you find the experience of speaking to others?

Extremely useful    Neutral    Not useful at all

5.d. Were there any other external factors (outside of this specific complication) that may have had an impact on you at this time?  
If so, please briefly outline them in the box below.

---

We are particularly interested in how this complication impacted upon you professionally.

6.a. My surgical practice changed as a result of this complication

Strongly agree    Neither agree nor disagree    Strongly disagree

6.b. If you feel that your practice has changed, please indicate in what ways it has changed.  
(Please select all applicable options)

- Surgical practice has improved as a result of learning from this experience
- Able to advise others on similar complications as a result of my experience
- Conduct more investigations prior to surgery
- Made more referrals than previously
- Ask for more frequent observations than previously
- Carried out more tests than previously
- Avoided particular procedures
- Avoided particular surgical approaches
- Stopped doing aspects of your work
- Other

(Please specify)

---

6.c. To what extent do you feel that this greater precaution is necessary?

Not necessary at all				To some extent				Absolutely necessary
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

6.d. To what extent do you feel that you are a better or worse practitioner as a result of your experience with this complication?

Much poorer				Same as before				Much better
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

6.e. How easy/difficult was the complication to deal with professionally?

Very easy				Neither easy nor difficult				Very difficult
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

---

7.a. To what extent do you think that your training prepared you for the personal impact of this complication?

Not at all				To some extent				Well prepared
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

7.b. If you feel you were prepared in some way, which aspects of training helped you prepare you for the personal impact of this complication?

7.c. What support is available to you when complications arise?

7.d. Training should prepare surgeons better for dealing with the personal impact of complications.

Disagree completely	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Neither agree nor disagree	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Agree completely	<input type="checkbox"/>
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7.e. If surgeons could be better prepared in advance for the personal impact of complications, what form might this preparation take?

7.f. As a result of this complication I worry more about what my colleagues think of my practice.

Disagree completely	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Neither agree nor disagree	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Agree completely	<input type="checkbox"/>
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8.a. Did the complication lead to a formal investigation?  Yes  No\*

\*If you have answered 'no' please proceed directly to question 9.a.

8.b. What was the nature of the investigation?

8.c. How easy/difficult did you find this process to deal with?

Very easy				Neither easy nor difficult				Very difficult
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

8. d. What was the outcome of this investigation? (Please select all applicable)

- No fault/Exonerated
  - Retraining imposed
  - Disciplinary action
  - Legal action
  - Suspension from practice
  - The investigation is ongoing
  - The process has reached no clear conclusion
  - Other
- (Please specify)
- 

8.e. How easy/difficult did you find this outcome to deal with?

Very easy				Neither easy nor difficult				Very difficult
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

---

9.a. Generally, how would you say that you would respond to issues at work?

	Never true	Very Seldom True	Seldom True	Sometimes True	Frequently true	Almost always true	Always True	9.b. To what
I am able to work effectively in spite of any personal worries that I have	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
I can admit to my mistakes at work and still be successful	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
I can still work very effectively, even if I am nervous about something	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Worries do not get in the way of my success	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
I can perform as required no matter how I feel	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
I can work effectively, even when I doubt myself	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
My thoughts and feelings do not get in the way of my work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

extent do you agree with the following statements?

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I tend to bounce back quickly after hard times	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I have a hard time making it through stressful events	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
It does not take me long to recover from a stressful event	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

---

It is hard for me to snap back when something bad happens

---

I usually come through difficult times with little trouble

---

I tend to take a long time to get over setbacks in my life

---



Part Two

The second part of this survey aims to explore your thoughts and feelings in greater detail.

10.a. Please respond to the following statements

	Always	Often	Sometimes	Seldom	Never
How often do you feel tired?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do you feel worn out at the end of the working day?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Are you tired of working with patients?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How often do you feel worn out?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do you feel exhausted in the morning at the thought of another day at work?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How often are you physically exhausted?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do you have enough energy for family and friends during leisure time?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do you sometimes wonder how long you will be able to continue working with patients?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How often are you emotionally exhausted?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How often do you feel weak and susceptible to illness?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How often do you think 'I can't take it anymore'?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do you feel that every working hour is tiring for you?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

10.b. Please respond to the following statements

	To a very high degree	To a high degree	Somewhat	To a low degree	To a very low degree
How often do you feel tired?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do you feel worn out at the end of the working day?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Are you tired of working with patients?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How often do you feel worn out?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do you feel exhausted in the morning at the thought of another day at work?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How often are you physically exhausted?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Do you have enough energy for family and friends during leisure time?

10.c. Please read each statement below and select how much the statement applied to you over the past week. There are no right or wrong answers. Do not spend too much time on any statement.

	Did not apply to me at all	Applied to me to some degree, or some of the time	Applied to me to a considerable degree, or a good part of the time	Applied to me very much, or most of the time
I found it hard to wind down	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I was aware of dryness of my mouth	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I couldn't seem to experience any positive feeling at all	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I experienced breathing difficulty (eg, excessively rapid breathing, breathlessness in the absence of physical exertion)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I found it difficult to work up the initiative to do things	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I tended to over-react to situations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I experienced trembling (e.g., in the hands)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I felt that I was using a lot of nervous energy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I was worried about situations in which I might panic and make a fool of myself	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I felt that I had nothing to look forward to	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I found myself getting agitated	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I found it difficult to relax	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I felt down-hearted and blue	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I was intolerant of anything that kept me from getting on with what I was doing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I felt I was close to panic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I was unable to become enthusiastic about anything	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I felt I wasn't worth much as a person	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

I felt that I was rather touchy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I was aware of the action of my heart in the absence of physical exertion (eg, sense of heart rate increase, heart missing a beat)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I felt scared without any good reason	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I felt that life was meaningless	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

10.d. I see myself as someone who...

	Disagree Strongly	Disagree a little	Neither agree nor disagree	Agree a little	Agree Strongly
Is talkative	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tends to find fault with others	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Does a thorough job	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is depressed/blue	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is original/comes up with new ideas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is reserved	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is helpful and unselfish with others	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Can be somewhat careless	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is relaxed, handles stress well	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is curious about many different things	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is full of energy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Starts quarrels with others	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is a reliable worker	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Can be tense	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is ingenious, a deep thinker	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Generates a lot of enthusiasm	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Has a forgiving nature	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tends to be disorganised	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Worries a lot	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Has an active imagination	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tends to be quiet	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is generally trusting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

10.e. I see myself as someone who...

	Disagree Strongly	Disagree a little	Neither agree nor disagree	Agree a little	Agree Strongly
Tends to be lazy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is emotionally stable, not easily upset	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is inventive	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Has an assertive personality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Can be cold and aloof	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Perseveres until the task is finished	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Can be moody	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Values artistic, aesthetic experiences	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is sometimes shy, inhibited	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is considerate and kind to almost everyone	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Does things efficiently	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Remains calm in tense situations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is a reliable worker	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Prefers work that is routine	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is outgoing, sociable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is sometimes rude to others	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Makes plans and follows through with them	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gets nervous easily	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Likes to reflect, play with ideas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Has few artistic interests	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Likes to cooperate with others	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is easily distracted	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is sophisticated in art, music, or literature	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Thank you for taking the time to complete this questionnaire. Your responses will help to generate a national picture of the impact of adverse events on surgeons.

Should you have any questions about the questionnaire or encounter any issues then please do not hesitate to contact Catherine Johnson ([johnsonc@bournemouth.ac.uk](mailto:johnsonc@bournemouth.ac.uk)) or Professor Sine McDougall ([smcdougall@bournemouth.ac.uk](mailto:smcdougall@bournemouth.ac.uk)). For more information please visit our website at [www.surgeonwellbeing.co.uk](http://www.surgeonwellbeing.co.uk)

If you would like further information or support about any of the issues raised in this research then there are lots of organisations who can help you. Please find a list of resources available to you below:

ePhysicianHealth.com - a comprehensive online physician health and wellness resource.

International Stress Management Association - promotes sound knowledge and best practice in the prevention and reduction of human stress.

Your Health Matters - information and advice from the GMC for doctors who have concerns about their own health.

Royal College of Surgeons Confidential Support and Advice Services for Surgeons (CSAS) - offers a confidential telephone line as a point of personal contact between surgeons which is intended to offer a listening ear and will act as an informed signpost to appropriate sources of advice and support.

Other useful links for support in a range of areas can be found on the BMA website.

In event of any issues or complaints regarding the survey please contact Professor Keith Phalp, Dean of the Faculty of Science & Technology at Bournemouth University ([KPhalp@bournemouth.ac.uk](mailto:KPhalp@bournemouth.ac.uk); tel:01201975847 .)

## Appendix C: Data Cleaning Procedure

Please be advised that the following instructions are based on the cleaning and amalgamating of data from the original two-part survey and the full survey utilised from June 2017. For data from the full survey only please commence the data cleaning at step 6.

1. Using unique identifier or embedded email sort cases so that parts 1 & 2 are next to each other within the datasheet.
2. Copy and paste part two of each participants' survey so that it is in line with their part 1 response
3. Remove any identifiers from the data (email addresses)
4. Specify each data source (1=Amalgamated 1&2, 2=Full survey)
5. Part 1 data only – recode speciality

Appendix Table: Speciality Recoding

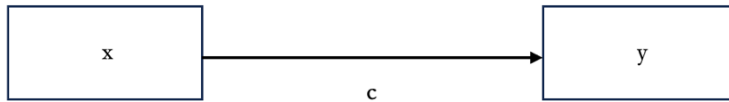
Part One Code	Speciality	Recode to:
1	Cardio	1
2	General	2
3	Ophthal	13
4	Neuro	3
5	Oral/Max	4
6	ENT	5
7	Paeds	6
8	Plastics	7
9	Trauma/Ortho	8
10	Urology	9
11	Vascular	11
12	Academic	12
N/A*	OB/GYN	10
* OB/GYN was not included within the original survey due to the survey distribution originally having been restricted to RCSEng members. These will have to be found manually within the 'other' section and added to category 10.		

6. Assign each condition with an 'event type' (1=Complication, 2=Error)
7. Sort by event type
8. Copy and paste all of error responses so that they are in line with complications
9. Remove incomplete responses
10. Add in columns to allow for expansion of 'contributing factors', 'who did you speak to?' and 'ways changed' CSV

11. One at a time, sort dataset by changing ‘contributing factors’, ‘who did you speak to?’ and ‘ways changed’ CSV columns into ascending values
12. Using sorted data manually expand ‘contributing factors’, ‘who did you speak to?’ and ‘ways changed’ CSV columns
13. Recode PC-PTSD scores (2=0)
14. Add an additional column creating a PC-PTSD total score [=SUM(First PC-PTSD item>Last PC-PTSD item)]
15. Add an additional two columns after WAAQ. WAAQ total [=SUM(First WAAQ Value>Last WAAQ Value)] and WAAQ average [=SUM(WAAQ total/7)]
16. Reverse score the BRS – items 2, 4 & 6.
17. Add an additional two columns after BRS. BRS total [=SUM(First BRS Value>Last BRS Value)] and BRS average [=SUM(BRS total/6)]
18. Recode CBI values
19. Reverse score CBI item 7
20. Add an additional six columns after CBI. Client total [=SUM(First client Value>Last client Value)] and Client average [=SUM(Client total/6)], Personal total [=SUM(First personal Value>Last personal Value)] and Personal average [=SUM(Personal total/6)], Work total [=SUM(First Work Value>Last Work Value)] and Work average [=SUM(Work total/7)]
21. Recode DASS-21(1=0, 2=1, 3=2, 4=3)
22. Add an additional three columns after DASS-21. D total [=SUM(First D Value>Last D Value)] A total [=SUM(First A Value>Last A Value)] S total [=SUM(First S Value>Last S Value)]
23. If you wish to be able to compare DASS-21 scores with the original DASS scores then create columns that double each of the above totals. This is not absolutely necessary now that normative data exists for the DASS-21.
24. Reverse score BFI items 2, 6, 8, 9, 12, 18, 21, 23, 24, 27, 31, 34, 35, 37, 41 & 43
25. Add an additional five columns after BFI. O total [=SUM(First O Value>Last O Value)] C total [=SUM(First C Value>Last C Value)] E total [=SUM(First E Value>Last E Value)] A total [=SUM(First A Value>Last A Value)] N total [=SUM(First N Value>Last N Value)]

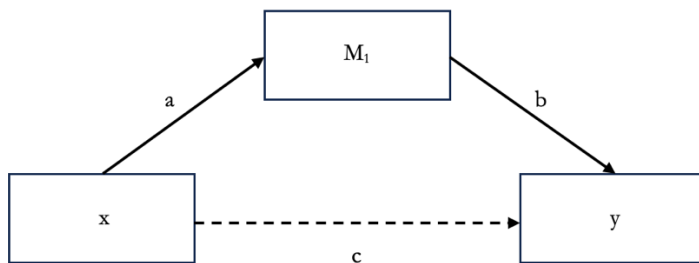
## Appendix D: Moderation and Mediation Diagrams

Appendix Figure: Direct effect between variables



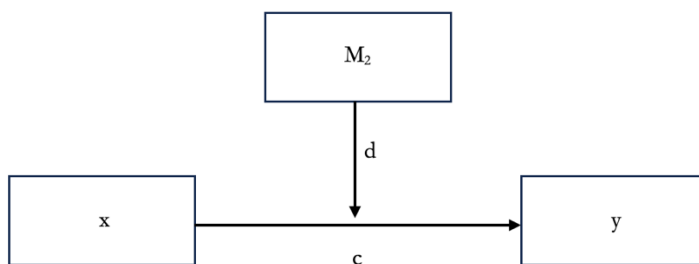
x: input variable  
y: outcome variable  
c: observed direct effect

Appendix Figure: Mediation process



x: input variable  
y: outcome variable  
 $M_1$ : mediating variable  
c: observed direct effect  
 $a+b$ : mediated effect of input variable on outcome variable

Appendix Figure: Moderation process



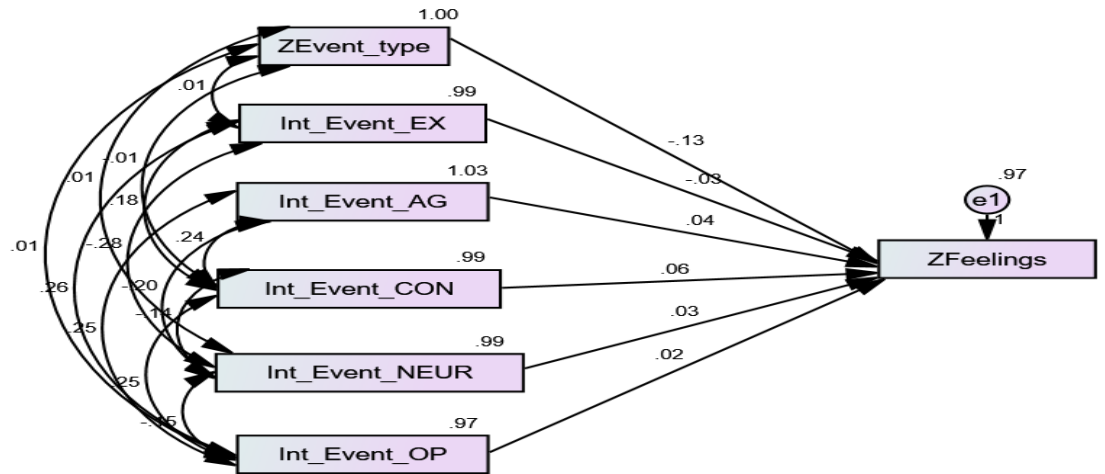
x: input variable  
y: outcome variable  
 $M_2$ : moderating variable  
c: observed direct effect  
d: moderating effect on relationship between variables



**Appendix E: Moderation analysis – Personality factors**

**Impact of Event type on Feelings when moderated by personality factors**

Appendix figure: Impact of Event type on Feelings when moderated by personality factors



Appendix table: Impact of Event type on Feelings when moderated by personality factors

		Standardized Coefficients		R Square	P value
		Beta	SE		
ZFeelings	<--- ZEvent Type	-0.126	0.047	0.124	<b>0.008**</b>
ZFeelings	<--- Int_Event_EX	-0.027	0.052		<b>&lt;0.001***</b>
ZFeelings	<--- Int_Event_AG	0.037	0.050		<b>&lt;0.001***</b>
ZFeelings	<--- Int_Event_CON	0.064	0.051		<b>&lt;0.001***</b>
ZFeelings	<--- Int_Event_NEUR	0.032	0.051		<b>&lt;0.001***</b>
ZFeelings	<--- Int_Event_OP	0.023	0.052		<b>&lt;0.001***</b>

\*\*\*p<0.001, \*\*p<0.01, \*p<0.05

The above table outlines the impact of event type on Feelings when moderated by personality factors. The fit indices reveal a good fit. There is a significant effect of event type on feelings when moderated by personality factors. Hence, there is a significant association between event type, feelings and personality factors.

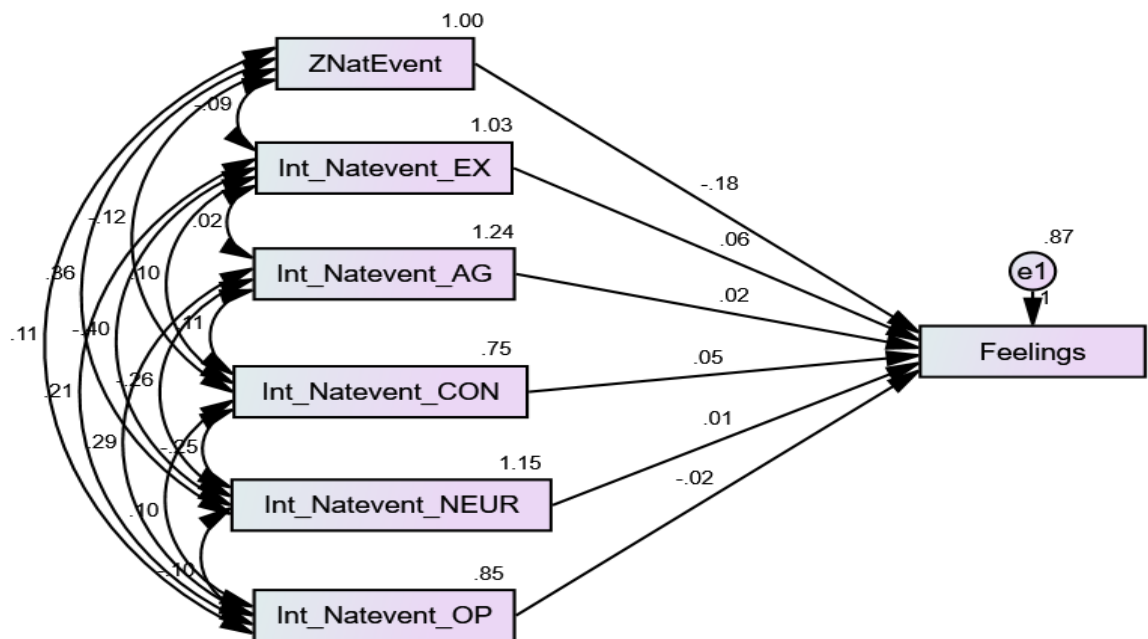
Appendix table: Model fit summary: Impact of Event type on Feelings when moderated by personality factors

Variable	Value	Suggested value
Chi-square value (X2)	3.518	
Degrees of freedom (df)	2	
$\chi^2$ /df	1.759	
P value	0.172	P-value >0.05 (Hair et al., 2006)
GFI	0.998	>0.90 (Hair et al., 2006)
AGFI	0.968	>0.90 (Hair et al., 2006)
NFI	0.982	> 0.90 (Daire et al., 2008)
IFI	0.992	> 0.90 (Bollen, 1989)
CFI	0.991	>0.90 (Hu and Bentler, 1999)
RMR	0.020	< 0.08 (Hair et al., 2006)
RMSEA	0.028	< 0.08 (Hair et al., 2006)

The above table reveals the summary of the model. Within the structural model, the quality of fit was acceptable illustration of the sample data ( $\chi^2(2) = 3.518$ , GFI = 0.998, AGFI = 0.968, CFI = 0.991, NFI = 0.982 and IFI = 0.992, which are greater than the 0.90 criteria. Similarly, RMSEA = 0.028 and RMR = 0.020 which are lower than 0.08 critical value.

## Impact of Nature of Event on feelings when moderated by personality factors

Appendix figure: Impact of Nature of Event on feelings when moderated by personality factors



Appendix figure: Impact of Nature of Event on feelings when moderated by personality factors

		Standardized Coefficients		R Square	P value
		Beta	SE		
Feelings	<--- ZNature of Event	-0.176	0.048	0.044	<0.001***
Feelings	<--- Int_Nature of Event_EX	0.060	0.049		<0.001***
Feelings	<--- Int_Nature of Event_CON	0.048	0.054		<0.001***
Feelings	<--- Int_Nature of Event_NEUR	0.011	0.050		<b>0.029*</b>
Feelings	<--- Int_Nature of Event_OP	-0.018	0.053		<0.001***
Feelings	<--- Int_Nature of Event_AG	0.024	0.043		0.582

\*\*\*p<0.001, \*\*p<0.01, \*p<0.05

The above table outlines the impact of Nature of Event on Feelings when moderated by personality factors. The fit indices reveal a model of good fit. There is a significant impact

of Nature of Event on Feelings when moderated by personality factors. Hence, there is a significant association between nature of event, feelings, and personality factors.

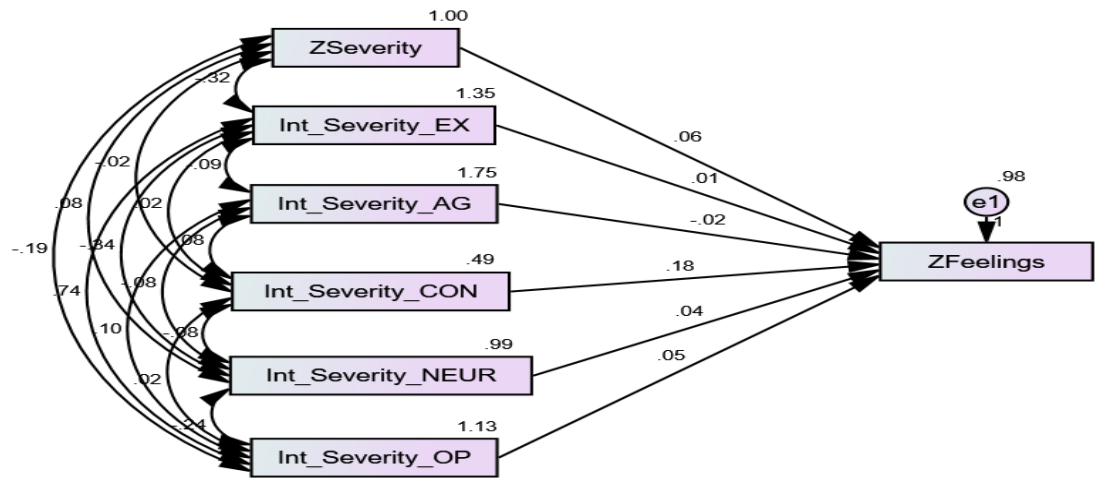
Appendix table: Model fit summary: Impact of nature of event on feelings when moderated by personality factors

Variable	Value	Suggested value
Chi-square value (X <sup>2</sup> )	1.718	
Degrees of freedom (df)	1	
$\chi^2 / df$	1.718	
P value	0.190	P-value >0.05 (Hair et al., 2006)
GFI	0.999	>0.90 (Hair et al., 2006)
AGFI	0.968	>0.90 (Hair et al., 2006)
NFI	0.994	> 0.90 (Daire et al., 2008)
IFI	0.997	> 0.90 (Bollen, 1989)
CFI	0.997	>0.90 (Hu and Bentler, 1999)
RMR	0.015	< 0.08 (Hair et al., 2006)
RMSEA	0.041	< 0.08 (Hair et al., 2006)

The above table reveals the summary of the model. Within the structural model, the quality of fit was acceptable illustration of the sample data ( $\chi^2(1) = 1.718$ , GFI = 0.999, AGFI = 0.968, CFI = 0.997, NFI = 0.994 and IFI = 0.997, which are greater than the 0.90 criteria. Similarly, RMSEA = 0.041 and RMR = 0.015 which are lower than 0.08 critical value.

## Impact of Severity on feelings when moderated by personality factors

Appendix figure: Impact of Severity on feelings when moderated by personality factors



Appendix table: Impact of Severity on feelings when moderated by personality factors

		Standardized Coefficients		R Square	P value
		Beta	SE		
ZFeelings	<--- ZSeverity	0.056	0.049	0.122	<0.001***
ZFeelings	<--- Int_Severity_EX	0.011	0.053		<0.001***
ZFeelings	<--- Int_Severity_CON	0.128	0.068		0.008**
ZFeelings	<--- Int_Severity_NEUR	0.040	0.050		0.029*
ZFeelings	<--- Int_Severity_OP	0.056	0.056		0.047*
ZFeelings	<--- Int_Severity_AG	-0.027	0.036		0.570

\*\*\*p<0.001, \*\*p<0.01, \*p<0.05

The above table outlines the impact of Severity on Feelings when moderated by personality factors. The fit indices reveal a good fit. There is a significant impact of Severity on Feelings when moderated by personality factors. Hence, there is a significant association between severity, feelings, and personality factors.

Appendix table: Model fit summary Impact of Severity on feelings when moderated by personality factors

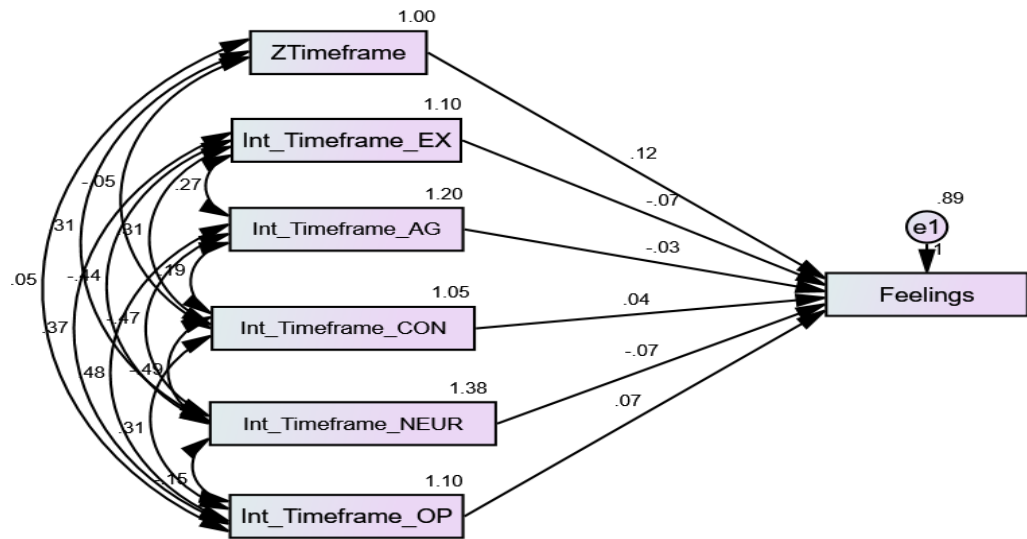
Variable	Value	Suggested value
Chi-square value (X2)	8.158	
Degrees of freedom (df)	2	
$\chi^2 / df$	4.079	
P value	0.004	P-value >0.05 (Hair et al., 2006)

GFI	0.995	>0.90 (Hair et al., 2006)
AGFI	0.952	>0.90 (Hair et al., 2006)
NFI	0.973	> 0.90 (Daire et al., 2008)
IFI	0.976	> 0.90 (Bollen, 1989)
CFI	0.974	>0.90 (Hu and Bentler, 1999)
RMR	0.037	< 0.08 (Hair et al., 2006)
RMSEA	0.028	< 0.08 (Hair et al., 2006)

The above table reveals the summary of the model. Within the structural model, the quality of fit was acceptable illustration of the sample data ( $\chi^2(2) = 8.158$ , GFI = 0.995, AGFI = 0.952, CFI = 0.974, NFI = 0.973 and IFI = 0.976, which are greater than the 0.90 criteria. Similarly, RMSEA = 0.028 and RMR = 0.037 which are lower than 0.08 critical value.

## Impact of Timeframe on feelings when moderated by personality factors

Appendix figure: Impact of Timeframe on feelings when moderated by personality factors



Appendix table: Impact of Timeframe on feelings when moderated by personality factors

		Standardized Coefficients		R Square	P value
		Beta	SE		
Feelings	<--- ZTimeframe	0.124	0.047	0.125	<b>0.013*</b>
Feelings	<--- Int_Timeframe_EX	-0.074	0.049		<b>&lt;0.001***</b>
Feelings	<--- Int_Timeframe_CON	0.038	0.051		<b>&lt;0.001***</b>
Feelings	<--- Int_Timeframe_NEUR	-0.091	0.049		<b>&lt;0.001***</b>
Feelings	<--- Int_Timeframe_OP	0.079	0.051		<b>&lt;0.001***</b>
Feelings	<--- Int_Timeframe_AG	-0.038	0.049		<b>&lt;0.001***</b>

\*\*\*p<0.001, \*\*p<0.01, \*p<0.05

The above table outlines the impact of timeframe on feelings when moderated by personality factors. The fit indices reveal a of good fit. There is a significant impact of timeframe on feelings when moderated by personality factors. Hence, there is an significant association between timeframe, feelings, and personality factors.

Appendix table: Model fit summary: Impact of Timeframe on feelings when moderated by personality factors

Variable	Value	Suggested value
Chi-square value ( $X^2$ )	10.756	

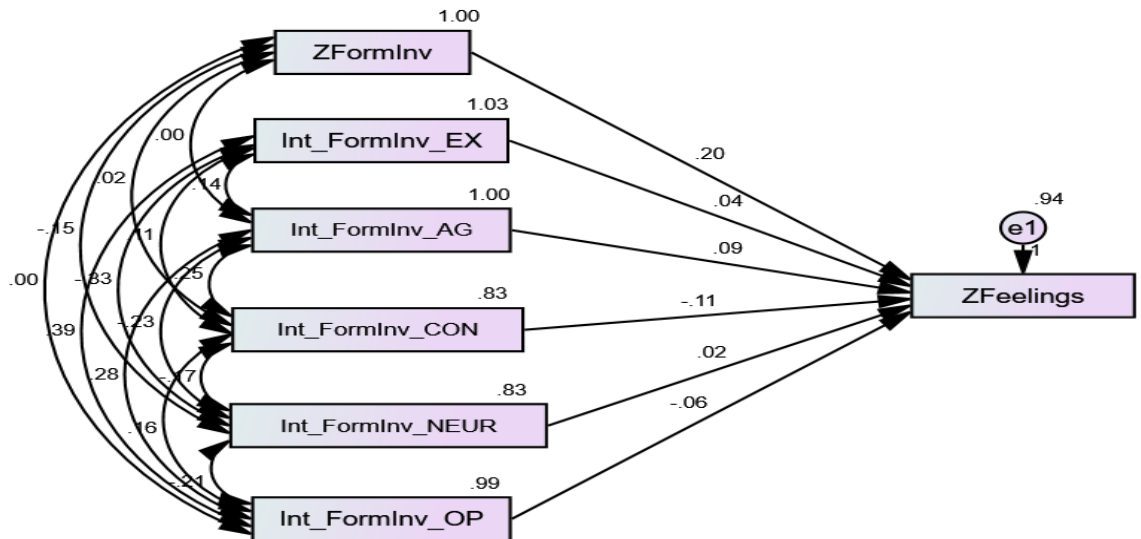
Degrees of freedom (df)	2	
$\chi^2$ /df	5.378	
P value	0.005	P-value >0.05 (Hair et al., 2006)
GFI	0.993	>0.90 (Hair et al., 2006)
AGFI	0.903	>0.90 (Hair et al., 2006)
NFI	0.975	> 0.90 (Daire et al., 2008)
IFI	0.980	> 0.90 (Bollen, 1989)
CFI	0.979	>0.90 (Hu and Bentler, 1999)
RMR	0.037	< 0.08 (Hair et al., 2006)
RMSEA	0.001	< 0.08 (Hair et al., 2006)

The above table reveals the summary of the model. Within the structural model, the quality of fit was acceptable illustration of the sample data ( $\chi^2(2) = 10.756$ , GFI = 0.993, AGFI = 0.903, CFI = 0.979, NFI = 0.975 and IFI = 0.980, which are greater than the 0.90 criteria. Similarly, RMSEA = 0.001 and RMR = 0.037 which are lower than 0.08 critical value.



## Impact of Formal Investigation on feelings when moderated by personality factors

Appendix figure: Impact of Formal Investigation on feelings when moderated by personality factors



Appendix table: Impact of Formal Investigation on feelings when moderated by personality factors

			Standardized		R Square	P value
			Beta	SE		
ZFeelings	<---	ZFormal Investigation	0.200	0.047	0.155	<0.001***
ZFeelings	<---	Int_Formal Investigation_EX	0.046	0.052		0.390
ZFeelings	<---	Int_Formal Investigation_CON	-0.103	0.054		<b>0.036*</b>
ZFeelings	<---	Int_Formal Investigation_NEUR	0.021	0.057		<0.001***
ZFeelings	<---	Int_Formal Investigation_OP	-0.062	0.053		<0.001***
ZFeelings	<---	Int_Formal Investigation_AG	0.090	0.051		<b>0.007**</b>

\*\*\*p<0.001, \*\*p<0.01, \*p<0.05

The above table outlines the impact of Formal Investigation on Feelings when moderated by personality factors. The fit indices reveal a good fit of factors. There is a significant impact of formal investigation on feelings when moderated by personality factors. Hence, there is a significant association between formal investigation, feelings, and personality factors.

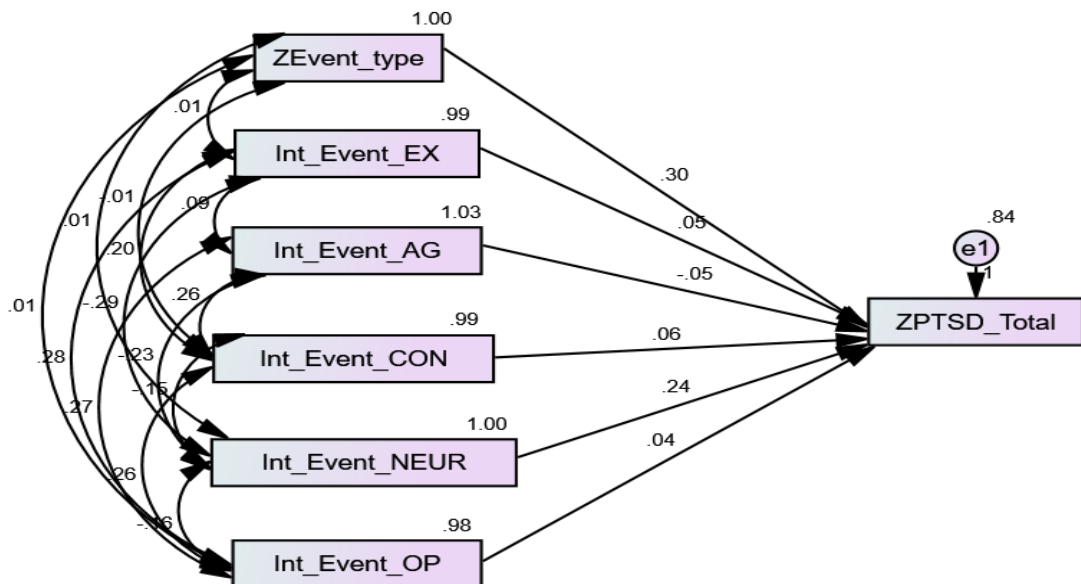
Appendix table: Model fit summary: Impact of Formal Investigation on feelings when moderated by personality factors

Variable	Value	Suggested value
Chi-square value ( $\chi^2$ )	7.513	
Degrees of freedom (df)	1	
$\chi^2$ /df	7.513	
P value	0.006	P-value >0.05 (Hair et al., 2006)
GFI	0.995	>0.90 (Hair et al., 2006)
AGFI	0.963	>0.90 (Hair et al., 2006)
NFI	0.974	> 0.90 (Daire et al., 2008)
IFI	0.977	> 0.90 (Bollen, 1989)
CFI	0.975	>0.90 (Hu and Bentler, 1999)
RMR	0.029	< 0.08 (Hair et al., 2006)
RMSEA	0.022	< 0.08 (Hair et al., 2006)

The above table reveals the summary of the model. Within the structural model, the quality of fit was acceptable illustration of the sample data ( $\chi^2(1) = 7.513$ , GFI = 0.995, AGFI = 0.963, CFI = 0.975, NFI = 0.974 and IFI = 0.977, which are greater than the 0.90 criteria. Similarly, RMSEA = 0.022 and RMR = 0.029 which are lower than 0.08 critical value.

## Impact of Event type on PTS symptomology when moderated by personality factors

Appendix figure: Impact of Event type on PTS symptomology when moderated by personality factors



Appendix table: Impact of Event type on PTS symptomology when moderated by personality factors

			Standardized		R Square	P value
			Beta	SE		
ZPTSD Total	<---	ZEvent Type	0.301	0.044	0.154	<0.001***
ZPTSD Total	<---	Int_Event_EX	0.051	0.048		0.037*
ZPTSD Total	<---	Int_Event_AG	-0.047	0.047		<0.001***
ZPTSD Total	<---	Int_Event_CON	0.063	0.047		0.181
ZPTSD Total	<---	Int_Event_NEUR	0.244	0.047		<0.001***
ZPTSD Total	<---	Int_Event_OP	0.041	0.049		0.023*

\*\*\*p<0.001, \*\*p<0.01, \*p<0.05

The above table outlines the impact of Event type on PTS symptomology when moderated by personality factors. The fit indices reveal a good fit. There is a significant impact of Event type on PTS symptomology when moderated by personality factors. Hence, there is a significant association between Event type, PTS symptomology, and personality factors.

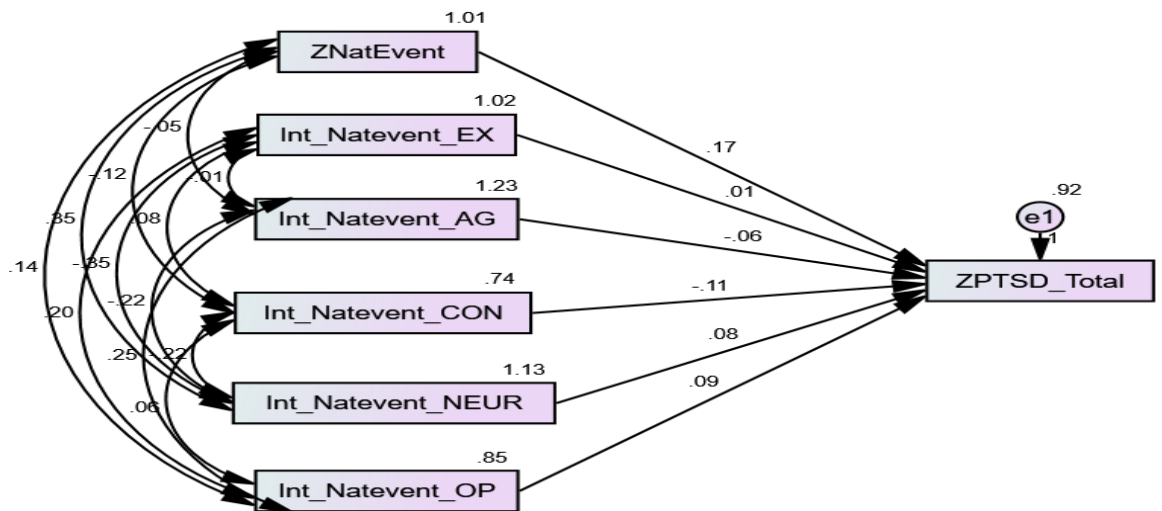
Appendix table: Model fit summary: Impact of Event type on PTS symptomology when moderated by personality factors

Variable	Value	Suggested value
Chi-square value ( $X^2$ )	0.129	
Degrees of freedom (df)	1	
$\chi^2 / df$	0.129	
P value	0.719	P-value >0.05 (Hair et al., 2006)
GFI	0.999	>0.90 (Hair et al., 2006)
AGFI	0.998	>0.90 (Hair et al., 2006)
NFI	0.999	> 0.90 (Daire et al., 2008)
IFI	0.999	> 0.90 (Bollen, 1989)
CFI	0.999	>0.90 (Hu and Bentler, 1999)
RMR	0.004	< 0.08 (Hair et al., 2006)
RMSEA	0.001	< 0.08 (Hair et al., 2006)

The above table reveals the summary of the model. Within the structural model, the quality of fit was acceptable illustration of the sample data ( $\chi^2(1) = 0.129$ , GFI = 0.999, AGFI = 0.998, CFI = 0.999, NFI = 0.999 and IFI = 0.999, which are greater than the 0.90 criteria. Similarly, RMSEA = 0.001 and RMR = 0.004 which are lower than 0.08 critical value.

## Impact of Nature of Event on PTSD symptomology when moderated by personality factors

Appendix figure: Impact of Nature of Event on PTSD symptomology when moderated by personality factors



Appendix table: Impact of Nature of Event on PTSD symptomology when moderated by personality factors

			Standardized Coefficients		R Square	P value
			Beta	SE		
ZPTSD Total	<---	ZNature of Event	0.173	0.050	0.176	<0.001***
ZPTSD Total	<---	Int_Nature of Event_EX	0.010	0.050		0.839
ZPTSD Total	<---	Int_Nature of Event_CON	-0.106	0.055		<b>0.050*</b>
ZPTSD Total	<---	Int_Nature of Event_NEUR	0.076	0.051		<b>0.038*</b>
ZPTSD Total	<---	Int_Nature of Event_OP	0.088	0.054		<b>0.004**</b>
ZPTSD Total	<---	Int_Nature of Event_AG	-0.058	0.044		0.193

\*\*\*p<0.001, \*\*p<0.01, \*p<0.05

The above table outlines the impact of Nature of Event on PTSD symptomology when moderated by personality factors. The fit indices reveal a model of good fit. There is a significant impact of Nature of Event on PTSD symptomology when moderated by personality

factors. Hence, there is a significant association between Nature of Event, PTS symptomology, and personality factors.

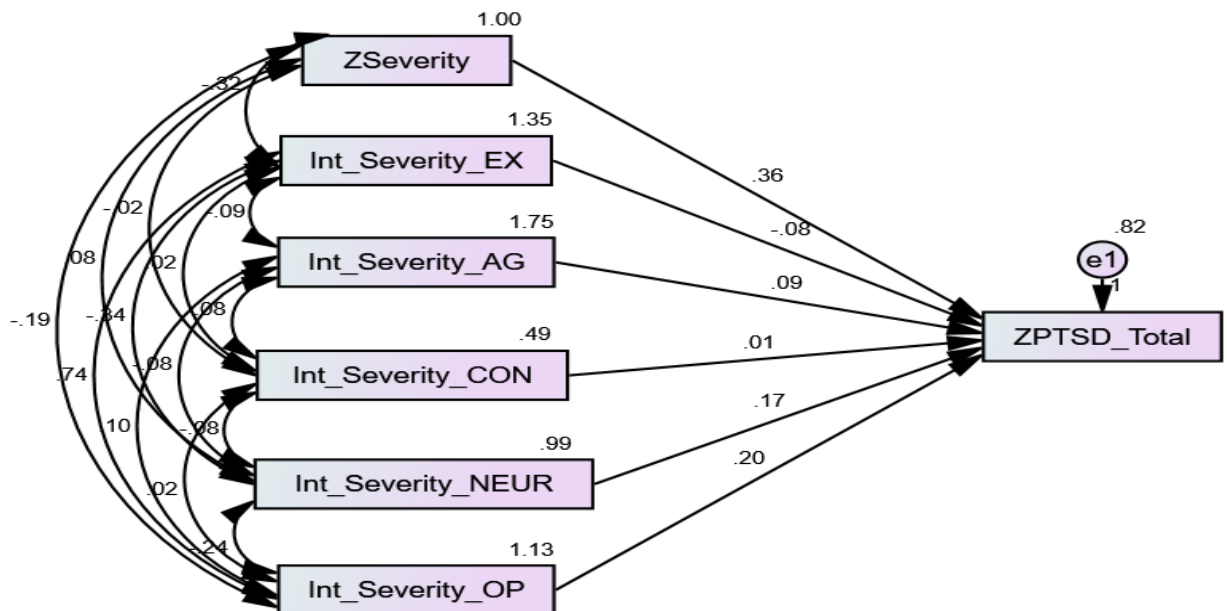
Appendix table: Model fit summary: Impact of Nature of Event on PTS symptomology when moderated by personality factors

Variable	Value	Suggested value
Chi-square value (X <sup>2</sup> )	14.568	
Degrees of freedom (df)	3	
$\chi^2$ /df	4.856	
P value	0.002	P-value >0.05 (Hair et al., 2006)
GFI	0.990	>0.90 (Hair et al., 2006)
AGFI	0.911	>0.90 (Hair et al., 2006)
NFI	0.950	> 0.90 (Daire et al., 2008)
IFI	0.960	> 0.90 (Bollen, 1989)
CFI	0.957	>0.90 (Hu and Bentler, 1999)
RMR	0.044	< 0.08 (Hair et al., 2006)
RMSEA	0.074	< 0.08 (Hair et al., 2006)

The above table reveals the summary of the model. Within the structural model, the quality of fit was acceptable illustration of the sample data ( $\chi^2$  (3)= 14.568, GFI =0.990, AGFI = 0.911, CFI =0.957, NFI = 0.950 and IFI = 0.960, which are greater than the 0.90 criteria . Similarly, RMSEA =0.074 and RMR =0.044 which are lower than 0.08 critical value.

## Impact of Severity on PTS symptomology when moderated by personality factors

Appendix figure: Impact of Severity on PTS symptomology when moderated by personality factors



Appendix table: Impact of Severity on PTS symptomology when moderated by personality factors

			Standardized Coefficients		R Square	P value
			Beta	SE		
ZPTSD Total	<---	ZSeverity	.353	.045	0.192	<0.001***
ZPTSD Total	<---	Int_Severity_EX	-.095	.049		0.093
ZPTSD Total	<---	Int_Severity_CON	.010	.062		<b>0.014*</b>
ZPTSD Total	<---	Int_Severity_NEUR	.171	.046		<0.001***
ZPTSD Total	<---	Int_Severity_OP	.210	.051		<0.001***
ZPTSD Total	<---	Int_Severity_AG	.113	.033		<b>0.010*</b>

\*\*\*p<0.001, \*\*p<0.01, \*p<0.05

The above table outlines the impact of Severity on PTS symptomology when moderated by personality factors. The fit indices reveal a good fit. There is a significant impact of Severity on PTS symptomology when moderated by personality factors. Hence, there is a significant association between Severity, PTS symptomology, and personality factors.

Appendix table: Model fit summary: Impact of Severity on PTS symptomology when moderated by personality factors

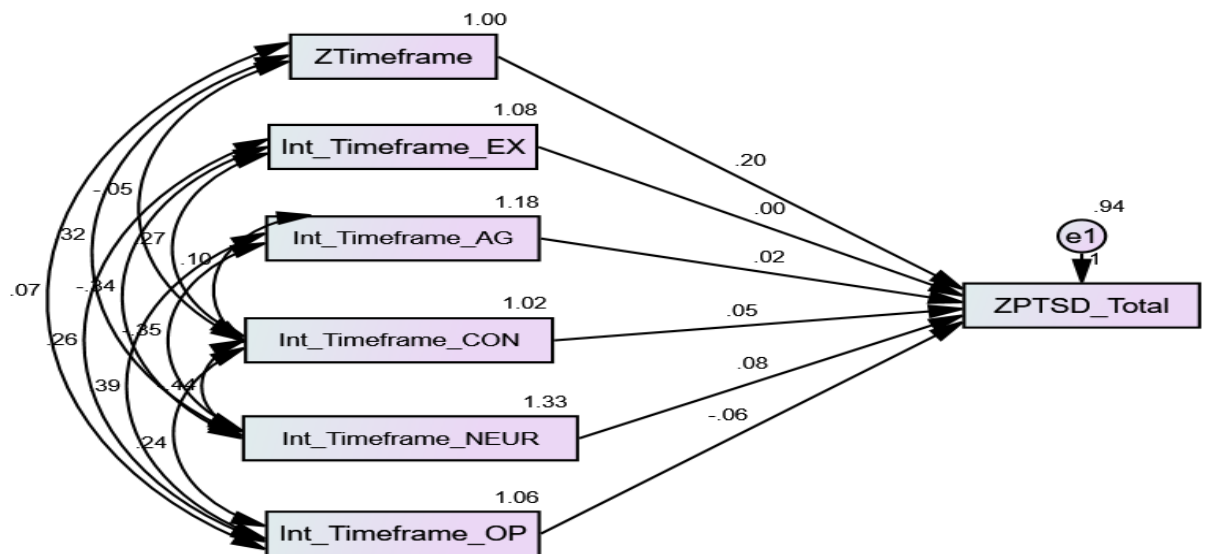
Variable	Value	Suggested value
Chi-square value (X <sup>2</sup> )	8.158	
Degrees of freedom (df)	1	
$\chi^2$ /df	8.158	
P value	0.004	P-value >0.05 (Hair et al., 2006)
GFI	0.995	>0.90 (Hair et al., 2006)
AGFI	0.952	>0.90 (Hair et al., 2006)
NFI	0.978	> 0.90 (Daire et al., 2008)
IFI	0.981	> 0.90 (Bollen, 1989)
CFI	0.980	>0.90 (Hu and Bentler, 1999)
RMR	0.039	< 0.08 (Hair et al., 2006)
RMSEA	0.028	< 0.08 (Hair et al., 2006)

The above table reveals the summary of the model. Within the structural model, the quality of fit was acceptable illustration of the sample data ( $\chi^2(1) = 8.158$ , GFI = 0.995, AGFI = 0.952, CFI = 0.980, NFI = 0.978 and IFI = 0.981, which are greater than the 0.90 criteria. Similarly, RMSEA = 0.028 and RMR = 0.039, which are lower than 0.08 critical value.



## Impact of Timeframe on PTS symptomology when moderated by personality factors

Appendix figure: Impact of Timeframe on PTS symptomology when moderated by personality factors



Appendix table: Impact of Timeframe on PTS symptomology when moderated by personality factors

		Standardized Coefficients		R Square	P value
		Beta	SE		
ZPTSD Total	<--- ZTimeframe	0.199	0.049	0.156	<0.001***
ZPTSD Total	<--- Int_Timeframe_EX	0.001	0.050		0.987
ZPTSD Total	<--- Int_Timeframe_CON	0.048	0.052		0.358
ZPTSD Total	<--- Int_Timeframe_NEUR	0.094	0.050		<b>0.006**</b>
ZPTSD Total	<--- Int_Timeframe_OP	-0.065	0.052		<b>0.030*</b>
ZPTSD Total	<--- Int_Timeframe_AG	0.021	0.049		<0.001***

\*\*\*p<0.001, \*\*p<0.01, \*p<0.05

The above table outlines the impact of Timeframe on PTS symptomology when moderated by personality factors. The fit indices reveal a model of good fit. There is a significant impact of Timeframe on PTS symptomology when moderated by personality factors. Hence, there is a significant association between Timeframe, PTS symptomology, and personality factors.

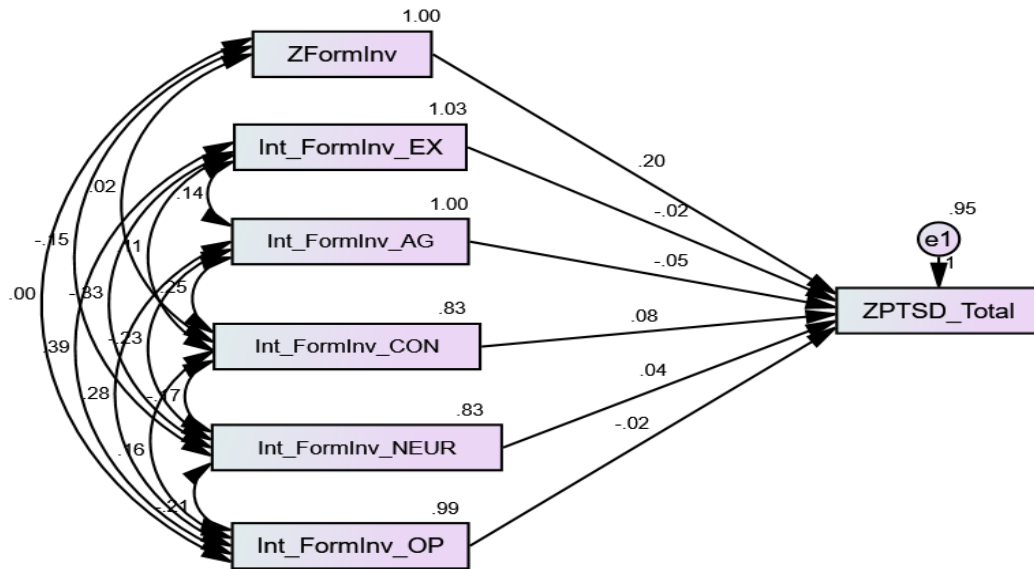
Appendix table: Model fit summary: Impact of Timeframe on PTS symptomology when moderated by personality factors

Variable	Value	Suggested value
Chi-square value (X <sup>2</sup> )	38.863	
Degrees of freedom (df)	8	
$\chi^2$ /df	4.851	
P value	0.000	P-value >0.05 (Hair et al., 2006)
GFI	0.975	>0.90 (Hair et al., 2006)
AGFI	0.926	>0.90 (Hair et al., 2006)
NFI	0.914	> 0.90 (Daire et al., 2008)
IFI	0.922	> 0.90 (Bollen, 1989)
CFI	0.919	>0.90 (Hu and Bentler, 1999)
RMR	0.008	< 0.08 (Hair et al., 2006)
RMSEA	0.042	< 0.08 (Hair et al., 2006)

The above table reveals the summary of the model. Within the structural model, the quality of fit was acceptable illustration of the sample data ( $\chi^2$  (8)= 38.863, GFI =0.975, AGFI = 0.926, CFI =0.919, NFI = 0.914 and IFI = 0.922, which are greater than the 0.90 criteria. Similarly, RMSEA =0.042 and RMR =0.008, which are lower than 0.08 critical value.

**Impact of Formal Investigation on PTS symptomology when moderated by personality factors**

Appendix figure: Impact of Formal Investigation on PTS symptomology when moderated by personality factors



Appendix table: Impact of Formal Investigation on PTS symptomology when moderated by personality factors

		Standardized Coefficients		R Square	P value
		Beta	SE		
ZPTSD Total	<--- ZFormal Investigation	0.196	0.048	0.146	<0.001***
ZPTSD Total	<--- Int_Formal Investigation_EX	-0.025	0.053		<0.001***
ZPTSD Total	<--- Int_Formal Investigation_CON	0.077	0.054		0.019*
ZPTSD Total	<--- Int_Formal Investigation_NEUR	0.038	0.058		0.471
ZPTSD Total	<--- Int_Formal Investigation_OP	-0.016	0.053		<0.001***
ZPTSD Total	<--- Int_Formal Investigation_AG	-0.045	0.051		0.026*

\*\*\*p<0.001, \*\*p<0.01, \*p<0.05

The above table outlines the impact of Formal Investigation on PTS symptomology when moderated by personality factors. The fit indices reveal a good fit for the model. There is a significant impact of Formal Investigation on PTS symptomology when moderated by

personality factors. Hence, there is a significant association between Formal Investigation, PTS symptomology, and personality factors.

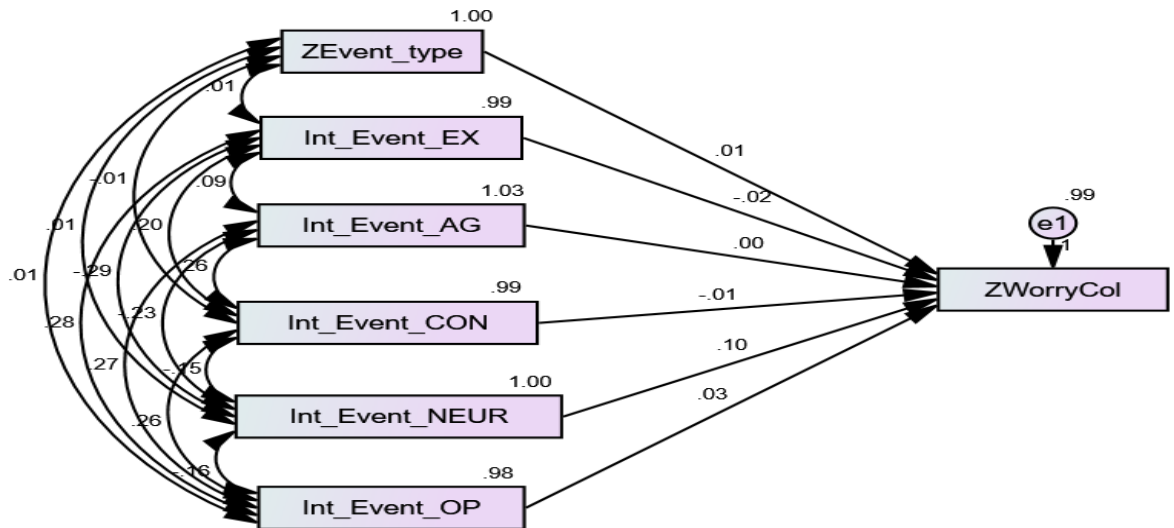
Appendix table: Model fit summary: Impact of Formal Investigation on PTS symptomology when moderated by personality factors

Variable	Value	Suggested value
Chi-square value ( $\chi^2$ )	7.513	
Degrees of freedom (df)	2	
$\chi^2 / df$	3.757	
P value	0.023	P-value >0.05 (Hair et al., 2006)
GFI	0.995	>0.90 (Hair et al., 2006)
AGFI	0.932	>0.90 (Hair et al., 2006)
NFI	0.973	> 0.90 (Daire et al., 2008)
IFI	0.980	> 0.90 (Bollen, 1989)
CFI	0.979	>0.90 (Hu and Bentler, 1999)
RMR	0.029	< 0.08 (Hair et al., 2006)
RMSEA	0.080	< 0.08 (Hair et al., 2006)

The above table reveals the summary of the model. Within the structural model, the quality of fit was acceptable illustration of the sample data ( $\chi^2(2) = 7.513$ , GFI = 0.995, AGFI = 0.932, CFI = 0.979, NFI = 0.973 and IFI = 0.980, which are greater than the 0.90 criteria. Similarly, RMSEA = 0.080 and RMR = 0.029, which are lower than 0.08 critical value.

**Impact of Event type on Worry about colleagues when moderated by personality factors**

Appendix figure: Impact of Event type on Worry about colleagues when moderated by personality factors



Appendix table: Impact of Event type on Worry about colleagues when moderated by personality factors

			Standardized Coefficients		R Square	P value
			Beta	SE		
ZWorry about colleagues	<---	ZEvent Type	0.015	0.048		<0.001***
ZWorry about colleagues	<---	Int_Event_EX	-0.018	0.052		<0.001***
ZWorry about colleagues	<---	Int_Event_CON	-0.010	0.051		<0.001***
ZWorry about colleagues	<---	Int_Event_NEUR	0.104	0.051	0.013	0.041*
ZWorry about colleagues	<---	Int_Event_OP	0.029	0.053		0.578
ZWorry about colleagues	<---	Int_Event_AG	-0.005	0.051		0.026*

\*\*\*p<0.001, \*\*p<0.01, \*p<0.05

The above table outlines the impact of event type on worry about colleagues when moderated by personality factors. The fit indices reveal a model of good fit. There is a significant impact of event type on worry about colleagues when moderated by personality

factors. Hence, there is an significant association between event type, worry about colleagues and personality factors.

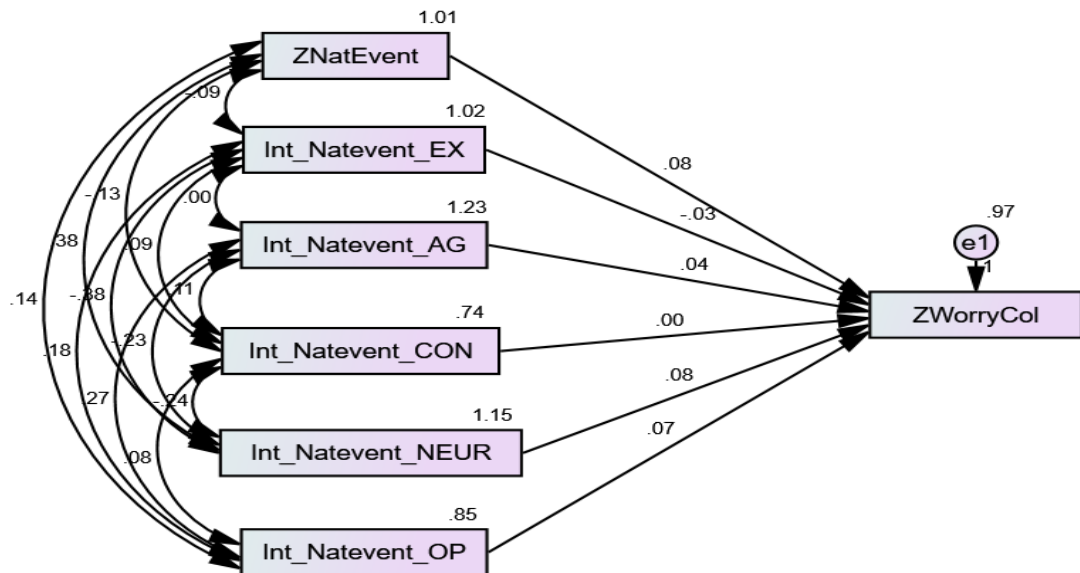
Appendix table: Model fit summary: Impact of Event type on Worry about colleagues when moderated by personality factors

Variable	Value	Suggested value
Chi-square value (X2)	0.129	
Degrees of freedom (df)	1	
$\chi^2 / df$	0.129	
P value	0.719	P-value >0.05 (Hair et al., 2006)
GFI	0.999	>0.90 (Hair et al., 2006)
AGFI	0.998	>0.90 (Hair et al., 2006)
NFI	0.999	> 0.90 (Daire et al., 2008)
IFI	0.999	> 0.90 (Bollen, 1989)
CFI	0.999	>0.90 (Hu and Bentler, 1999)
RMR	0.004	< 0.08 (Hair et al., 2006)
RMSEA	0.001	< 0.08 (Hair et al., 2006)

The above table reveals the summary of the model. Within the structural model, the quality of fit was an acceptable illustration of the sample data ( $\chi^2(1) = 0.129$ , GFI = 0.999, AGFI = 0.998, CFI = 0.999, NFI = 0.999 and IFI = 0.999, which are greater than the 0.90. Similarly, RMSEA = 0.004 and RMR = 0.004, which are lower than 0.08 critical value.

**Impact of nature of event on worry about colleagues when moderated by personality factors**

Appendix figure: Impact of Nature of Event on Worry about colleagues when moderated by personality factors



Appendix table: Impact of Nature of Event on Worry about colleagues when moderated by personality factors

			Standardized Coefficients		R Square	P value
			Beta	SE		
ZWorry about colleagues	<---	ZNature of Event	.077	.051	0.127	<0.001***
ZWorry about colleagues	<---	Int_Nature of Event_EX	-.026	.052		0.024*
ZWorry about colleagues	<---	Int_Nature of Event_CON	.001	.057		<0.001***
ZWorry about colleagues	<---	Int_Nature of Event_NEUR	.084	.053		0.138
ZWorry about colleagues	<---	Int_Nature of Event_OP	.061	.056		0.233
ZWorry about colleagues	<---	Int_Nature of Event_AG	.046	.046		<0.001***

	Standardized Coefficients Beta	SE	R Square	P value
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\*\*\*p<0.001, \*\*p<0.01, \*p<0.05

The above table outlines the impact of Nature of Event on Worry about colleagues when moderated by personality factors, a structural equation model was used. The fit indices reveal a model of good fit. There is a significant impact of nature of event on worry about colleagues when moderated by personality factors. Hence, there is an significant association between nature of event, worry about colleagues and personality factors.

Appendix table: Model fit summary: Impact of Nature of Event on Worry about colleagues when moderated by personality factors

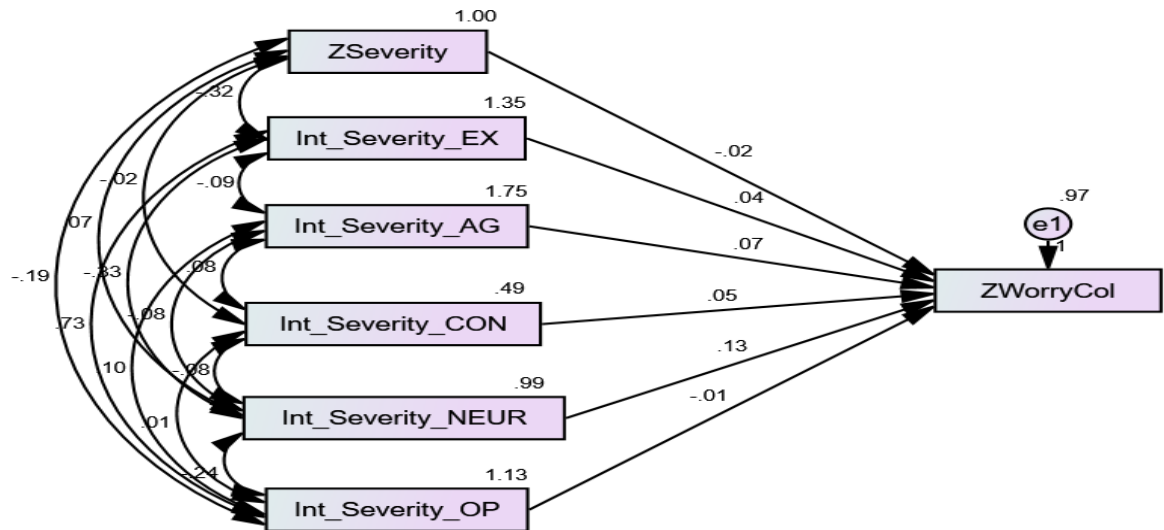
Variable	Value	Suggested value
Chi-square value ( $X^2$ )	6.367	
Degrees of freedom (df)	2	
$\chi^2$ /df	3.183	
P value	0.041	P-value >0.05 (Hair et al., 2006)
GFI	0.996	>0.90 (Hair et al., 2006)
AGFI	0.942	>0.90 (Hair et al., 2006)
NFI	0.976	> 0.90 (Daire et al., 2008)
IFI	0.984	> 0.90 (Bollen, 1989)
CFI	0.982	>0.90 (Hu and Bentler, 1999)
RMR	0.030	< 0.08 (Hair et al., 2006)
RMSEA	0.071	< 0.08 (Hair et al., 2006)

The above table reveals the summary of the model. Within the structural model, the quality of fit was acceptable illustration of the sample data ( $\chi^2(2) = 6.367$ , GFI = 0.996, AGFI = 0.942, CFI = 0.982, NFI = 0.976 and IFI = 0.984, which are greater than the 0.90 criteria. Similarly, RMSEA = 0.071 and RMR = 0.030, which are lower than 0.08 critical value.



## Impact of Severity on Worry about colleagues when moderated by personality factors

Appendix figure: Impact of Severity on Worry about colleagues when moderated by personality factors



Appendix table: Impact of Severity on Worry about colleagues when moderated by personality factors

			Standardized Coefficients		R Square	P value
			Beta	SE		
ZWorry about colleagues	<---	ZSeverity	-0.018	0.049		<b>0.016*</b>
ZWorry about colleagues	<---	Int_Severity_EX	0.049	0.053		<b>0.029*</b>
ZWorry about colleagues	<---	Int_Severity_CON	0.036	0.068	0.023	<b>0.053*</b>
ZWorry about colleagues	<---	Int_Severity_NEUR	0.128	0.050		<b>0.011*</b>
ZWorry about colleagues	<---	Int_Severity_OP	-0.007	0.056		<b>0.013*</b>
ZWorry about colleagues	<---	Int_Severity_AG	0.090	0.036		0.062

\*\*\*p<0.001, \*\*p<0.01, \*p<0.05

The above table outlines the impact of Severity on Worry about colleagues when moderated by personality factors, a structural equation model was used. The fit indices reveal a model of good fit. There is a significant impact of Severity on Worry about colleagues when

moderated by personality factors. Hence, there is an significant association between Severity, Worry about colleagues and personality factors.

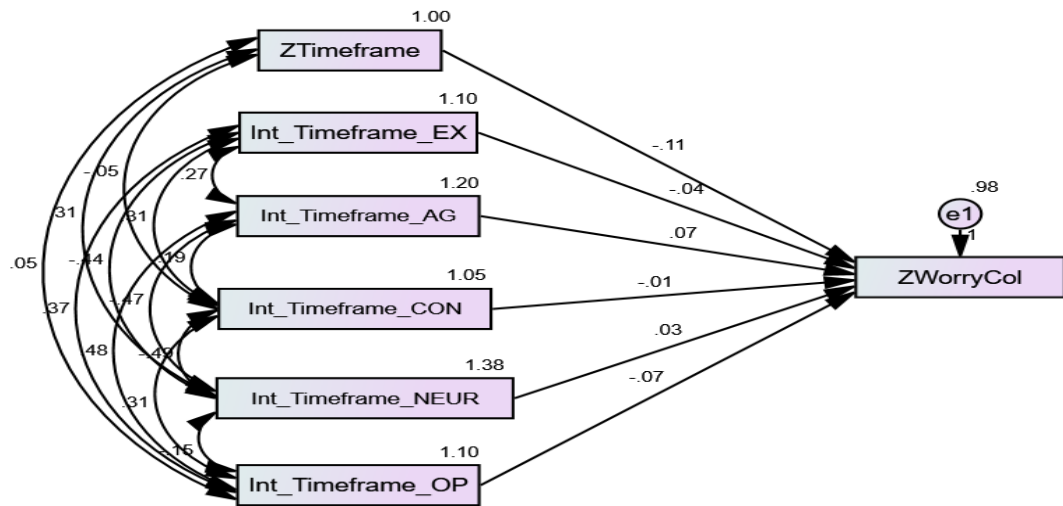
Appendix table: Model fit summary: Impact of Severity on Worry about colleagues when moderated by personality factors

Variable	Value	Suggested value
Chi-square value ( $X^2$ )	8.514	
Degrees of freedom (df)	2	
$\chi^2$ /df	4.257	
P value	0.014	P-value >0.05 (Hair et al., 2006)
GFI	0.994	>0.90 (Hair et al., 2006)
AGFI	0.923	>0.90 (Hair et al., 2006)
NFI	0.972	> 0.90 (Daire et al., 2008)
IFI	0.978	> 0.90 (Bollen, 1989)
CFI	0.977	>0.90 (Hu and Bentler, 1999)
RMR	0.038	< 0.08 (Hair et al., 2006)
RMSEA	0.077	< 0.08 (Hair et al., 2006)

The above table reveals the summary of the model. Within the structural model, the quality of fit was acceptable illustration of the sample data ( $\chi^2(2) = 8.514$ , GFI = 0.994, AGFI = 0.923, CFI = 0.977, NFI = 0.972 and IFI = 0.978, which are greater than the 0.90 criteria. Likewise, RMSEA = 0.077 and RMR = 0.038, which are lower than 0.08 critical value.

## Impact of Timeframe on Worry about colleagues when moderated by personality factors

Appendix figure: Impact of Timeframe on Worry about colleagues when moderated by personality factors



Appendix table: Impact of Timeframe on Worry about colleagues when moderated by personality factors

		Standardized Coefficients		R Square	P value
		Beta	SE		
ZWorry about colleagues	<--- ZTimeframe	-0.108	0.050		<b>0.030*</b>
ZWorry about colleagues	<--- Int_Timeframe_EX	-0.043	0.052		0.430
ZWorry about colleagues	<--- Int_Timeframe_CON	-0.007	0.053	0.020	<b>&lt;0.001***</b>
ZWorry about colleagues	<--- Int_Timeframe_NEUR	0.036	0.051		<b>&lt;0.001***</b>
ZWorry about colleagues	<--- Int_Timeframe_OP	-0.069	0.054		<b>0.020*</b>

		Standardized Coefficients		R Square	P value
		Beta	SE		
ZWorry about colleagues	<--- Int_Timeframe_AG	0.075	0.051		0.180

\*\*\*p<0.001, \*\*p<0.01, \*p<0.05

The above table outlines the impact of severity on worry about colleagues, when moderated by personality factors. The fit indices reveal a good fit. There is a significant effect of severity on worry about colleagues when moderated by personality factors. Hence, there is a significant association between severity, worry about colleagues and personality factors.

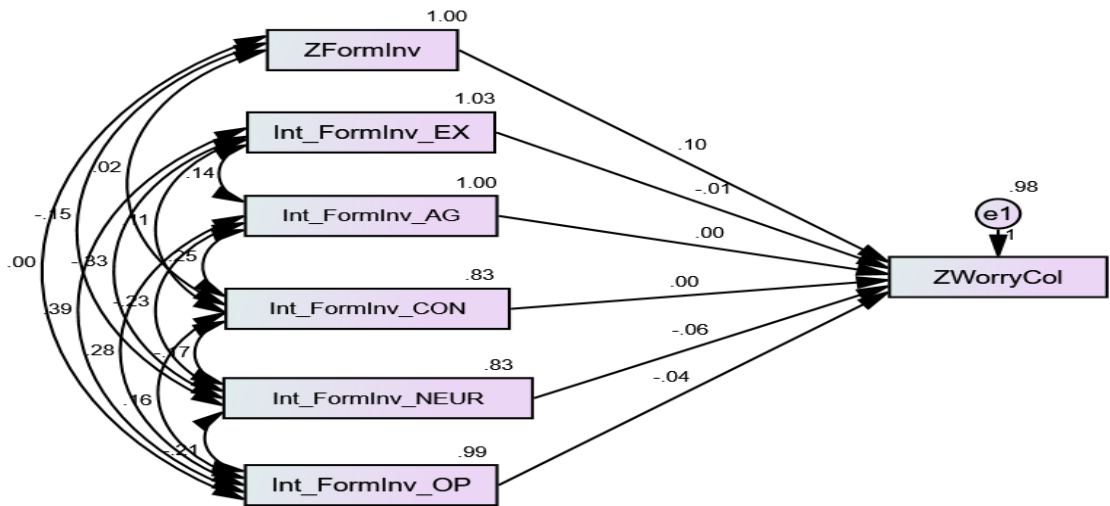
Appendix table: Model fit summary: Impact of Timeframe on Worry about colleagues when moderated by personality factors

Variable	Value	Suggested value
Chi-square value ( $\chi^2$ )	10.756	
Degrees of freedom (df)	2	
$\chi^2$ /df	5.378	
P value	0.005	P-value >0.05 (Hair et al., 2006)
GFI	0.993	>0.90 (Hair et al., 2006)
AGFI	0.903	>0.90 (Hair et al., 2006)
NFI	0.975	> 0.90 (Daire et al., 2008)
IFI	0.980	> 0.90 (Bollen, 1989)
CFI	0.979	>0.90 (Hu and Bentler, 1999)
RMR	0.037	< 0.08 (Hair et al., 2006)
RMSEA	0.025	< 0.08 (Hair et al., 2006)

The above table reveals the summary of the model. Within the structural model, the quality of fit was acceptable illustration of the sample data ( $\chi^2$  (2)= 10.756, GFI =0.993, AGFI = 0.903, CFI =0.979, NFI = 0.975 and IFI = 0.980, which are greater than the 0.90 criteria. Likewise, RMSEA =0.025 and RMR =0.037, which are lower than 0.08 critical value.

## Impact of formal Investigation on Worry about colleagues when moderated by personality factors

Appendix figure: Impact of formal investigation on worry about colleagues when moderated by personality factors



Appendix table: Impact of formal investigation on worry about colleagues when moderated by personality factors

		Standardized Coefficients		R Square	P value
		Beta	SE		
ZWorry about colleagues	<--- ZFormal Investigation	0.095	0.048		<b>0.049*</b>
ZWorry about colleagues	<--- Int_Formal Investigation_EX	-0.012	0.053		<b>&lt;0.001***</b>
ZWorry about colleagues	<--- Int_Formal Investigation_CON	0.000	0.055		0.993
ZWorry about colleagues	<--- Int_Formal Investigation_NEUR	-0.057	0.059	0.140	<b>&lt;0.001***</b>
ZWorry about colleagues	<--- Int_Formal Investigation_OP	-0.036	0.054		<b>&lt;0.001***</b>
ZWorry about colleagues	<--- Int_Formal Investigation_AG	-0.001	0.052		<b>0.012*</b>

\*\*\*p<0.001, \*\*p<0.01, \*p<0.05

The above table outlines the impact of formal investigation on worry about colleagues when moderated by personality factors. The fit indices reveal a good model fit. There is a significant effect of formal investigation on worry about colleagues when moderated by personality factors. Hence, there is a significant association between formal investigation on worry about colleagues and personality factors.

Appendix table: Model fit summary Impact of Formal Investigation on Worry about colleagues when moderated by personality factors

Variable	Value	Suggested value
Chi-square value ( $\chi^2$ )	7.513	
Degrees of freedom (df)	2	
$\chi^2 / df$	3.757	
P value	0.023	P-value >0.05 (Hair et al., 2006)
GFI	0.995	>0.90 (Hair et al., 2006)
AGFI	0.932	>0.90 (Hair et al., 2006)
NFI	0.972	> 0.90 (Daire et al., 2008)
IFI	0.979	> 0.90 (Bollen, 1989)
CFI	0.978	>0.90 (Hu and Bentler, 1999)
RMR	0.029	< 0.08 (Hair et al., 2006)
RMSEA	0.080	< 0.08 (Hair et al., 2006)

The above table reveals the summary of the model. Within the structural model, the quality of fit was acceptable illustration of the sample data ( $\chi^2(2) = 7.513$ , GFI = 0.995, AGFI = 0.932, CFI = 0.978, NFI = 0.972 and IFI = 0.979, which are greater than the 0.90 criteria. Likewise, RMSEA = 0.080 and RMR = 0.029, which are lower than 0.08 critical value.

Appendix F: Detailed SEM

