

**Research Proposal for Confirmation of Candidature**

University of Southern Queensland

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| Title; | Threat versus challenge: cognitive appraisal and stress response comparisons of final year paramedicine students |
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Research Protocol

# Title

Threat versus challenge: cognitive appraisal and stress response comparisons of final year paramedicine students.

# Aims

The broad aims of this study are (a) to evaluate and compare the cognitive decision-making processes and stress responses of final year paramedicine students when managing high acuity scenarios, (b) to assess if learning and targeted skills training can allow these novice clinicians to move their mindset to enable and encourage the appraisal of a ‘challenge’ state when faced with high stress clinical scenarios, and (c) to develop a training package for undergraduate paramedicine students that can be adopted by higher education providers.

# Research question

* Does teaching challenge appraisal as a skill improve clinical performance with novice paramedicine students?

## Sub questions

* How much stress is attributed to clinical decision-making in paramedicine students approaching the beginning of their careers?
* Does stress mitigation / challenge adoption improve clinical outcomes in simulated high acuity scenarios?

# Introduction / Literature Review

Within the biopsychosocial model, undergraduate paramedicine students evaluate the demands of a high-acuity scenario and then determine if they possess the necessary cognitive and technical resources to complete the scenario to a required standard. High acuity scenarios depict a high severity of illness or injury and often present as a stressful situation for attending trainees (Chrimes, 2016). If the student feels they lack resources to meet the demands of the scenario, then a state of *threat* appraisal occurs. However, if resources are perceived to sufficiently meet the demands of the scenario, then a state of *challenge* appraisal emerges. Threat is correlated with ‘losses’, or poor performance; whereas challenge has linkages to promotion or perceived ‘gains’ (Sassenberg, Sassenrath, & Fetterman, 2015). Positive and negative emotions can occur in a challenge state while a threat state is associated with negative emotions only (Jones et al., 2009). The appraisal of the situation as a threat or challenge may be linked to the perceived stress of the upcoming situation, with researchers identifying patterns of cardiovascular responses correlated to the level of stress exhibited (Tomaka et al., 1993; Tomaka et al., 1997). Blascovich (2013) proposes that while threat and challenge both involve physiological and psychological movement toward goal achievement, threat state is likely to be more variable, fragile, and stressful of the two. Importantly, research from psychology demonstrates that a challenge mindset enhances performance, whilst threat has been shown to hinder performance during stressful situations (Blascovich et al., 2004; Mendes et al., 2007; Seery et al., 2010). Classic research from Lazarus and Folkman (1984) demonstrates that individuals who appraise situations as a challenge are more likely to exhibit confidence and are less likely to be emotionally overwhelmed than those in a threat appraisal state of mind.

A systematic literature conducted by Hase et al. (2019) concluded that a challenge state had clear benefits on performance is sport, business and education. However, little research examines the concepts of threat and challenge relative to experience in the field of healthcare. Harvey et al. (2010) studied a small group of emergency medicine and general surgery junior medical residents in Toronto – concluding that the acute stress response witnessed in high acuity events was likely to impair performance. In the field of paramedicine, there is relatable research demonstrating that experienced paramedics make significantly more drug calculation errors following exposure to a stressful event (LeBlanc et al., 2005) and paramedics also produced poorer performance in high-acuity scenarios (Leblanc et al., 2012). Of note, Harvey et al. (2010), Leblanc et al. (2012) and more recently Hase et al. (2019) have all recommended that training in high acuity areas of medicine should include challenge-promoting interventions specifically relevant to stress mitigation.

Training of paramedics in Australia has progressively moved from a post-employment vocational training model in the latter part of the 20th century to now sitting firmly within the pre-employment tertiary education sector (Hou, Rego, & Service, 2013). Alongside this, and with the recognition of the paramedic as a Registered Health Professional within the Australian Health Practitioner Regulation Agency (AHPRA) (O'Meara & Duthie, 2018), education has also evolved away from a heavy emphasis on rote learning of clinical practice guidelines and treatment protocols to incorporate cultural, cognitive and emotional readiness of the paramedic graduate (O’Brien et al., 2014). The science of decision-making relative to expertise has also been well studied (Ericsson, 2005; Patel, Glaser, & Arocha, 2000), and novice clinicians are known to perceive high acuity scenarios as stressful situations (Jimenez, Navia-Osorio, & Diaz, 2010). A study of 30 university students assessed salivary cortisol, demonstrating higher cortisol levels post stress exposure correlated with an increased level of memory impairment leading to poorer performance (Takahashi et al., 2004). This has led higher education providers to incorporate specific stress mitigation and coping strategies to assist their student cohorts as part of their curriculum delivery model. But to date little research exists as to how successful these are in improving clinical performance. In the general realm of university paramedicine students, research has been conducted in relation to empathy (Williams, Boyle, & Earl, 2013), prevention of mental health and psychological disorders (Wild et al., 2018), workplace violence (Boyle & McKenna, 2017), physical characteristics (Davies, Naidoo, & Parr, 2008) and pre-employment fitness testing (Thornton & Sayers, 2014), but nothing involving cognitive decision-making under stress. Given the inter-relationship between acute stress and the degradation of cognitive decision-making ability, further research is warranted to characterise this physiological response in undergraduate paramedicine students.

I purpose that sub-optimal patient care may be delivered by the ‘threatened’ student in both the simulated and the clinical practicum setting. Furthermore, both Harvey et al. (2010) and more recently Hase et al. (2019) have recommended that training in high acuity areas of medicine should include challenge-promoting interventions specifically relevant to stress mitigation. Therefore, targeted-education packages must be explored and developed that prioritise challenge state in novice paramedicine students.

# Proposed Research Method

## Study type/design

### Type / design

This quantitative study is based on experimental research design utilising pre-test post-test control group design incorporating a randomized control trial of a ‘control arm’ and an ‘intervention arm’, detailed below. Centred around the research theory of Behaviourism, learning requiring a recall of facts, defining concepts, or automatically performing a

physical skill or task can be directly applied to simulation-based learning activities with a focus on psychomotor skills (Ross, 2021). An initial pilot study (Study 1) involving ten (10) participants will be undertaken in late 2023 / early 2024 as a means of evaluating the methodology and equipment. Qualitative data (interviews / subjective questionnaires), will be undertaken to refine the protocol for Study 2.

### Setting

Participants will perform the scenarios at The Australian Catholic University on the St Patrick’s campus, Melbourne.

### Intervention

Targeted, individualized training will be provided to participants in the intervention arm (see below). This training package will involve online / app-based clinical and skills-based prompts that will be specific to the confidence level indicated via Likert scale. This means that a participant will select a number on the Likert scale to the demand / resource questions asked, with a specific level of targeted training provided based on each participants’ individual answers. The training interventions will range from short 5-10 second prompts for high resource / low demand answers, to longer 20-30 second prompts incorporating videos / images / flow charts tailored to low resource / high demand answers. These training interventions will be developed in collaboration with TacMed, an industry leader in comprehensive and immersive training of medical first responders. The intention of the training is that one package will be accessed each day by the participant over a 7 day period. If a package is not accessed on a specified day, the participant will be notified by email and SMS to complete that training package. Each package should only take 10-15 mins to complete and is designed to be repetitive learning. Repetition of cognitive and psychomotor skills in health education is vital to improve knowledge and minimise risk to patients (Motola et al., 2013).

### Control Arm

Participants undertake a high-acuity scenario with quantitative assessments pre and post scenario. Seven days later, the same participants will complete a different but equivalent scenario without any external intervention. Participants serve as their own control and are assessed pre and post scenario in both occurrences.

### Intervention Arm

Participants undertake a high-acuity scenario with quantitative assessments pre and post scenario. Across the following days, training and education will be provided to establish a challenge mindset in the participants. Seven days after the original scenario, the same participants will complete a different but equivalent scenario. Participants serve as their own control and are assessed pre and post scenario in both occurrences.

## Participants

### Sampling

Students from the Australian Catholic University (ACU) enrolled in Bachelor of paramedicine (BP) undertake high acuity scenario-based leaning as part of their education. Promotion of the study will include presentations to students at ACU and information on the ACU student paramedicine society Facebook page. Participants will register their interest via the [Research Participation Form](https://docs.google.com/forms/d/1j9n0q6MyC_lBi1VFd2mYrswySLVbK3TrYvO3r2LcPIY/edit) (Appendix 1) and will then contacted by phone to discuss the research project and their eligibility for the study assessed.

### Sample sizes

The sample size will be estimated based on pilot study data. The pilot study (Study 1) will use the same experimental design, variables, measures, and recruitment methods as for the main experiment (Study 2). I will use the pilot study to perform a statistical power analysis and to estimate the final N needed. Relatable studies have utilised sample sizes ranging from N=13 (Harvey et al., 2010) to N=120 (Moore et al., 2014), with N=22 (Leblanc et al., 2012), N=30 (LeBlanc et al., 2005) and N=52 (Vine et al., 2013) in between. Working from the power calculation (two-side, two-sample t-test) published by Harvey et al. (2010), I have updated the expected standard deviation and means from the Demand and Resource questionnaire (Stressor Appraisal Scale (SAS)) questionnaire. The SAS is a 10 question, 7 Likert scale, questionnaire. Using a mean value of 30 and 40 for the two conditions and a standard deviation of 30 to encompass a significant change of 15-20 points – the significance tests modelled in GPower will be tests of independent groups. For example, using estimate for a two-sided, two-sample t-test within GPower, a Power (1-β) of 0.20, a Type 1 error rate (α) of 5% and accepted means and standard deviations as stated – the estimated sample size is 23. To account for the requested 30% drop out rate, and to accommodate more robust data, the sample size will be 40 with 20 randomly allocated to each condition.

### Inclusion criteria

The inclusion criteria for this experiment are as follows:

1. Participants must be proficient in English because the tasks require communication.
2. To maintain a consistent level of academic ability, only students with a GPA of 5.0 and above are considered to be eligible participants.
3. Final year undergraduate Bachelor of paramedicine students will be targeted for recruitment into this study. If eligible student numbers are low, then cross-institutional recruitment may be explored via email though other universities in Victoria that offer a recognised paramedicine degree and Facebook posts via their student societies.

### Exclusion criteria

Exclusion criteria included diagnosed anxiety or stress-related disorders, those taking medication which affects the central nervous system or cardiovascular system (e.g. medications for epilepsy, anxiety, mood disorders, sleeping tablets such as Stilnox, benzodiazepines, melatonin or beta blockers). Potential participants were advised of this exclusion criteria via the University of Southern Queensland Research Participation Form.

## Measurements

### Demand and Resources – Challenge versus Threat

The Stressor Appraisal Scale (SAS), validated and described by Schneider (2008), is used to determine cognitive appraisal before the scenario is undertaken. Primary appraisal items include: (1) how threatening do you expect the upcoming task to be; (2) how demanding do you think the upcoming task will be; (3) how stressful do you expect the upcoming task to be; (4) to what extent do you think you will need to exert yourself to deal with this task; (5) how much effort (mental or physical) do you think the situation will require you to expend; (6) how important is it for you to do well on this task; and (7) how uncertain are you about what will happen during this task. Secondary appraisal items included: (1) how well do you think you can manage the demands imposed on you by this task; (2) how able are you to cope with this task; and (3) how well do you think you will perform this task. Immediately after participants complete the scenario, follow-up resource and demand questions will be incorporated; (1) how demanding was the task you just completed, and (2) How able were you to cope with this task. Using a 7-point Likert scale to quantify results, if resources are deemed to be greater than or equal to demands, then the scenario can be deemed a challenge. If demands are scored as higher than resources, then the participant perceives the scenario as a threat. Recommendations for Hase et al. (2019) suggests a calculation of the threat and challenge score difference, as ratio scores often produce highly nonlinear distribution (Vine et al., 2013). Evaluative data will be gathered to measure student stress and confidence levels, providing options to assess improvements in student mindset of challenge versus threat response.

### Salivary stress hormones

When an individual is subjected to a stressful situation or physiologically fatigued, the hypothalamus-pituitary-adrenal cortex (HPA) axis is activated. This leads to an increased secretion of the glucocorticoid cortisol from the adrenal cortex (Kirschbaum & Hellhammer, 1989). Once released into the blood stream, cortisol acts on almost every cell in the body to maintain allostasis. By mobilising energy to deal with actual or perceived environmental or physiological stressors, internal equilibrium can be maintained. Cortisol also has a major role in metabolic priming leading to energy synthesis and mobilisation (Fries, Dettenborn, & Kirschbaum, 2009) as a response to an increased state of threat. It also increases cardiovascular output and redistributes blood flow, increases immune response, and cause a marked spike in cerebral perfusion and glucose utilisation (McEwen & Seeman, 1999). The non-invasive nature of salivary cortisol testing and ability for participants to administer the test themselves makes it an appropriate test for stress levels. Salivary cortisol samples have been found to be stable when stored at 5oC for up to three months and up to one year when stored at -20oC (Garde & Hansen, 2005). A consistent high correlation between the accuracy of saliva cortisol testing and plasma cortisol testing has also been found (Francis et al., 1987; Ryoji, 1981; Vining et al., 1983). Urine sampling research has also been undertaken to assess cortisol levels (Soo-Quee Koh & Choon-Huat Koh, 2007). However, as urine can remain in the bladder for extended periods of time and the half-life of cortisol is known to be approximately one hour (Gatti et al., 2009; Weitzman et al., 1971); the validity and practicality of urine sampling was not considered here.

Duplicate analyses of the salivary cortisol levels will be conducted using an enzyme‐linked immunosorbent assay (ELISA) technique in Stratech Centre for Excellence Saliva Lab. By using this world leading facility to test all samples at the same time, inter-assay variability is reduced and this produces more robust data that can only strengthen publication success. In experimental studies, mean cortisol responses to acute stressors have ranged from 29% to > 200% above baseline levels (Bohnen et al., 1990; Buchanan & Lovallo, 2001; Dominique et al., 2000). Researchers also need to be aware of the possible interactions of diet and cortisol secretion. Proteins, specifically meat products, have been shown to stimulate secretion of cortisol (Anderson et al., 1987; Benedict et al., 2005; Slag et al., 1981) and care must be taken not to allow diet to influence cortisol testing. Furthermore, consumption of alcohol, nicotine and caffeine (Kudielka, Hellhammer, & Kirschbaum, 2007) and certain medications (Brody et al., 2002; Fries, Hellhammer, & Hellhammer, 2006) have been shown to impact the magnitude and duration of the stress response exhibited. In the scope of this research study, participants are requested to not eat large portions of food or consume and alcohol, nicotine or caffeine prior to testing. Also, participants will be excluded based on specific medications that might impact cortisol levels. Whole saliva samples are collected with SalivaBio’s 2ml cryovials and the Saliva Collection Aid (exclusively from Salimetrics, State College, PA), a collection device specifically designed to improve volume collection and increase participant compliance, and validated for use with salivary cortisol.

### Capillary blood glucose

As mentioned, stressful situations predominantly trigger a cardiovascular response which in turn facilitates neurohumoral activation leading to cortisol secretion (Kim et al., 2009). Cortisol stimulates gluconeogenesis (Melmed et al., 2015) and glycogenolysis with rapid increased in circulating blood glucose levels (Pradhan & Goel, 2011). In order to assess blood glucose levels, antisepsis of the third finger digital pulp for each patient will be undertaken using a 70% alcohol sterilised wipe. A blood sample (one drop) will be collected using a disposable lancet (Accu-Chek Softclix Pro; Roche) (Hortensius et al., 2011). The blood glucose is then measured using a calibrated Accu-Chek Performa (Roche) monitor.

### Cardiovascular responses to infer psychological states

In this context, challenge leverages high resources and low demands; conversely threat results from a situation of low resources and high demands. Both states have been shown to increase heart rate (HR) and cardiac output (CO) when compared to rest (Seery, 2013), however challenge leads to a decrease in total peripheral resistance (TPR) with a subsequent decrease in systolic blood pressure (SBP) and a decrease in blood volume of the microvascular bed of tissue. In the clinically setting, estimates of CO are both invasive and expensive. This has led to commonly used validated methods of obtaining estimated CO from HR and the mean systolic and diastolic blood pressure in non-clinical studies (Hill, Sollers, & Thayer, 2011). Mean arterial pressure (MAP) is determined from a widely used algorithm (MAP (mmHg) = [1 ∕ 3 × SBP (mmHg)] + [2 ∕ 3 × DBP (mmHg)]) and TRP is then calculated by dividing the CO by MAP, with that total multiplied by 80 (Sherwood et al., 1990). Wearable devices, such as the Equivital EQ02+ (ADInstruments, Sydney Australia) measure changes in skin sweat levels via a Galvanic Skin Response (GSR) sensor and an infrared Thermopile to detect peripheral skin temperature changes. An increase in skin temperature and sweat levels is indicative of a threat response and increased physiological stress. These wearable devices also measures Blood Volume Pulse (BVP) variability via a photoplethysmogram (PPG) sensor; an increase in blood volume to the microvascular tissue beds also indicates a stress and threat response.

### Wearable Functional near-infrared spectroscopy

Functional near-infrared spectroscopy (fNIRS) uses wavelengths of near-infrared light as a method for studying neural activity outside the clinical laboratory (Pinti et al., 2020). In a similar way to functional magnetic resonance imaging (fMRI), fNIRS uses near-infrared light to estimate cortical hemodynamic activity and increased cerebral metabolic demands as proxies for increased neuronal activity (Meidenbauer et al., 2021). In simplistic terms, when brain activity increases, metabolic demand increases and so does the flow of oxygenated blood. The non-invasive nature of fNIRS allows neural activation to be measured in naturalistic settings and has been shown to be an excellent tool for tests of cognitive stress (Buxton, 2010). As discussed earlier, stress affects both brain and cardiac function and leads to an increased HR. Typically, HR is assessed by the use of an ECG or chest worn HR monitor. Of note, HR can also be obtained from the fNIRS signal and has been shown to be better align with mental stress as opposed to chest worn measurements of HR alone (Hakimi & Setarehdan, 2018). fNIRS may not be appropriate for experienced clinicians who rely on muscle memory and previous experience, but for novice clinicians the increased blood flow to the brain should correlate with an increased stress response.

## Procedure

### Duration

The experiment should last between 45-60 minutes and be undertaken between 1100 hrs and 1800 hrs when cortisol levels are most stable (Kudielka et al., 2004).

### Procedure

1. **Meet and greet:** Participants will be welcomed by the experimenter.
2. **Information sheet:** Participants will be informed verbally by the experimenter that they can withdraw from the study at any time without adverse consequences for their academic standing or employment. Reasons for withdrawal do not need to be justified. There will be no attempts by the researchers to convince participants to take part or stay in the study. An information sheet including summary details of the experiment will be shown for the participants to read. Participants will be given as much time as they need to read through the forms.
3. **Consent:** Informed consent will be obtained prior to testing. The experiment will only continue once the participants have signed the consent form.
4. **Rest Period:** Participants are given a 15 minute rest period during which baseline HR, BP, RR and fNIRS are recorded. Baseline salivary cortisol samples and baseline blood glucose samples are also obtained.
5. **Demand / resources questionnaire:** Participants will fill out a questionnaire based on the validated method described by Schneider (2008), cognitive appraisal will be established before the scenario utilising ‘demand’ questions such as “How demanding do you expect the upcoming task to be?”.
6. **Cognitive test / executive function:** Participants will complete Part B of the Trail Making Test on an I-Pad (Trail Making Test J Lite). Time to completion (seconds) and number of misses will be recorded.
7. **Detailed instruction:** Each participant will be given verbal instructions about their tasks and demonstrations of the equipment used in the experiment.
8. **Scenario:** Each participant completes the scenario as instructed. A checklist of performance will be completed to ensure the simulated patient outcome was a success.
9. **Intra-scenario:**
	* **fNIRS:** With the rapid expansion of wearable real-time monitoring devices such as the Portalite fNIRS (Artinis Medical Systems, The Netherlands), it may be possible to obtain unobtrusive measures of the physiological response in brain activity (Gradl et al., 2019) to the threat state. Beta band (13-25 Hz) activity at the anterior temporal sites will be recorded throughout the scenario and for five minutes after the completion of the scenario. Mean activity levels will be obtained for comparison to the subsequent scenario 7 days later. This equipment is owned by Exercise Science (Melbourne campus) who have agreed to loan to our research team for this study.
	* **Skin:** Equivital sensors will measure changes in skin sweat levels via a GSR sensor and an infrared Thermopile to detect peripheral skin temperature changes. Mean levels will be obtained for comparison to the subsequent scenario seven days later.
10. **Post Test:**
	* **Cortisol:** When the participant experiences the stressful scenario, the HPA axis is activated and cortisol is released. Cortisol levels peak at 20-30 minutes after the onset of the stressful event (Kemeny, 2016), therefore post-test salivary cortisol will be sampled at 25 minutes from the commencement of the scenario.
	* **Cardiovascular:** HR, RR and BP readings are obtained to assess response to scenario and for comparison to the subsequent scenario seven days later.
	* **Questionnaire:** Follow-up demand questioning along the lines of “How demanding was the task you just completed?” will be undertaken. Also, follow-up ‘Resource’ questions will also be asked such as “How able were you to cope with this task?”. Results will be quantified using a 7-point Likert scale.
	* **Cognitive test / executive function:** Participants will complete Part B of the Trail Making Test on an I-Pad (Trail Making Test J Lite). Time to completion (seconds) and number of misses will be recorded.
11. **Debrief and credit:** There will be an open-ended discussion / interview between the researcher and the participants about the scenarios presented, the technology, and the experience of being in the study. The researcher will answer any questions. Participants will be thanked and informed about the next phase of the study.

## Statistical Analysis

The main focus of this research project is to assess if the appraisal of a stressful scenario can be shifted from ‘threat’ state to ‘challenge’ state in the novice clinician. To obtain objective measures of threat and challenge states, quantitative data will be obtained as outlined above. Statistical analysis will be completed using SPSS version 28 (SPSS Inc; Chicago, IL, USA) and GraphPad Prism version 5.0 (GraphPad Software, San Diego, CA, USA). All data reported as median ± IQR, and means ± SD, with significance determined with p <0.05. Non-parametric and other statistics associated with small *n* designs, typically used for evaluation of design frameworks within educational research, will be undertaken to determine difference (if any) between cognitive and stress data in the control and intervention arms of this project.

# Proposed Contribution to the Field of Research

The scoping review suggests that challenge and threat (CAT) appraisal as a tool in paramedicine undergraduate programs is an under-researched aspect of higher education. The review also highlights significant gaps in the literature and inconsistencies amongst assessment procedures for determination the appraisal of CAT. What is clear is the need for validation of a consistent methodology to determine CAT appraisal. Once consistent methodology has been established, then challenge-promoting clinical scenarios can be implemented into paramedicine education. Furthermore, the limited published research also makes it difficult to draw any firm conclusion as to the viability of this concept relevant to improving student confidence and clinical ability. Other relatable fields, such as medicine and employed paramedics, demonstrate that challenge state appraisal leads to improved motor skill performance and improved self-confidence. These key findings offer suggestions for future research of CAT appraisal in paramedicine higher education leading to the desired outcomes to be achieved from the PhD research.

# Milestones and Timelines

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| --- | --- | --- | --- |
| TASK | NOTES | DUE TO BE COMPLETED | PROGRESS / COMPLETED |
| Mandatory training | * Academic Integrity Mandatory Training
* Academic Integrity Tool
 |  | Completed |
| Research and Library Training  | * Higher Degree by Research
* HDR Library & Information tutorial
 |  | Completed |
| Ethics approval | * Ethical approval granted by the University of Southern Queensland’s HREC,
* Administrative review /ethics ratification approved from the Australian Catholic University HREC.
 |  | Approved on the 26th August 2021 (reference number: H21REA158).Approved on the 10th September 2021 (reference number: 2021-204R). |
| Confirmation of Candidature  | CoC Seminar and Panel. Location TW Q303 |  | Completed |
| Paper submission | Scoping literature review, submit a paper for publication in a Q1 journal; ie.* *Paramedicine*
 | May 2023 | Draft nearing completion.  |
| Equipment purchase  | As per “9 Resources Required to Complete the Research” | Mid 2023 | All equipment has been purchased with exception of Saliva testing requirements  |
| Participant Recruitment | As per approved ethics for Participant Recruitment:* Survey students to identify student interest
* Flyers / information session
* GPA check
 | September / October 2023. |  |
| Start of testing protocols | Pilot study to commence in late 2023 (Study 1) | November - December 2023 |  |
| Data analysis and evaluation of pilot study | Evaluation (mixed methods) of pilot study (Study 1) to refine major study (Study 2) protocol | Early 2024 |  |
| Start of major study testing protocols | Refined protocol and major research to commence during semester break 2023 (Study 2) | June - July 2024 |  |
| Data analysis and evaluation  |  | August – December 2024 |  |
| Thesis Preparation / Submission |  | Across 2025 | Have leeway to go in to 2026 if required |
| Conference presentation and final manuscript submission | Journal and conference TBC  |  |  |

# Ethical issues

## Ethics approval

Ethical approval was granted by the University of Southern Queensland’s Human Research Ethics Committee (HREC) on the 26th August 2021 (reference number: H21REA158). Administrative review and ethics ratification was sought from the Australian Catholic University HREC and approved on the 10th September 2021 (reference number: 2021-204R).

## Social risks

As participants will be completing a simulated stressful scenario, there is a possibility that they may be distressed by any perceived negative opinion of them. To minimize this risk, researchers will clearly describe the communicative nature of the experimental tasks in the recruitment advertisement. Additionally, no student peers will view the scenarios or debrief. Some participants may feel that their identity is threatened by their perceived performance during the experimental tasks. This risk will be minimized during the debrief by explaining that (a) the difficulty of the experimental tasks was higher than normal in order to enhance the potential effects between the baseline and intervention, and (b) the intervention is being tested, not them. Additionally, some participants may have concerns about the Principal Researcher being on the teaching staff whilst exposing students to simulated stressful situations. To counter this, the Principal Researcher will not be directly teaching this cohort of students in their final semester of study – a time when they will be offered the opportunity to volunteer as a participant in this research.

## Privacy and data security

As per the University of Southern Queensland’s Data Management Plan approved by the HREC on the 26th August 2021 (reference number: H21REA158).

## COVID-19 Precautions and Physical Risk

Participants will not be interacting face-to-face with each other or the experimenters during the experiment. This research will comply with the government’s and ACU’s (and USQ’s) rules for conducting research during COVID-19, and will adhere to social distancing and hygiene rules in place at the time of testing. Researchers will comply with ACU’s policies for safe research practices at the time of testing, and will thoroughly clean all equipment between sessions. Apart from the above, there are no physical risks to participants beyond those of their everyday activities.

# Resources Required to Complete the Research

Funding for this experiment has been provided by the University of Southern Queensland’s HDR support funds. This funding was used to purchase all hardware resource requirements. Further funding is sought to allow cortisol salivary analysis to be undertaken in the Stratech Centre for Excellence Saliva Lab, a world leading facility that will provide results that can only strengthen publication success.

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| **ITEM** | **Number required** | **Total Cost** |
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|  | **Total** |  |

(prices subject to inflation / supply chain variability)

# Type of Thesis

My intention is to complete this PhD with a Thesis by Publication. Manuscript number one (a scoping literature review) is complete and ready for submission to a journal (see below in Dissemination Plan). As paramedicine is an emerging field of research and considered quite ‘niche’, should there be issues with acceptance of manuscripts for publication, I plan to consider a Standard Thesis as an option also.

# Dissemination Plan

Results will be disseminated through peer-reviewed journals and/or conference presentations. Potential journals (among others) for publication of the results include:

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| Manuscript 1 - Physiological responses to high acuity clinical scenarios – what can educators of undergraduate Paramedicine students learn from the literature? - a scoping review | *Advances in Health Sciences Education* |
| Manuscript 2 – Pilot study data / results (Study 1) | *Advancing Scholarship and Research in Higher Education* |
| Manuscript 3 – Major project data / results (Study 2) | *Student Success; or Journal of University Learning & Teaching Practice* |

Potential conferences (among others) for publication of the results include:

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AIMS:

The broad aims of this study are (a) to evaluate and compare the cognitive decision-making processes and stress responses of final year paramedicine students when managing high acuity scenarios, (b) to assess if learning and targeted skills training can allow these novice clinicians to move their mindset to enable and encourage the appraisal of a ‘challenge’ state when faced with high stress clinical scenarios, and (c) to develop a training package for undergraduate paramedicine students that can be adopted by higher education providers.

RESEARCH QUESTION:

Does teaching challenge appraisal as a skill improve clinical performance with novice paramedicine students?

SUB QUESTIONS:

•    How much stress is attributed to clinical decision-making in paramedicine students approaching the beginning of their careers?

•    Does stress mitigation / challenge adoption improve clinical outcomes in simulated high acuity scenarios?

The training of paramedics in Australia has progressively moved from a post-employment vocational training model in the latter part of the 20th century to now sitting firmly within the pre-employment tertiary education sector. In this expanding cohort of university-trained paramedicine students, research has been conducted in relation to empathy, prevention of mental health and psychological disorders, workplace violence, physical characteristics and pre-employment fitness testing. However, there has been no published literature on cognitive decision-making under stress and how these aid or hinder learning.

In health-related disciplines such as nursing and medicine, practical assessment are commonly known as objective structured clinical examinations (OSCEs) and can centre around high acuity simulated patients. In the emerging field of undergraduate paramedicine education, little research has explored this type of assessment nor the associated physiological and cognitive stress. This is despite O’Meara, Furness and Gleeson (2017) discussing the expectation of paramedics to provide high level emergency care immediately following graduation and in high pressure, time-critical environments. The very real prospect of this occurring has led many education providers to incorporate high acuity OSCE assessments as a capstone assessment piece for undergraduate paramedicine courses, like those in other health education programs. And educators have traditionally adopted the approach of placing students in simulated stressful situations as a way of learning to cope with these challenges as they approach their chosen career. What we don't know is weather this stress enhances or hinders learning? Acute stress response is well known to lead to performance degradation, so are these students being set up to fail when really educators should be encouraging learning as a priority. Research must be undertaken to determine how much physiological and cognitive stress is too much.

Early career is a time when graduates should be undertaking new skills, honing the theoretical knowledge from their university education, and applying it in practice. Research from nursing indicates that the first five months of employment is an intense period of adaption, often involving self-doubt, anxiety and a lack of confidence which can lead to emotional exhaustion. Devenish, Clark and Flemming (2016) note that paramedicine graduates must negotiate workplace politics and culture along with immense stress when faced with high acuity patients early in their careers. Higher education providers have predominantly taken the approach that students will need to find their own way of coping or dealing with the stress they face. What is unknown is how this stress is reflected in challenge or threat appraisal, and if the ‘threatened’ student is prone to sub-standard performance in both the simulated and clinical practicum setting. This leads to two important questions – 1. Can researchers quantify how much stress these novice clinicians are under as they approach the beginning of their careers? And – 2. Can higher education providers better equip them to appraise high acuity patient scenarios as a challenge instead of a threat? Other relatable fields of research, such as medicine or studies involving employed paramedics, demonstrate that challenge state appraisal leads to improved motor skill performance and improved self-confidence. It is logical to conclude that if challenge appraisal can be firmly established as a pre-employment skill, then improved clinical outcomes and reduced stress-related burnout may be achievable in the workforce.

This quantitative study is a randomized control trial, involving a ‘control arm’ and an ‘intervention arm’, detailed below. An initial pilot study (Study 1) involving ten (10) participants will be undertaken in late 2023 / early 2024 as a means of evaluating the methodology and equipment. Qualitative data (interviews / subjective questionnaires), will be undertaken to refine the protocol for the larger study.

INTERVENTION

Targeted, individualized training will be provided to participants in the intervention arm (see below). This training package will involve online / app-based clinical and skills-based prompts that will be specific to the confidence level indicated via Likert scale. This means that a participant will select a number on the Likert scale to the demand / resource questions asked, with a specific level of targeted training provided based on each participants’ individual answers. The training interventions will range from short 5-10 second prompts for high resource / low demand answers, to longer 20-30 second prompts incorporating videos / images / flow charts tailored to low resource / high demand answers.  These training interventions will be developed in collaboration with TacMed, an industry leader in comprehensive and immersive training of medical first responders. The intention of the training is that one package will be accessed each day by the participant over a 7 day period. If a package is not accessed on a specified day, the participant will be notified by email and SMS to complete that training package. Each package should only take 10-15 mins to complete and is designed to be repetitive learning.

CONTROL ARM

Participants undertake a high-acuity scenario with quantitative assessments pre and post scenario. Seven days later, the same participants will complete a different but equivalent scenario without any external intervention. Participants serve as their own control and are assessed pre and post scenario in both occurrences.

INTERVENTION ARM

Participants undertake a high-acuity scenario with quantitative assessments pre and post scenario. Across the following days, training and education will be provided to establish a challenge mindset in the participants. Seven days after the original scenario, the same participants will complete a different but equivalent scenario. Participants serve as their own control and are assessed pre and post scenario in both occurrences.

PARTICIPANTS

Students from the Australian Catholic University (ACU) enrolled in Bachelor of paramedicine (BP) undertake high acuity scenario-based leaning as part of their education. Promotion of the study will include presentations to students at ACU and information on the ACU student paramedicine society Facebook page. Participants will register their interest via the Research Participation Form and their eligibility for the study assessed.

SAMPLE SIZE

The sample size will be estimated based on pilot study data. Based estimates for a two-sided, two-sample t-test within GPower, a Power (1-β) of 0.20, a Type 1 error rate (α) of 5% and accepted means and standard deviations as stated – the estimated sample size is 23. To account for 30% drop out rate, and to accommodate more robust data, the sample size will be 40 with 20 randomly allocated to each condition.

Ethical approval granted by the University of Southern Queensland’s HREC on 26th August 2021 (reference number: H21REA158). and Administrative review /ethics ratification approved from the Australian Catholic University HREC on 10th September 2021 (reference number: 2021-204R).

Confirmation of Candidature (CoC) Seminar and Panel Completed June 2022

Scoping literature review drafted and planned submission to *Paramedicine*by June 2023.

All equipment has been purchased.  This application for $3000 to cover this final technical services to enable the implementation of a project: cortisol salivary analysis to be undertaken in the Stratech Centre for Excellence Saliva Lab, a world leading facility that will provide results that can only strengthen publication success.

Participant Recruitment: September / October 2023.

Pilot study to commence in late 2023 (Study 1)

November - December 2023: Data analysis and evaluation (mixed methods) of pilot study (Study 1) to refine major study (Study 2) protocol for early 2024

Start of major study testing protocols to commence during semester break June - July 2024 Data analysis and evaluation: August – December 2024

Thesis Preparation / Submission: Across 2025 (have leeway to go in to 2026 if required)

Conference presentation and final manuscript submission    Journal and conference TBC

Some funding for this experiment has been provided by the University of Southern Queensland’s HDR support funds. This funding was used to purchase all hardware resource requirements (Equivital and fNIRS wearable devices).

Further funding is sought to allow cortisol salivary analysis to be undertaken in the Stratech Centre for Excellence Saliva Lab, a world leading facility that will provide results that can only strengthen publication success.

This aligns with the Research Grant Guidelines as below:

*College will consider funding applications for:*

*• technical services to enable the implementation of a project*

The quote from Stratech can be emailed / attached if required. Details are:

Analysis, Saliva Biomarker Analysis for Cortisol in duplicate (unit price $24.95). 103 samples, plus GST and Cold Chain Courier transport - total costing AUD $2990.74

# Appendix 1: [Research Participation Form](https://docs.google.com/forms/d/1j9n0q6MyC_lBi1VFd2mYrswySLVbK3TrYvO3r2LcPIY/edit)

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