# Language-Related Factors Affecting the Academic Performance of International Medical Students 

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This thesis includes two original papers published in peer reviewed journals and one unpublished publication. The core theme of the thesis is neurophysiological and language-related factors that affect academic outcomes of international medical students. The ideas, development and writing up of all the papers in the thesis were the principal responsibility of me, the candidate, working within the Department of Physiology, Monash University under the supervision of Associate Professor Ramesh Rajan and Professor Benedict Canny.

The inclusion of co-authors reflects the fact that the work came from active collaboration between researchers and acknowledges input into team-based research.

In the case of chapters $\mathbf{2}$ to $\mathbf{4}$, my contribution to the work involved the following:

| Thesis chapter | Publication title | Publication status | Nature and extent of candidate's contribution |
| :---: | :---: | :---: | :---: |
| Two | The Influence of Language Family on Academic Performance in Year 1 and 2 MBBS Students | published | Study design, data collation, statistical analysis and manuscript preparation |
| Three | Medical School Assessment is Affected by Student Origin but not Language Family and varies with Year Of Study: Implications for the Education of International Medical Students | rejected | Study design, data collation, statistical analysis and manuscript preparation |
| Four | Poorer verbal working memory for a second language selectively impacts academic achievement in university medical students | published | Study design, data collection, neurophysiological testing, statistical analysis and manuscript preparation |

I have renumbered sections of submitted or published papers in order to generate a consistent presentation within the thesis.

Signed: $\qquad$

Date: $\qquad$

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## Abstract


oncerns regarding the poorer scholastic performance of international students in western tertiary institutions have generated studies to determine which factors affect academic success. A significant factor appears to be proficiency in the classroom language, generally a second language (L2) for the international students. There is also growing evidence that some sociological attributes and neuropsychological skills, such as cultural dissimilarities and working memory (WM), impact on academic attainment in L2 learners. The present study was conducted to examine the role of language-related factors that may affect academic differences between local and international Bachelor of Medicine/Bachelor of Surgery (MBBS) students in an Australian university.

Data were obtained from two separate cohorts of medical students for both their 1st and 2nd years of study. Altogether, academic data from a total of 13 years were used and analysed for this thesis. Studies 1 and 2 examined the same cohort of students who commenced their studies in 2002-2006 (i.e. 1st year 2002-2006 and 2nd year 2003-2007; data from the 2004 cohort (i.e. 1st year 2004 \& 2nd year 2005) was incomplete and, therefore, not useable). This data was from a pool of previously collected information obtained by the Faculty of Medicine, Nursing and Health Sciences for census and other academic purposes. For Study 3, data were obtained from students who commenced their 1st year studies in 2008-2010 and 2nd year studies for only the 2008 and 2009 students (i.e. 1st year 2008-2010 and 2nd year 2009-2010; due to time constraints 2nd year information for the 2010 students was not collected) and data were obtained specifically for the present doctorate studies.

For all three studies, information on social demographics, first language (L1) and/or L2 usage and various psychometric scales were obtained via questionnaire and academic assessment outcomes were gathered from official university records. Additionally, 103 students in Study 3 undertook a well-established Speech-in-Noise (SiN) measure of verbal working memory.

In Study 1, overall End of Year academic totals were compared between 872 local and international students categorized by the Language Family (LF) of their L1. In Study 2, the individual assessments that made up the End of Year Totals were examined for 707 students from the same cohort of Study 1. Assessment instruments varied, but included Examinations, Coursework and Objective Structured Clinical Examinations (OSCEs). In Study 3, the SiN task was used to develop a model correlating verbal WM and various measures of English usage to the 103 students' academic outcomes of overall End of Year Totals and individual Assessment instruments.

In Study 1, the local students, generally, outperformed their international counterparts academically and this depended not only on Origin (i.e. Local versus International) but also on Language Family of their first language. Given that language proficiency is somewhat controlled for, this indicated that the differences may be due to acculturative stressors rather than English language skills. This was elaborated in Study 2, which examined the details of performance differences in the varying assessment types making up the course assessment each year of Years 1 and 2. There were year-specific differences between local and international students, suggesting that varying factors occurred. In the 1st year, international students showed poorer performance only in communicationsbased tasks, but in the 2nd year, international students performed worse than the locals in all assessments. After establishing that English proficiency did not appear to be the main influencing factor in academic achievement by international students in the Monash MBBS course, the final study 3 in this thesis examined one major neurophysiological factor that has been suggested to impact on learning, i.e. working memory, and specifically verbal working memory in the language of instruction in the Monash MBBS course (a language that is L2 for a significant number of the international students in the course). In this study, a model was developed to significantly predict the performance difference in a communications-based assessment, but not in other assessments requiring mainly factual knowledge.

Overall, evidence from all three studies suggests that international students show poorer performance in academic attainment compared to their local peers as a probable result of impaired verbal WM for the L2 in specific communications-based assessments. Possible greater demands on English language skills and acculturative stress in the 1st year may
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## Abbreviations and Symbols

The abbreviations listed below apply to the entire text, including legends of tables and figures. Abbreviations are written in full on first appearance in the thesis.

| Abbreviat |  |
| :---: | :---: |
| alTs | Anterior Inferior Temporal Sulcus |
| AMEB | Australian Music Examinations Board |
| aMTG | Anterior Middle Temporal Gyrus |
| ANCOVA | Analysis of Co-variance |
| ANOVA | Analysis of Variance |
| AoA | Age of Acquisition |
| AoAoE | Age of Acquisition of English |
| AT | Assessment Type |
| BICS/CALP | Basic Interpersonal Communicative Skills/Cognitive Academic Language Proficiency |
| BKB | Bench Kowal \& Bamford |
| BKB $(\mathrm{A})$ | Bench Kowal \& Bamford(Australia) |
| BN | Babble Noise |
| CPH | Critical Period Hypothesis |
| CS | Competing Speaker |
| dB HL | Decibel Hearing Level |

Dba Decibels Amplitude
df
Degrees of Freedom

EFL English as a First Language

ELS English Language Skills

EMQ Extended Matching Questions

ERP Event Related Potential

ESB English Speaking Background

ESL English as a Second Language

ESLM English Spoken In The Last Month

F

F
fMRI Functional Magnetic Resonance Imaging

HECS Higher Education Contribution Scheme

HL Hearing Level

HP
Hewlett-Packard

Hz

ID
Hertz

D Identity Number (Student)

IELTS International English Language Testing System

Int
International

ISAT
International Student Admissions Test

| kHz | Kilohertz |
| :---: | :---: |
| L1 | First Language |
| L2 | Second Language |
| LF | Language Family |
| Loc | Local |
| LOTE | Language Other Than English |
| LSD | Least Significant Differences |
| LTM | Long Term Memory |
| M | Male |
| MARA | Majlis Amanah Rakyat |
| MBBS | Bachelor of Medicine/Bachelor of Surgery |
| MCQ | Multiple Choice Questions |
| MSE | Mother Spoke English |
| MUHREC | Monash University Human Research Ethics Committee |
| n | Number |
| NESB | Non-English Speaking Background |
| OAT | Objective Structured Clinical Examination Assessment Type |
| OR | Origin |
| OSCE | Objective Structured Clinical Examination |
| OSCE-Comms | Objective Structured Clinical Examination-Communications |


| OSCE-Tech | Objective Structured Clinical Examination-Technical |
| :---: | :---: |
| $p$ | p -value (significance) |
| PBL | Problem Based Learning |
| PEP | Perceived English Proficiency |
| PET | Positron Emission Topography |
| pIFG | Posterior Inferior Frontal Gyrus |
| pITS | Posterior Inferior Temporal Sulcus |
| PM | Premotor Cortex |
| pMTG | Posterior Middle Temporal Gyrus |
| PSE | Prefer To Speak English |
| PSS | Perceived Stress Scale |
| $r$ | Pearson's r |
| $\mathrm{r}^{2}$ | Pearson's r squared |
| rDLPFC | Right Dorsolateral Prefrontal Cortex |
| RMS | Root Mean Square |
| RST | Reading Span Test |
| S | Seconds |
| SAQ | Short Answer Questions |
| SAT | Scholastic Aptitude Test |
| SD | Standard Deviation |


| SEM | Standard Error of Mean |
| :---: | :---: |
| SiN | Speech-in-Noise |
| SMN | Modulated Speech-shaped Noise |
| SNR | Signal-to-Noise Ratio |
| $\mathrm{SNR}_{50}$ | Signal-to-Noise Ratio at which 50\% detected correctly |
| SPIN | Speech Perception In Noise |
| SPL | Sound Pressure Level |
| SPQ | Study Processes Questionnaire |
| SPSS | Statistical Package for the Social Sciences |
| SRT | Speech Reception Threshold |
| SSN | Speech-shaped Noise |
| STG | Superior Temporal Gyrus |
| STS | Superior Temporal Sulcus |
| STS | Short Term Storage (Phonological Loop) |
| t | Students' t-test |
| TDH | Total Dynamic Head |
| TOEFL | Test of English as a Foreign Language |
| UK | United Kingdom |
| UMAT | Undergraduate Medicine and Health Sciences Admission Test |
| US/USA | United States of America |

## Symbols

$\alpha$
alpha
$\beta$
beta
*/**
$\dagger / \ddagger$
$>$
$<$
$\leq$
\#
$\eta^{2}$
\%
$\pm$
.WAV
denotes significance level
denotes significance level
greater than
less than
less than or equal to
number
partial eta squared
percentage
plus or minus

Waveform Audio File Format

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## Chapter 1

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## Preface

$\tau$his thesis explores the academic performance of international and local students in the initial two years of a Bachelor of Medicine/Bachelor of Surgery (MBBS) undergraduate degree, at Monash University, a major Australian university.

In 2002 this course underwent a major curriculum change when it was restructured from a traditional 6-year degree to a hybrid curriculum composed of lectures, tutorials and practicals with content-integrated Problem-Based Learning (PBL) sessions in a 5-year degree program. The changes to the MBBS curriculum created the opportunity to examine how this new structure impacted on the academic outcomes of future students, and in particular, for international students who mostly come from, and are used to, a more passive learning environment. The current literature shows that, generally, international students do not perform academically as well as local students and therefore, this study is, at least, partly driven by a concern for the implications of the effects of such learning environments for equity. Numerous factors have been suggested to affect the academic achievement of international medical students. These factors may not be specific to the medical area but may also have profound influences across many other disciplines including Education, Linguistics, Socio-cultural, Physiology and Psychology. Therefore, it is reasonable to assume that there is unlikely to be just one factor responsible for the poorer performance seen in international students, but that a combination of behavioural, cognitive and psychological factors may play a role. Further, international students are not a homogenous group and there may be differences within this cohort depending on their ethnicity or the ethnic group with which they identify.

The majority of the literature indicates a lack of English proficiency is the main cause of the poorer achievement by international students in English-speaking institutions. (Note that not all evidence supports this notion, and it is yet to be unequivocally established as the major factor). However, it is unclear as to what exactly is meant by the term 'proficiency' in the literature, and often the word 'proficiency' is used interchangeably with other terms such as 'language skills', or 'native-like'. Further, how English proficiency itself is measured is also a subject of avid debate amongst researchers, e.g. is the learner
proficient in English based on their knowledge of grammar and semantics, or if the learner can speak with no trace of accent?

For the purposes of this thesis, 'proficiency' is used in regards to grammatical, syntactic and phonological knowledge and comprehension of English as measured by international validated language assessments such as the International English Language Testing System (IELTS); whereas 'language skills' refers to how the students use this knowledge, e.g. in oral presentations, expression of ideas, etc. 'Language barriers' refers to factors that hinder the learner in using these skills, such as unfamiliarity with local and foreign accents, cultural differences in discourse and language use, or colloquialism.

The MBBS students provide an ideal cohort for measuring academic performance as, English proficiency is, to a large extent, controlled for through the entry requirements of the course (see Appendix A). This allows this study to look beyond proficiency (as defined in this thesis) and examine four other major factors that have been shown to impact on academic performance of students who are taught in a non-native language and are not wholly dependent on the level of the student's language proficiency. These are: 1) age at which the language of instruction was acquired; 2) the effect of the nature of their first language; 3) working memory for the second language; and 4) a range of sociometric variables. All four factors have significant relevance in second language (L2) comprehension, with the last factor having particular (but not sole) application to international students.

The subject of academic performance of international students is of particular relevance to the current educational environment. Many western countries using English as the language of instruction enrol international students from diverse cultural and language backgrounds and it is imperative for educators to be aware of possible factors that impact on academic achievement of all students, be they international or local. The four categories above were chosen as they cover a broad range of behavioural, cognitive and cultural aspects that greatly influence academic performance outcomes. It is fortunate that this university enrols an increasingly large number of international students, as well as having a large immigrant population, thus allowing for an in-depth examination of these influential language-related factors in the following chapters.

## CHAPTER 1:

## GENERAL

## INTRODUCTION

### 1.1. Language Comprehension


anguage comprehension is critical to learning and requires both auditory perception and cognitive processing skills (see Figure 1.1 for example of a commonly-cited theorised model). It has been widely documented that students who have acquired the classroom language of instruction as a second language generally underperform, academically, compared to their counterparts who have learnt the said language as their first language (Childs \& O'Farrell, 2003; Collier, 1987; Demie \& Strand, 2006; Ferris \& Tagg, 1996; Haq, Higham, Morris, \& Dacre, 2005; Kao, 1995; Liddell \& Koritsas, 2004; Light, Xu, \& Mossop, 1987; McManus, Woolf, \& Dacre, 2008; Schoonheim-Klein, Hoogstraten, Habets, Aartman, Van der Vleuten, Manogue, \& Van der Velden, 2007; Wass, Roberts, Hoogenboom, Jones, \& Van der Vleuten, 2003; Woolf, Haq, McManus, Higham, \& Dacre, 2007). While this is especially pertinent to international students, students who come from a migrant background seem also to be affected (Kao \& Thompson, 2003). This phenomenon has been noted across a wide variety of pedagogical settings, across a range of study disciplines and educational institutions, and in countries with different cohorts of second language speakers. Whilst language proficiency is thought to be a major contributor, a number of factors have also been shown to significantly impact academic results. Moreover, these difficulties for foreign students in acquiring information may be exacerbated in some measure by the absence of awareness of academic staff on appropriate mechanisms to communicate to students for whom the language of instruction is an L2. Daly and Brown (2007) videorecorded four lecturers during a real classroom lecture in order to analyse their communication techniques. A number of measures were recorded, such as Rate of Speech, Number of Complete Sentences, Number of Incomplete Sentences, Colloquialism or Slang Used, Length of Pauses etc. The authors concluded, as results indicated, that the lecturing academia were not aware of their communication behaviours and as such would not be helpful to students who may find these lectures linguistically challenging.

Nevertheless, poorer language proficiency cannot account for the effects seen worldwide in programs such as MBBS courses, which demand stringent standards must be met in the language of instruction via validated, internationally-standardised tests e.g. Test of English as a Foreign Language (TOEFL) and International English Language Testing System
(IELTS) in cases where English is the classroom language. Further, international students endeavouring to undertake study in this linguistically-demanding course (IELTS Handbook, 2007, p. 5) must attend and pass an interview to demonstrate high motivation and selfexpectations, in addition to meeting the stringent measures of English proficiency, prior to enrolment. To a large extent, these factors obviate the confounding effects of English proficiency skills in this study, allowing examination of how factors other than English proficiency play a role in influencing the academic performance of international students.


Figure 1.1 A schematic diagram of dual auditory streams for speech processing as proposed by Hickok and Poeppel. The ventral stream in pink is thought to process speech signals for comprehension and the dorsal stream in blue is thought to process speech signals to the frontal lobes. (From Hickok \& Poeppel, 2004).

What follows below is a review of the current literature on some of the most commonly recognized behavioural, cognitive and social factors that impact on academic performance of L2 students, particularly medical students, given the focus of this thesis.

### 1.2. Academic Performance of Medical Students

A vast library of studies has shown that the phenomenon of international students performing academically worse than their local peers is not discipline-specific, occurring also in medical studies on a global level (Haq et al., 2005; Kay-Lambkin, Pearson, \& Rolfe, 2002; Li, Chen, \& Duanmu, 2009; Liddell \& Koritsas, 2004; Light et al., 1987; McManus et al., 2008; Morrison, Merrick, Higgs, \& Le Metais, 2005; Sawir, 2005; Wass et al., 2003). This is despite the stringent measures placed on international students prior to enrolment of these courses. Therefore, some international medical students may return to their home country, often under-developed or newly-developing countries (Brisset, Safdar, Lewis, \& Sabatier, 2010) and the poorer performance in their medical studies raises concerns about the quality of care they may be able to provide.

### 1.2.1. Academic Assessment

Assessment in the instruction of medicine must be rigorous enough to ensure that future practitioners have acquired the necessary skills and competencies to meet the demands of the healthcare needs of the societies in which they will practice. The broad discipline of education in medicine needs to impart more than just discipline knowledge and technical competence; it must also include communication and interpersonal skills, as well as empathy. All this must be taken into consideration when designing the medical curriculum, particularly as the outcomes are critical for individuals and communities.

Assessments in other disciplines often are divided into examinations (usually referring to written examinations) and coursework assessments (Bridges, Cooper, Evanson, Haines, Jenkins, Scurry, Woolf, \& Yorke, 2002; Downs, 2006). However, in medicine, there is also significant practical assessment of trainees demonstrating skills they may use in future practice. One such technique is known as the Objective Structured Clinical Examination (OSCE), where tasks, often involving simulated patients, are also assessed (Amin \& Khoo, 2003). The broad categories of assessment are designed to measure across the range of specific skills required for future practice, e.g. technical knowledge via examinations, clinical competence via OSCEs, or integrative and descriptive abilities via coursework (Amin, Chong, \& Khoo, 2006).

Coursework assignments may include essays, portfolios, case commentaries, etc., and are therefore, more linguistically demanding than examinations (Downs, 2006; Smith, 2011; Zhang \& Mi, 2009). Coursework is also considered to offer greater potential for students to encounter a deeper learning experience (Yorke, Bridges, \& Woolf, 2000), as students are given a number of weeks to complete assignments, in which time they are able to refine their ideas, edit their work to their grammatical or syntactical satisfaction, and be able to exploit the use of reference tools. Although this type of assessment challenges the language skills of international students, studies have found that most students perform better in this component than in examinations (Bridges et al., 2002; Downs, 2006; Yorke et al., 2000). However, not many studies have compared this assessment type between national and international students to see if there were any performance differences. Conversely, examinations are time-restricted, closed-book and may be a disadvantage to students who write or process more slowly in their L2 than those using their first language (De Vita, 2002; Smith, 2011).

The OSCE is unique in that it assesses clinical competence via the use of simulated patients and measures the student's ability to demonstrate what will be expected of them in real life (Amin \& Khoo, 2003). Academic achievement differences between international and local students have been well documented in this assessment type (Fernandez, Wang, Braveman, Finkas, \& Hauer, 2007; Haq et al., 2005; Liddell \& Koritsas, 2004; McManus et al., 2008; Newble, 2004; Schoonheim-Klein et al., 2007), with a number of theories posited for the generally poorer performance of the international students, including, but not limited to, discrimination (De Vita, 2002; Wass et al., 2003), bias (Bienstock, Tzou, Martin, \& Fox, 2000) and language background (Dzuganova, 2002).

### 1.3. Age of Language Acquisition

### 1.3.1. Age of Acquisition and Academic Attainment

The relationship between Age of Acquisition (AoA) of L2, and subsequent L2 proficiency has been a topic of great debate for the last three decades (DeKeyser, 2013; Hyltenstam \& Abrahamsson, 2000) and only a few studies have looked at the direct correlation between AoA or L2 proficiency and how it may affect academic achievement. Studies that have researched this question (Collier, 1987, 1989; Demie \& Strand, 2006; Hakuta, 1999;

Liyange \& Birch, 2001) have found that, generally, the younger the AoA or the more L2 proficient, the better the academic outcomes overall.

The question of how AoA of the classroom language may impact academic outcomes of international students has not been fully researched, but is important and could greatly benefit policy-makers and educational planners with respect to pedagogy for both international and NESB students.

### 1.3.1.1. $\quad$ The Critical Period Hypothesis and Language Acquisition

One theory that states the paradigm for first language acquisition is the 'Critical Period Hypothesis' (CPH). The original version of the CPH was refined by Lenneberg (1967) who argued that there are biological maturational processes that govern language acquisition capabilities similar to those that control sensory and motor development, i.e. from the primitive stages of early infancy through to puberty when the brain was once thought to become 'hard wired' for language acquisition (Vanhove, 2013). The word 'critical' was later modulated to 'sensitive' because while there were strong supporters for maturational constraints (Francis, 1999; McCardle \& Wilson, 1990; Newport, 1990; Weber-Fox \& Neville, 1996), other investigators felt this was too rigid a term and not observed in every case (for review see Nikolov \& Djigunovic, 2006). Lenneberg argued that the critical period for acquiring language was a biological process that occurred between the ages of two and puberty, with the intervening period coinciding with the lateralisation process of the brain, i.e. when the dominant hemisphere of the brain for language function (usually the left hemisphere) is developed and specialized (Singleton, 2005; Vanhove, 2013). Following this period, Lenneberg believed that the brain rapidly developed language learning blocks and acquiring language would only be through laboured and conscious efforts (Singleton, 2005). Much of Lenneberg's observations surrounding the CPH, however, arose from early case studies of deaf children; children raised in isolation or in the wild with no linguistic teaching, mostly, until after puberty; or children with serious cognitive impairments, so it is difficult to extrapolate his findings to normal language acquisition (Marinova-Todd, Marshall, \& Snow, 2000; Vanhove, 2013).

### 1.3.1.1.1. The Critical Period Hypothesis and Second Language Acquisition

Although Lenneberg's hypothesis was concerned mainly with first language acquisition, it raised questions as to whether the same limitations applied to second language learning and many studies have argued for these constraints (Au \& Oh, 2005; Collier, 1987, 1989; Demie, 2012; Flege \& Liu, 2001; Guerrero, 2004; Johnson \& Newport, 1989; Krashen, Long, \& Scarcella, 1979; Liyange \& Birch, 2001; Newport, 1990). Thus in a classic study in Korean and Chinese immigrants of early and late learners of English as a second language (ESL), proponents of the CPH, Johnson \& Newport (1989), found that native-like proficiency in an L2 could not be achieved if the L2 learning did not occur within what these authors considered a critical period. Flege and Liu (2001) also found that the length of residency in the US of Chinese immigrants correlated with higher scores in grammar and listening comprehension tests, suggesting that the earlier the acquisition of an L 2 , the more proficient the speaker.

Conversely, opponents of the CPH contended that even if there were maturational constraints this did not necessarily prevent an L2 learner from attaining native- or near native-like proficiency, and that poorer proficiency could be caused by other factors such as culture, medium of instruction, cognitive maturity or first language influences (Bialystok \& Miller, 1999; Birdsong, 1992; Birdsong \& Mollis, 2001; Cummins, 1981; Hakuta, Bialystok \& Wiley, 2003; Marinova-Todd et al., 2000). However, questions were raised (for review see Hyltenstam \& Abrahamsson, 2000) as to how 'native-like' proficiency was defined; was a learner with excellent grammar skills more proficient than a learner with no detectable accent or excellent discourse skills? Several of these researchers were also able to show that later learners were in fact quicker and more efficient than younger learners at attaining the L2 (Raja, 2009). Krashen et al (1979) summarized the debate succinctly: '...the older the faster, the younger the better', when the authors reviewed all research at the time and established that older L2 learners did acquire certain aspects of language structure (e.g. syntactic and morphological development) more quickly and easier than younger learners, but once the latter group 'caught up', they were generally more proficient on the whole.

Opponents like Birdsong (2006) and Hakuta, et al. (2003) also argued strongly that a prerequisite for the CPH to be acceptable, as a scientific hypothesis, would be a well-defined
onset and offset time-frame where significant changes in learning outcomes occur before and after the critical period (Hakuta et al., 2003). Birdsong proposed three basic patterns, derived from the existing literature, that met this criteria as shown in Figure 1.2: a stretched 'L' shape, a stretched ' 7 ' shape or a stretched ' $Z$ ' shape (Birdsong, 2006). Each shape represents ultimate attainment of language proficiency as a function of age of acquisition. In the stretched L pattern, there is a steady decline of attainment with age from birth until the end of the critical maturation period, and then a steady plateau. In the stretched 7 version, at the commencement there is no decline in ultimate attainment as a function of age, but instead a flat 'window of opportunity' phase where ultimate attainment is guaranteed. This model does not fit the CPH, as the window is not restricted by biological maturational constraints. There is then a steady decline as age progresses with ultimate attainment becoming less likely. The last pattern, the stretched $Z$, is almost a combination of the first two, where, again, it begins flat and is not subject to age effects and where learning potential is at its highest before inflecting into a steady decline and ending with a plateau. Singleton's review (2005), succinctly demonstrated that a multitude of studies showed too much variation and diversity in onset and offset timelines of the critical period, as to undermine the plausibility of the CPH. Hakuta, et al. (2003) also found convincing evidence against the CPH when they analysed data in a very large sample of 2.3 million immigrants in the US and found that while the degree of success in attaining English proficiency steadily declined with age, there were no discontinuities in the timeline slope, as would be expected if a critical period existed.


## A

B
C

Figure 1.2 Permutations showing three possibilities of bounded age effects in the CPH: A) stretched 'L' shape; B) stretched '7' shape; and C) stretched 'Z' shape. (From Birdsong, 2006).

Newer technologies also do not support the CPH; a large number of studies have shown that the brain demonstrates considerable plasticity well into adulthood (Pallier, Dehaene, Poline, LeBihan, Argenti, Dupoux, \& Mehler, 2003; Slabakova, 2006; Stowe \& Sabourin, 2005; Zhang, Kuhl, Imada, Iverson, Pruitt, Stevens, Kawakatsu, Tohkura, \& Nemoto, 2009; Zhang \& Wang, 2007). Even greater evidence of neural plasticity with regards to language
has been found in patients who have suffered aphasia, typically as a result of stroke (Perani, Cappa, Tettamanti, Rosa, Scifo, Miozzo, Basso, \& Fazio, 2003; Saur, Lange, Baumgaertner, Schraknepper, Willmes, Rijntjes, \& Weiller, 2006; van Oers, Vink, van Zandvoort, van der Worp, de Haan, Kappelle, Ramsey, \& Dijkhuizen, 2010). Many of the patients in these studies have made full recoveries of language use, depending on the severity of the patient's lesions, and with intensive remedial treatment. Interestingly, Saur, et al. (2006) found in their fMRI study that patients showed neural activation in perilesion areas not considered to be the classical 'language' areas, namely Broca's area or Wernicke's area in the temporal lobe, and took this to be evidence of synaptic reorganization and neural plasticity; evidence against the CPH (Saur et al., 2006).

While the current debate of attaining native-like proficiency in a second language still revolves around the age of acquisition, it does so from a different perspective, as stated in Birdsong's seminal 2006 review:
"It is widely recognized that AoA is predictive of L2A [second language acquisition] outcomes, in the simple sense that AoA is observed to significantly correlate negatively with attained L2 proficiency at the end state. This conclusion is based on the results of more than two dozen experimental studies..." (Birdsong, 2006 p. 12).

Therefore, if age effects are not due to biological maturational constraints such as the hemisphere dominance type proposed by Lenneberg and others, then there must be other factors involved. De Keyser (2013) posits it may be dependent on accumulated learning, whilst Birdsong (2006) argues there must be multiple dynamics at play, but suggests the natural cognitive aging of the brain, from as young as adolescence, may be a key factor. Further theories include neurophysiological and cognitive influences, which are discussed in the following sections.

The studies detailed above on Second Language Acquisition (SLA) and AoA have examined ultimate attainment of English proficiency of early (children) versus late (adults) learners. However, in this thesis, the MBBS students are approximately the same age (young adulthood) and as stated earlier, must be of sufficient proficiency to enter the course. Therefore, the studies of this thesis are not focused on ultimate attainment, but rather
what effects AoA will have on academic performance in international students, an area that is only sparsely studied in the current literature.

### 1.3.1.2. Neurophysiological Studies

Whilst it is now widely accepted that the CPH cannot be valid for SLA, neurophysiological studies have found some evidence to show that there is still an age effect with regards to L2 acquisition. Weber-Fox and Neville (1996) investigated Event Related Potentials (ERPs) in early and late English L2 learners, finding evidence to suggest that maturational changes significantly constrain the development of the neural systems relevant for language. ERPs gauge electrical activity in various regions of the brain, which the authors measured to obtain responses from Chinese/English bilinguals of varying ages of English acquisition. Their results showed that the late-learning bilinguals displayed slower linguistic processing of sentences than the early-learning bilinguals. The researchers also found that language-related neural systems of late-learners were different in loci and function from the early-learners such as the processing of syntactic versus semantic aspects of language, opening the door for new debates on the differences between L1 and L2 processing. The two subsystems of language processing (syntactic and semantic) were differentially affected by delays of the subjects' age of language learning indicating different development periods for aspects of language learning.

The advent of newer neuroimaging techniques such as Positron Emission Topography (PET) and functional Magnetic Resonance Imaging (fMRI) allowed for more detailed examinations of whether L1 and L2 shared the same neural structures or mechanisms (Briellmann, Saling, Connell, Waites, Abbott, \& Jackson, 2004; Chee, Caplan, Soon, Sriram, Tan, Thiel, \& Weekes, 1999; Chee, Tan, \& Thiel, 1999; Kim, Relkin, Lee, \& Hirsch, 1997; Mechelli, Crinion, Noppeney, O'Doherty, Ashburner, Frackowiak, \& Price, 2004; Perani, Dehaene, Grassi, Cohen, Cappa, Dupoux, Fazio, \& Mehler, 1996; Perani, Paulesu, Galles, Dupoux, Dehaene, Bettinardi, Cappa, Fazio, \& Mehler, 1998). However, results have been mixed to date, with evidence to support both possibilities of shared and separated mechanisms in L1/L2 processing. It is likely that the differences in outcomes have mainly been due to the different methods used or variations required by the different imaging techniques. In an early PET study, Perani et al. (1996) found separate neural substrates were used for Italian L1 and English L2 languages, but could not conclude from the results
if the differences were due to the level of English language proficiency or to the age of L2 acquisition. Their follow-up study (Perani et al., 1998) compared high- and lowproficiency late-acquisition L2 subjects from their earlier experiment, and high- and lowproficiency early-acquisition Spanish-Catalan bilinguals. The authors found similar PET activation foci in the left hemisphere and bilaterally for the high-proficiency groups regardless of whether the subjects were early or late acquirers of their respective L2. However, the low-proficiency subjects showed no activation for L2 in the same key areas of the brain as the high-proficiency subjects, leading the authors to conclude that the differing cortical responses were dependent on language proficiency and not age of language acquisition. In contrast, Kim et al. (1997), acquired fMRI images of various subjects who collectively represented ten different languages including English, European and Asian languages, and concluded that age of acquisition was a major factor in determining the neural organization for language when their results showed that activation for L1 and L2, in late language learners of L2, was spatially segregated in the cortex. Interestingly, both Perani et al. (1998) and Kim et al. (1997) did find segregation in the left inferior frontal cortex (Broca's area), an area responsible for speech production, but differed in their findings in the area of the brain responsible for speech comprehension (Wernicke's area). Therefore, age of acquisition may be influential only in speech production.

### 1.4. First Language Influences

### 1.4.1. Cross-Language Transference

Since the mid-1940s, (Saville-Troike, 1984) there has been debate as to the extent to which L1 influences (positive transfer) or hinders (negative transfer) L2 learning (for review see Kroll \& Sunderman, 2008). Positive transfer of L1 learning habits (such as sentence structure) is thought to occur when there are phonological, syntactical or morphological similarities between languages, which aid in L2 learning (Hornberger, 1989; Saville-Troike, 1984). However, dissimilarities may have the opposite effect and result in interference between languages and, therefore, impede learning (Hornberger, 1989; Saiegh-Haddad \& Geva, 2010). The need to inhibit L1 in order to produce L2 almost invariably comes as a cost in processing speed (Kroll, Michael, Tokowicz, \& Dufour, 2002),
which could ultimately impact on academic performance, especially where there may be time constraints, e.g. in examinations.

Finn et al. (2013) found evidence for this theory in a recent fMRI study. Here the authors scanned two groups of English speaking adults who had learnt one of two artificial languages that were either phonologically or non-phonologically similar to English. The MRI data showed that there was a greater processing cost for the non-phonological language and the researchers surmised that being more selective for the native language resulted in being less plastic for the new artificial language.

Paradoxically, researchers have also found that the greater the proficiency in L1, the greater the achievement in L2 learning, regardless of linguistic dissimilarities (Hornberger, 1989; Saville-Troike, 1984) although Kroll et al. (2002) argues that this may be due to possible higher cognitive abilities of the fluent bilinguals. Cummins (1979) refers to this as his 'developmental interdependence' hypothesis where competence in a second language is a function of the type of competence already developed in the learner's L1 when L2 learning begins. His BICS/CALP (Basic Interpersonal Communicative Skills/Cognitive Academic Language Proficiency) model (Cummins, Jim, 1979) illustrates his subsequent theory that there is a very different time period required to gain fluency in a second language for conversational skills (two years) as opposed to age appropriate fluency for academic elements of the second language (4-8 years) as reported in an extensive cohort study by Collier (1987). In this, Collier looked at how later language acquisition resulted in poorer English proficiency in three different age groups of schoolchildren.

### 1.4.2. Linguistic Origins

Consistent with the findings of Hornberger (1989), several studies (Corson, 1997; Fernandez et al., 2007; Long, Ingram, Pugh, Bowes, Haigh, \& Moss, 2008; Yamazaki \& Yamazaki, 2007) argue that as current medical, mathematical and scientific terminologies traditionally have their origins in the Latin and Greek languages (Dzuganova, 2002), then there is a potential bias and greater level of difficulty for MBBS students whose L1 do not share these geolinguistic origins, such as the Asian languages. In Long's (2008) report, pharmaceutical students who had studied Latin obtained significantly higher test scores in scientific word comprehension than students whose L1 was English but who had not
studied Latin. Further, the students whose parents' language was English or of a European background scored significantly higher than the students who did not come from a European background. However, as the literature shows that international medical students worldwide experience similar other difficulties, i.e. difficulties apart from terminologies used, this suggests that the typological relation of the first language may only account for some, but not the entire problem. The first chapter of this thesis looks at this theory in greater detail by investigating academic differences between MBBS students divided into different Language Families ${ }^{1}$.

### 1.5. Sociometric Variables

Sociometry refers to a quantitative method for measuring social relationships and their dynamics, first defined by Jacob Moreno (Moreno, 1937).

### 1.5.1. Parental Background

Another important contributor to the academic performance of students is parental background and education (Allen, 1999; De Courcy, 2007; Fejgin, 1995; Kao, 1995; Long et al., 2008; Rumberger \& Larson, 1998; Yan \& Lin, 2005). These studies found that parents of a higher educational background are more likely to provide an environment conducive to study, which resulted in higher academic attainment in each study, regardless of the ethnicity of the students. These environments would include appropriate work areas (Kao, 1995), better attitudes towards education as a high priority (Kao, 1995), higher educational expectations and motivations (Yan \& Lin, 2005), the communication of the value of 'social capital' via the participation in extra educational activities, a limit on television watching, and through the parents' network of friends (Fejgin, 1995).

Along these lines, a report by De Courcy (2007) showed that in Iraqi refugees, the mother's literacy in her children's first language played a significant role on language proficiency, while Allen (1999) states that mothers with higher education provide a role model for female students to persist in completing university. This is demonstrated in Chapter 3, where how often the student's mother spoke English to them as the student

[^0]was growing up, is significantly correlated to a number of English language measures including the student's perceived English proficiency and the age of acquisition of English.

### 1.5.2. Learning Styles

Another factor that has been reported to impact on the performance of international students is the teacher/student interaction and high level of participation required in a Western classroom setting compared with rote-learning and passive participation more commonly employed in Asian institutions, the so-called 'Confucian-Socratic' framework (Abel, 2002; Hawthorne, Minas, \& Singh, 2004; Kao \& Gansneder, 1995; Niles, 1995; Volet \& Renshaw, 1995). In a recent longitudinal study at Monash University by Bagot et al. (2005), the authors used a revised version of Biggs' (1987) Study Process Questionnaire (SPQ) to assess the learning style of first year national and international medical students. Their results revealed a higher rate of use of the Surface learning style, compared with the Deep and Strategic learning styles, in international students. Surface learning involves the student memorising factual details in isolation from the wider context of knowledge. In contrast, the Deep and Strategic learning style involves understanding and integrating the wider context of the information gained whilst also undertaking independent study (i.e. self-directed learning).This may have attributed to the lower academic results noted in this study, as Deep and Strategic learning styles are generally thought to be correlated to higher academic achievement whilst Surface learning is thought to result in a superficial level of understanding (Biggs, 1987; Newble \& Entwistle, 1986). However, this theory is still widely argued and more research in this area is required.

### 1.5.3. Acculturation

Acculturation refers to the process of change that transpires when people of different cultural backgrounds interact and there is cultural and psychological change either on a group or individual level (Berry, 1997; Sam \& Berry, 2010).

CULTURAL/GROUP LEVEL


Figure 1.3 Framework for conceptualizing and studying acculturation. (From Sam \& Berry, 2010, Figure 1. p. 474).

The research on acculturation was originally developed in reference to immigrants and refugees, and a number of predictive models have been developed to identify the key factors that may impact on the acculturation process in these populations (Arends-Tóth \& van de Vijver, 2006; Berry, 1997; Safdar, Lay, \& Struthers, 2003; Ward, 2001). Of these, Berry's framework (Berry, 1997; Sam \& Berry, 2010) is one of the most widely accepted models of acculturation effects at group and individual levels (see Figure 1.3). In this model, the subsequent and eventual outcome of adaptation can be achieved through four acculturation strategies: integration, assimilation, separation/segregation and marginalization (Berry, 2009) and individuals use different strategies for adapting to suit varying circumstances, such as maintaining religious beliefs or classroom participation. Outside of these frameworks, other variables also come into play, such as the individual's age and motivation (Poyrazli \& Kavanaugh, 2006) or, in the case of immigrants, if the country they are migrating to is a 'settler society' (i.e. a country that is experienced in settling migrants) (Sam \& Berry, 2010). Integration occurs when the individual is engaged in both their native culture and in the culture of the larger society and more likely to result in better adaptation than those who utilize the other three acculturation strategies (Berry, 2003, 2006). Assimilation is defined as the individuals or groups totally adapting to the other culture at the risk of losing their heritage culture, whereas Separation can be
viewed as the opposite with groups maintaining their own culture above the host culture. Marginalization is the strategy used when a person orients to neither culture (Berry, 1997; Berry \& Sabatier, 2011).

Immigrants and refugees may be more motivated to use the integration strategy once the decision to migrate has been made or if there is a determination to leave behind their traditional culture, whereas sojourners and travellers may not wish to lose their own culture when their stay is only temporary (Berry, Kim, Minde, \& Mok, 1987).

### 1.5.3.1. Acculturation, Acculturative Stress and International Students

There is now a large body of literature, derived from the increasing number of students schooling outside their country (Andrade, 2006) that discusses acculturation specifically regarding experiences of international students (Fritz, Chin, \& DeMarinis, 2008; Henning, Hawken, Krageloh, Moir, \& Doherty, 2012; Henning, Krägeloh, Moir, Doherty, \& Hawken, 2012a; Henning, Krägeloh, Manalo, Doherty, Lamdin, \& Hawken, 2013; Hsien-Chuan Hsu, Krägeloh, Shepherd, \& Billington, 2009; Jung, Hecht, \& Wadsworth, 2007; Kashima \& Loh, 2006; Khawaja \& Dempsey, 2008; Kline \& Liu, 2005; Lee, Koeske, \& Sales, 2004; Mukminin, 2012; Pan, Fu Keung Wong, Joubert, \& Chan, 2007; Smith \& Khawaja, 2011; Vergara, Smith, \& Keele, 2010; Wei, Heppner, Mallen, Ku, Liao, \& Wu, 2007; Wei, Liao, Heppner, Chao, \& Ku, 2012; Ying, 2005; Zhang \& Goodson, 2011). These studies have uniformly reported that first-year international students have a number of additional challenges beyond that faced by first-year university domestic students (e.g. Ridley, 2004). Consequently, international students may experience acculturation stressors and when these become overwhelmingly difficult and interfere with daily function, then students experience 'acculturative stress' (Berry et al., 1987; Brisset et al., 2010; Smith \& Khawaja, 2011). The acculturative stressors of international students may range from causing daily difficulties to severe depression and include: a high degree of homesickness (Sandhu \& Asrabadi, 1994), extreme loneliness (Lacina, 2002; Mori, 2000) culture shock (Mori, 2000; Sandhu \& Asrabadi, 1994) language barriers (Lacina, 2002), perceived and psychological stress (Bagot et al., 2005; Baker, 2004; Wan, Chapman, \& Biggs, 1992) and perhaps greater familial and financial pressure to succeed (Lacina, 2002; Mori, 2000). This may be particularly true for those who have obtained Government funding (Volet, Renshaw, \& Tietzel, 1994).

Language barrier is arguably one of the greatest stressors for foreign students as overcoming this barrier is a daily challenge and likely one of the most influential factors in obtaining their goal of high academic achievement. Barriers such as understanding lecturers' nuances and accents can directly affect academic achievement regardless of the student's knowledge of the L2 (Yeh \& Inose, 2003). These problems can also combine with other stressors resulting in a snowball effect to cause acculturative stress in sociocultural areas, and indirectly influence academic performance, e.g. psychological stress, loneliness, depression etc., (Smith \& Khawaja, 2011). In a recent study, Salamonson et al (2008) found a direct correlation between low academic grades among first year ESL nursing students and low English-language acculturation scores, on a validated acculturation assessment tool, with items only related to language preference and usage, from Marin et al., $1987^{2}$. In this instance, it is not clear whether low language acculturation is predominantly due to a lack of English proficiency; however, this finding is consistent with a number of studies that have found an association between lower English proficiency scores and lower academic achievement in international students (Andrade, 2006; Li et al., 2009; Light et al., 1987; Portes, 1999; Poyrazli \& Kavanaugh, 2006; Zhang \& Mi, 2009).

Yeh \& Inose (2003) used Sandu and Asrabadi's ${ }^{3}$ Acculturative Stress Scale for International Students (ASSIS) and found acculturative stress differences in a US university depended on the students' first language, with international students from Europe experiencing less stress than their counterparts from Asia, Central/Latin America, and Africa. The authors posit this to be because the European students were of similar appearance to the American students and therefore, may have encountered less racism and discrimination than their Asian, African and Latin/Central American peers. The European students may have also experienced less of a contrast in cultural patterns of behaviour and value systems, i.e. less cultural distance, allowing for a smoother adjustment in their daily interactions. The authors also noted that the higher the degree of self-reported English fluency and the level of comfort speaking in English, then the lower the acculturative stress experienced by the students.

[^1]Verbal communication difficulties are often considered to be a major source of acculturative stress (Jung et al., 2007; Lacina, 2002; Li et al., 2009; Malau-Aduli, 2011; Webb, 2002; Yang, 2004). These studies suggest that low communication skills coexist as a function of low English proficiency, but students may also struggle to adjust to cultural differences in language use such as miscomprehension of local phrases e.g. "jumping on a bus" may be taken literally (Lacina, 2002). Colloquialisms, body language, gestures and eye gaze are also behaviours that originate from cultural norms and may be misconstrued or interpreted as offensive (Kusmierczyk, 2011). Often students suffer a lack of selfconfidence when communicating or a failure to meet their own expectations, which may lead to social isolation and in turn to anxiety or depression (Wei et al., 2007).

Communication skills are a crucial clinical skill in the medical profession (Hawken \& Henning, 2012; Malau-Aduli, 2011), and can influence a student's stress level and ultimately their academic performance (Fritz et al., 2008). Van Dulmen et al. (2007) found that in medical students the act of delivering bad news to simulated patients produced a physiological stress response and impacted on the type of communication used. In another study (Malau-Aduli, 2011), international medical students at an Australian university rated the OSCE examination as the most stressful assessment type with students finding it difficult to establish what were the cultural expectations required for these examinations even though they rated their level of integration and academic language into the host culture as moderate.

Overall, though there is a substantial library of studies exploring the social experiences of international students' adjustment and transition into local educational institutions (Rosenthal, Russell, \& Thomson, 2007; Treloar, McCall, Rolfe, Pearson, Garvey, \& Heathcote, 2000), the literature is conspicuously dearth in studies that directly link academic performance outcomes with acculturative stress (e.g. Karuppan \& Barari, 2010; Nasir, 2012; Pan et al., 2007; Salamonson et al., 2008). And of these cited studies, only the Salamonson paper is related to medical students and the higher acculturative stress seen in the international students cannot be ruled out as due in part to low English proficiency skills.

### 1.6. Musical Abilities

Current research shows there is great similarity between the acquisition of language and music (Rauschecker, 1998). Both mediums are auditory, highly patterned and internally consistent (Saffran, 2003). Development and proficiency in both demonstrate age effects before puberty (Pantev, Oostenveld, Engelien, Ross, Roberts, \& Hoke, 1998). Also, both are dependent on different ranges of spectral (frequency) and temporal (time) processing. Indeed Rauschecker (1998) stated that music is merely a different form of the same ability to organize complex sounds into temporally ordered sequences. Considering these similarities, it would seem feasible that both domains would employ the same neural processing pathways. However, the current literature holds conflicting verdicts with some studies showing that speech and music have different cortical pathways (Peretz, Kolinsky, Tramo, Labrecque, Hublet, Demeurisse, \& Belleville, 1994; Zatorre, Belin, \& Penhune, 2002), whilst others state the two domains do process signals via the same auditory cortical pathways (Levitin \& Menon, 2003; Rauschecker, 1998; Tallal \& Gaab, 2006). Yet other studies believe that pathways utilised are dependent on a number of factors, e.g. function. In a recent study by Wong, et al. (2004), the authors found that when Mandarin and English-speaking listeners discriminated pitch embedded in Mandarin (a tonal language) the left anterior insular cortex was the most active. However, when the same listeners discriminated pitch patterns embedded in English words, the homologous area in the right hemisphere was activated as seen in the monolingual English listeners. Regardless of the incongruities found in these neurophysiological studies, investigators have shown a positive correlation between musical training and; increased mathematical skills (Cheek, 1999); improved perception of pitch contour in language (Schön, Magne, \& Besson, 2004); improved nonverbal rapid spectral-temporal processing (Gaab, Tallal, Kim, Lakshminarayanan, Archie, Glover, \& Gabrieli, 2005); improved speech perception in noise (Parbery-Clark, Skoe, \& Kraus, 2009a); and better integrative (non-attentive) and selective (attentive) listening skills (Crawley, Acker-Mills, Pastore, \& Weil, 2002). In Chapter 4, music skills are investigated to determine if greater musical abilities have a correlation to students' speech perception in noise and if so, does this factor influence students' academic performance.

### 1.7. Working Memory Capacity

### 1.7.1. $W M$ and the L2 Learner

Working Memory (WM) is defined as "the system for the temporary maintenance and manipulation of information, necessary for the performance of such complex cognitive activities as comprehension, learning, and reasoning..." (Baddeley, 1992, p. 281).

One core element of WM, and in particular verbal Working Memory (vWM) is what is termed the "phonological loop" (see Figure 1.4), which has been shown to be critical for language acquisition in development as well as language processing in daily life. However, it has been widely reported that WM capacity may be limited for students who are learning in an environment where the language of instruction is not their native language (Andersson, 2010; Kroll et al., 2002; Mackey, Philp, Egi, Fujii, \& Tatsumi, 2002; McDonald, 2006; Miyake \& Friedman, 1998; Service, 1992; Service, Simola, Metsänheimo, \& Maury, 2002; Sunderman \& Kroll, 2009; Tokowicz, Michael, \& Kroll, 2004) and this appears to be directly due to demands on verbal WM (vWM) resources in the non-native language (Service et al., 2002).

Linked to this, McDonald (2006) reported that late English language learners had, in addition to poorer WM, poorer English decoding ability and lower speed of processing in English, i.e. in what was termed 'basic level cognitive processing'. Takano and Noda (1993) posited this lower speed of L2 processing as a temporary decline in thinking ability because the demanding processing load involved caused strong interference in the L2 subject's thinking, beyond the normal foreign language processing difficulties per se, experienced by non-native speakers. Termed the 'foreign language effect', in a later study (Takano \& Noda, 1995), the authors demonstrated further that these differences were greater the more the foreign language was dissimilar to the native language with greater performance differences between, for instance, Japanese and English than German and English, which share similar language roots.

### 1.7.2. WM and Academic Attainment

In several studies, the relationship between WM capacity and academic achievement has been well documented in children (Alloway \& Elsworth, 2012; Gathercole \& Pickering,

2000a, 2000b; Gathercole, Pickering, Ambridge, \& Wearing, 2004a; Vock \& Holling, 2008) and in university students and adults (Daneman \& Carpenter, 1980; Daneman \& Hannon, 2001; Swanson, 1994; Tolar, Lederberg, \& Fletcher, 2009). However, whilst the studies in younger learners have shown strong correlations between WM and high academic attainment (Alloway \& Alloway, 2010; Gathercole, Pickering, Knight, \& Stegmann, 2004b; St Clair-Thompson \& Gathercole, 2006), studies in college students have reported WM has only weak or indirect effects in predicting academic performance (Krumm, Ziegler, \& Buehner, 2008; Rohde \& Thompson, 2007). Tolar et al (2009) found WM strongly related to the adults' ability on SAT scores, but effects were reduced when other cognitive factors were controlled for, such as spatial ability.

In contrast, some studies suggest that WM may not have as great an effect on processing abilities as the students' first language, including the ability to suppress L1 influences or the level of L1 proficiency and general language aptitude as mentioned earlier (for review see Juffs \& Harrington, 2011).

### 1.7.3. Neuroimaging Studies

Various neuroimaging studies have investigated the issue of neural physiological dissociation of L1 and L2, but only a few studies have addressed this matter in relation to WM (Kim, Kim, Lee, Lee, Lee, \& Kwon, 2002; Kim, Byun, Lee, Gaillard, Xu, \& Theodore, 2011; Xue, Dong, Jin, \& Chen, 2004). Both Kim et al. (2011) and Xue et al. (2004) used fMRI for their studies. However, whilst Xue et al. (2004) came to the conclusion that L1 and L2 WM processing recruited the same neural substrates, Kim et al. (2011) did not; their results showed that L2 processing was more bihemispheric compared with L1. The authors noted an overall increase in activation, particularly of the right hemisphere, during L2 processing, compared with L1 processing including in the left precuneus, the right superior parietal lobe, the left middle occipital gyrus and the left cerebellum. These results were more compatible with Kim et al. (2002) who, using PET, found that the anterior section of the right dorsolateral prefrontal cortex (rDLPFC) and the left superior temporal gyrus were activated for the native Korean language, while the posterior area of the rDLPFC and the left inferior temporal gyrus were activated for the subjects' L2 (English), leading the authors to conclude that the right DLPFC and the left temporal lobe


Figure 1.4 Illustration of the 'phonological loop' within the working memory model. Verbal information is temporarily stored and processed here for recall (Modified from Baddeley, 2003).
may be structured into discrete, language-specific functional regions for working memory. Of interest, participants in all three studies had acquired English after the age of 12 years with low to moderate proficiency skills in English and, therefore, the differing results between the studies cannot be due to language proficiency or fluency. Further research replicating these studies with participants of varying English proficiency skills and age of $L 2$ acquisition would be valuable for our understanding of WM in bilinguals. One major criticism of studies measuring WM for L2 is that these studies do not take into account L2 proficiency and are in effect still measuring working memory of the listeners' first language.

The last chapter of this thesis takes these criticisms into account and investigates if working memory capacity is another factor that can affect academic performance differences between ESL students and their English-as-a-First Language (EFL) counterparts using a WM task that allows for lack of English fluency.

### 1.7.4. Understanding L2 Speech in Noisy Environments

International students report difficulties in speech recognition and comprehension as being a major problem, leading to them misunderstanding the content and intent of lectures (Daly \& Brown, 2007; Dooey, 2006; Huang, 2005; Mulligan \& Kirkpatrick, 2000; Ridley, 2004; Yang, 2004). This is well illustrated in the study by Mulligan and Kirkpatrick (2000) who found significant differences between English Speaking Background (ESB) and NESB students at the end of a lecture, with $34 \%$ of ESB students indicating that they understood the lecture content very well in contrast to only 9\% of NESB students. More alarming was that $22 \%$ of the NESB students reported that they understood very little of the lecture.

One major factor that must play a role in the difficulties faced by L2 students in acquiring information in lectures, tutorials or clinical settings, is that most such settings are not quiet environments. A standard lecture theatre or tutorial room often has some, or even high, level of background sound. Thus, the L2 students are faced with the challenge of acquiring verbally-presented information in the presence of background "noise" (competing auditory signals, including speech). This is particularly pertinent given that a number of studies have shown that L2 speakers may possess native-like speech comprehension in a quiet environment, but find it harder to recognize L2 speech when there is background noise (Buus, Florentine, Scharf, \& Canevet, 1986; Florentine, 1985; Florentine, Buus, Scharf, \& Canevet, 1984; Roussohatzaki \& Florentine, 1990; Salvi, Lockwood, Frisina, Coad, Wack, \& Frisina, 2002; Shi, 2010; Shtyrov, Kujala, Ahveninen, Tervaniemi, Alku, Ilmoniemi, \& Näätänen, 1998; Takata \& Nabelek, 1990; Wong, Uppunda, Parrish, \& Dhar, 2008).

### 1.7.4.1. Studies of Speech in Noise Perception

It is not known why this difficulty exists, but a number of hypotheses have been suggested as discussed later. This phenomenon has been shown to be language-
independent, with non-native listeners finding it harder to recognize speech in noisy environments than native listeners regardless of the L1 or L2 under consideration (Brouwer, Van Engen, Calandruccio, \& Bradlow, 2012; Cooke, Lecumberri, Scharenborg, \& van Dommelen, 2010; Golestani, Rosen, \& Scott, 2009; Rhebergen, Versfeld, \& Dreschler, 2005; Rogers, Lister, Febo, Besing, \& Abrams, 2006; van Wijngaarden, Steeneken, \& Houtgast, 2002). However, the degree of noise masking is noise-dependent, with greater masking effects seen in multi-talker babble background noise, particularly with 8 -talker babble (Lecumberri, Cooke, \& Cutler, 2010; Simpson \& Cooke, 2005) or 2-talker babble (Freyman, Balakrishnan, \& Helfer, 2004), dependent on attention, spatial or linguistic properties (e.g. consonant versus whole word identification).

Cooke et al. (2010) explored the issues of language-independence and maskerdependence in listener groups of eight different European L1 languages, including an English group, with the task of identifying English consonants in three varying background maskers; speech-shaped noise (SSN), temporally-modulated speech-shaped noise (SMN) and competing speaker (CS). Not only did the non-native listeners have poorer consonant recognition scores overall than the native listeners, but four out of the seven groups were more negatively affected by the CS condition than the modulated speech masker, whereas the native listeners had no significant difference between these two conditions. The authors concluded this difference was probably due to informational, rather than energetic, masking. Energetic masking is thought to affect speech processing at the level of the auditory periphery, whereas informational masking interferes with higher-order processing such as attention and cognitive load (Lecumberri et al., 2010). (For an extensive review on masking and other adverse listening conditions see Mattys, Davis, Bradlow, \& Scott, 2012). Another important finding from this study the authors noted was that the more proficient the listener was in the L2, the less adverse was the impact of the CS condition. However, as discussed later, fundamental processing or neurophysiological differences must still exist as no matter how proficient, L2 listeners continue to suffer greater disadvantage and do not seem to ever attain the same level of perception in noise as an L1 listener. This is demonstrated in a study by Rogers et al. (2006) in a group of Spanish born listeners who had learnt English before the age of six years old and were considered highly proficient with little or no detectable accent. Under quiet conditions, both monolinguals and bilingual listeners obtained identical, perfect
scores on a word recognition test. However, both in noise and noise with reverberation, the Spanish bilingual listeners performed significantly worse than their monolingual counterparts. Interestingly, both groups displayed significantly poorer performance in the noise with reverberation condition compared to the noise only condition, the former mimicking a more realistic everyday environment of a university student in a classroom or lecture theatre where there is background noise and speech reverberation from lecturers and fellow students.

The studies aforementioned show, in general, that performance by non-native listeners on speech perception tasks in noise is poorer relative to native speakers. However, the target language and/or background speech noise used is invariably English. Linguistically, English target speech and English speech noise consist of many common properties (e.g., phonemes, syllable structures, prosodic features, etc.), which may make it more difficult for listeners, particularly non-native, to segregate target language from background noise and contribute to greater informational masking (Van Engen, 2010). Some studies have investigated effects using both L1 and L2 background noise (Rhebergen et al., 2005; Van Engen, 2010). However, only one study so far (Brouwer et al., 2012) has explored the effects of native (other than English), rather than the usual non-native, target recognition presented in both L1 and L2 background noises. In this study, Brouwer et al. (2012), found that the masking effects were more detrimental when the target speech was the same as the background speech, regardless of the language used and independent of the L1 of the listener, i.e. English target sentences with English background noise or Dutch target sentences with Dutch background noise. (This is similar to the findings of Van Engen (2010), with English-Mandarin listeners). Also, the gains were greater when the competing background noise was English non-meaningful sentences as opposed to meaningful English sentences for both English monolingual and Dutch bilingual listener groups. The authors concluded that, therefore, this type of speech-on-speech masking must interfere with auditory processing at a semantic level as well as a phonetic level. Also, as with the earlier-reported Cooke et al. study (2010), the authors found that how familiar the subject was with the background language also impacted on the overall results.

The hypotheses surrounding the difficulties of speech in noise perception, particularly for L2 learners, include: how proficient the listener is in the L2 (Buus et al., 1986; Shi, 2009); the suggestion (with reasonable data to show this may be accurate) that the brain pathways may differ for processing of speech in noise and in quiet (Shtyrov et al., 1998; Wong et al., 2004) (although there have been no studies to date to show that this differs for L1 and L2 listeners) and; in adverse listening conditions such as reverberation or competing speech, signals become degraded and the spatial and temporal cues used to decipher phoneme, lexical and semantic structures are harder to recognize (Davis \& Johnsrude, 2003; Takata \& Nabelek, 1990).

### 1.7.4.2. Speech in Noise and Age of Acquisition

Another possibility is that this difficulty in processing speech and therefore acquiring verbal information in noisy backgrounds may stem from a factor detailed above: the age of acquisition of the L2 and consequent formation of neural pathways in the brain. Mayo et al (1997) have previously proposed that the age of L2 acquisition affects the capacity to perceive speech in background noise (Mayo et al., 1997). Here, the researchers administered the Speech Perception in Noise (SPiN) test to native Mexican-Spanish speakers who had learnt English fluently, either before the age of six or after the age of 14. (The SPiN or Speech-in-Noise (SiN) task tests verbal WM by means of the storing and processing of speech recognition in background noise via the phonological loop, see Figure 1.5). The results showed that the younger age group had a higher score for correct speech perception in high levels of noise than the older group. Moreover, the older group did not benefit from sentence context with similar scores for high or low predictability sentences, whereas the younger group did benefit from context and was able to better estimate the low predictability words. This may also be linked to the neural mechanisms involved in L1 and L2 speech processing as discussed earlier, and which has been argued occurs in different regions of the brain (Chernigovskaya, Balonov, \& Deglin, 1983; Furtado \& Webster, 1991; van den Noort, Nordby, Bosch, \& Hugdahl, 2005).

### 1.7.4.3. Speech in Noise and Academic Attainment

Although it is generally accepted that loud classroom noise has a negative effect on the learning of primary school children in aspects of memory, reading and attention (Crandell
\& Smaldino, 1996; Elliott, 1979; Klatte, Lachmann, \& Meis, 2010; Nelson, Kohnert, Sabur, \& Shaw, 2005; Shield \& Dockrell, 2008), there has been only limited research in older students or L2 learners, and even less studies correlating effects of detrimental background noise with overall academic outcomes. As in WM studies, the research with younger children has consistently shown strong correlations between poor listening conditions and low academic attainment (Beaman, 2005; Ljung, Sorqvist, \& Hygge, 2009), particularly in L2 children (Crandell \& Smaldino, 1996; Nelson et al., 2005).

However, results are not so clear-cut in older listeners (Beaman, 2005; Hygge, Boman, \& Enmarker, 2003; Kidd, Watson, \& Gygi, 2007). In the study by Kidd et al. (2007) the authors found only a weak correlation between Scholastic Aptitude Test (SAT) scores and auditory abilities when they compared L1 adults using SiN tasks but in the study by Hygge et al. (2003), the researchers found that meaningful irrelevant speech noise did significantly impair recall in a text-reading memory task in 92 native high school students in Sweden. Neither study (nor any study to date as best as can be determined) investigates the detrimental effects of background noise on academic outcomes for L2 learners, however, given the evidence for deleterious effects of noisy environments on classroom performance for native primary school students, it seems reasonable to assume that this, attenuated by poorer verbal WM for L2 learners under degraded background acoustics, must be a major contributing factor to poorer academic performance of non-native and ESL students. This view is somewhat supported by a recent, important study by Ljung et al (2010). Here the authors tested 48 native Swedish university students in varying background maskers. Firstly, the students performed a standardized hearing test, after which they immediately repeated test sentences to verify hearing ability.

Students were then instructed to listen to spoken lectures of up to eight minutes long in broadband noise or quiet (experiment 1) or ten paragraphs of lectures in classrooms of differing reverberation times (experiment 2) before undergoing memory tests of openended questions about the lecture contents. The subjects' memory performance was significantly worse under both adverse conditions compared with the quiet condition,


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Figure 1.5 A functional model of the phonological loop depicting analysis and rehearsal of auditory input within the short term storage of the loop before being passed to an output buffer for recall (From Baddeley, 2003).
even when the students had heard correctly the spoken lectures. This strongly demonstrates that speech intelligibility is distinct from memory and that background noise can affect not just WM, but can have detrimental and cognitive effects on learning in university students.

### 1.8. Conclusion

Over the next three chapters, this thesis explores how all the above-mentioned variables may influence the poorer academic outcomes of the international/ESL students in this research, with some variables studied to a greater degree than others. To begin with, sociometric data from the 2002-2006 cohorts of MBBS students shows how Language Families of the students' first language has influenced their total End of Year Total marks for the 1st and 2 nd years of study of the course.

Chapter 3 progresses to an examination of the individual assessments that make up the End of Year Totals in an endeavour to target the specific Assessment Types that seemed to be consistently problematic for the international students.

Having noted a pattern of poorer communication skills of the international students in the first two studies, in the last phase of this thesis, an analytical model was developed to bring together the major variables of vWM, age of acquisition of English and English Language skills as predictors of academic attainment in the End of Year Total marks and the individual Assessment Types of the ESL students. However, these measures were now carried out with the 2008-2010 cohorts of MBBS students, as well as neurophysiological Speech-in-Noise testing of a sample population of these students.

### 1.9. Rationale

### 1.9.1. General Aims

International medical students must contend with a number of stressors and languagerelated problems in their academic studies. Several factors are thought to affect academic outcomes which may impact differently on foreign and home pupils, with poorer English language proficiency usually attributed as the underlying cause of the generally lower academic results obtained by these students compared with their local counterparts.

This thesis, therefore, aims to examine how academic performance differs between international and local students in highly academically-prepared students with strong motivations for entry into the course, and where high level English proficiency and course motivation are prerequisites for a linguistically demanding course (IELTS Handbook, 2007,
p. 5), by investigating several factors identified as major contributing factors of L2 proficiency.

The current literature presented herewith strongly indicates that L2 proficiency may be linked to the later acquisition of English as a second language, which, on a neurophysiological level, may impair the ability to perceive English speech in a noisy environment and in turn, working memory for that L2. Other studies also suggest that skills in L2 are dependent on L1 influences. This thesis, therefore, will investigate academic differences between local and international Monash University MBBS students in relation to how the age of English acquisition and understanding speech in noise impacts verbal working memory. As far as can be ascertained, no study has looked at how all these factors may impact on academic performance, but this research has the potential for immediate and practical ramifications for students who may have impairments or disadvantages in this function.

### 1.9.2. Specific Aims

The specific aims of this research project were to:

- Carry out a retrospective analysis of previous MBBS student academic results to document learning outcomes of national and international students in wellconstructed learning tasks with clearly defined educational rationale and objectives, to examine if differences in these outcomes were more prevalent in particular forms of assessment (e.g. exams vs. written assignments). This utilised existing data from a previous longitudinal study carried out from 2002-2006.
- Collect census data on learning outcomes in the 1st and 2nd years of study of 582 students from the 2008-2010 cohorts in parallel with sociometric data on their acquisition and use of English.
- Carry out a prospective study of 113 (out of the 582 ) national and international students from the 2008-2010 MBBS cohorts, examining neurophysiological indices of the ability to extract English speech from other competing sounds and correlate these neurophysiological measures with these students' sociometric data, musical abilities and academic performance in a range of assessment instruments.
- Determine if poorer performance of the international students is due to neurophysiological or socio-behavioural factors and if there is an interaction between the two.


### 1.9.3. Hypothesis

There are numerous studies in the extant literature that provide empirical evidence to support the theory that international students do not perform as well academically as local students. The hypothesis here is more refined stating that academic performance between the local and international cohorts will be dependent on the students' respective Language Family. Further, the students (be they national or international) who have acquired English as a second language at a later age (i.e. after five years of age), will achieve lower scores in the audiometry testing, showing poorer verbal working memory for English and which will result in lower academic scores than those students for which English is their native language.

### 1.9.4. Specific Hypotheses

Study 1, described in Chapter 2, firstly endeavoured to establish if international students from the Monash University MBBS cohorts did in fact underperform academically compared with their local counterparts. It was hypothesised that academic performance differences between local and international students would be related to the students' language family, with international students from an English speaking background performing better than international students from a non-English speaking background (NESB). Also, it was expected that native Indo-European students would obtain higher marks than students with a first language from an Asian language background given most studies show a correlation between languages with phonetic similarities (Dzuganova, 2002; Long et al., 2008; Takano \& Noda, 1995) and cultural distances (Wan et al., 1992). It was also theorised that student status would influence academic outcomes and that local students would still outperform international students, regardless if English was native to the international student (Ferris \& Tagg, 1996; Lun, Fischer, \& Ward, 2010).

In particular, the current literature shows that students transitioning from their home country to an overseas location for study can find the first year extremely difficult, regardless of whether they speak the language of the host country or not (Fritz et al.,

2008; Koch, Salamonson, Rolley, \& Davidson, 2011; López, Ehly, \& García-Vásquez, 2002; Salamonson et al., 2008). Speaking the host-country language may alleviate the matter, but perhaps only to a minimum. In comparison, one would reasonably expect that a local student who speaks English as their L2 is still immersed in the language everyday (through TV, radio or conversation) and so their academic performance may not be affected as much as the international English-speaking student, to the extent that the academic performance is dependent on just familiarity with daily use of the language. Zhang \& Mi (2009) found this to be true in their study of 40 Asian students who experienced language difficulties when studying in Australian universities, even though the students had learnt English (some for as long as 9 years prior to arrival in Australia) as an L2 in their native country.

Study 2, described in Chapter 3, aimed to further examine differences between local and international students from the above 2002-2006 cohorts. From the findings in Study 1 that academic performance differed as a function of student origin status and language family, it was hypothesised that more subtle effects would be evident in performance in the varying assessments that make up the MBBS course. Poorer performance of Object Structured Clinical Examinations (OSCEs) in foreign students have been well documented (Bienstock et al., 2000; Schoonheim-Klein et al., 2007; Woolf et al., 2007), as well as poorer writing (Silva, 1993; Zhang \& Mi, 2009), and listening comprehension skills (Christison \& Krahnke, 1986; Ferris \& Tagg, 1996; Sawir, 2005). Comparisons of these skills-specific assessments were theorised to lead to focused areas for further investigation of the difficulties experienced by international students. The intention is to ascertain what other factors rather than acculturative stress contribute to the poorer performance of the international students found in Chapter 2.

Study 3, described in Chapter 4, used a well-established Speech-in-Noise task as a novel verbal working memory test to develop a model correlating verbal working memory, age of acquisition of English and self-reported English proficiency skills to academic performance of local versus international students in the 2008-2010 cohort. For this study, it was hypothesised that ESL students, be they local or international, would have lower scores than EFL students in the audiometry test due to lower discrimination of speech-in-noise skills (i.e. a higher Speech-to-Noise-Ratio) (Florentine et al., 1984; Mayo
et al., 1997; Shi, 2010). It was further posited that these students with lower speech-innoise results would also display lower academic scores (Ljung et al., 2010), and would have learnt to play music at an older age as studies show that trained musicians have a significantly higher discrimination rate of speech in noisy conditions than non-musicians (Parbery-Clark et al., 2009a; Schön et al., 2004). Additionally, students who had learnt to play music from a younger age would also have higher academic scores, as musical abilities have been indirectly linked to greater academic achievements (Brand, 2001; Cheek, 1999; Francois \& Schön, 2011).

## CHAPTER 2: THE

## INFLUENCE OF LANGUAGE

 FAMILY ON ACADEMIC PERFOMANCE IN YEAR 1 AND 2 MBBS STUDENTS
### 2.1. Declaration for Thesis Chapter 2

## Declaration by candidate

In the case of Chapter 2 the nature and extent of my contribution to the work was the following:

| Nature of <br> contribution | Extent of <br> contribution <br> $(\%)$ |
| :--- | :--- |
| Study design, data collation and verification, statistical analysis, <br> manuscript preparation | $75 \%$ |

The following co-authors contributed to the work. Co-authors who are students at Monash University must also indicate the extent of their contribution in percentage terms:

| Name | Nature of contribution | Extent of contribution (\%) <br> for student co-authors only |
| :--- | :--- | :--- |
| Ramesh <br> Rajan | Conception, supervision, data interpretation <br> and manuscript editing. | N/A |
| Benedict <br> Canny | Overseeing the acquisition and collection of <br> data, statistical advice and comments on <br> manuscript. | N/A |
| Jennifer <br> Lindley | Data acquisition, database and subject <br> knowledge, comments on manuscript. | N/A |

Candidate's
Signature


Declaration by co-authors

The undersigned hereby certify that:
the above declaration correctly reflects the nature and extent of the candidate's contribution to this work, and the nature of the contribution of each of the co-authors.
they meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
they take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
there are no other authors of the publication according to these criteria;
potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit; and
the original data are stored at the following location(s) and will be held for at least five years from the date indicated below:

Location(s) | Department of Physiology, Monash University, Clayton Campus, |  |
| :--- | :--- |
|  | Melbourne, Vic Australia |

Signature 1

Signature 2

Signature 3

|  |  |
| :--- | :--- |
|  |  |
|  |  |

### 2.2. Explanatory Note

 cademic performance differences between local and international students have been well documented. However, it was still necessary for this initial study to establish that this phenomenon was indeed occurring in the present cohort of students being researched within the Monash MBBS course following the introduction of the new PBL-based curriculum in 2002.

One criticism of studies investigating educational behaviours of foreign students is the propensity for researchers to jointly examine these students as homogenous entities. Therefore, the aim of this first study was to remedy, in some part, this misleading view by comparing academic outcomes between local and international students as a function of the Language Family of the students' first language from census information routinely collected (via questionnaire) from all students for each year of enrolment since commencement of the new syllabus and which contained some basic information relating to language usage at home. This was a unique approach that was made possible due to the range and diversity of the cultural backgrounds of Monash University international students.

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### 2.3. Abstract


enerally, in most countries around the world, local medical students outperform, in an academic sense, when compared with international students. In an endeavour to understand if this effect is due to language proficiency skills, we investigated academic differences between local and international MBBS students categorized by different Language Families. Data were available and obtained from medical students for the 1st and $2 n d$ years of study from 2002, 2003, 2005 \& 2006. Information on social demographics, personal history, and language spoken at home was collected as well as academic assessments for each student. Statistical analysis was carried out with a data set containing a total of 872 students. Local students performed better than the international students in the first ( p <.001) as well as the 2nd year ( p <.001) assessments. Also, there was a main interaction effect between Language Family and Origin, in the 1st year ( $p<.05$ ). Within the international students only, there was a main effect for Language in the 2nd year ( $p<.05$ ), with students from the Sino-Tibetan Language Family background obtaining higher mean scores than the students with English or Indo-European Language Family backgrounds. Our results confirmed that overall, local students perform academically better than international students. However, due to the existence of Language Family differences, this may be due to acculturation rather than simply English language skills

### 2.4. Introduction

Medical students studying at universities outside their home country generally do not perform academically as well as their local counterparts (Haq et al., 2005; Hawthorne et al., 2004; Kay-Lambkin et al., 2002; Liddell \& Koritsas, 2004; McManus et al., 2008; Schoonheim-Klein et al., 2007; Wass et al., 2003; Woolf et al., 2007). When English is the language of instruction, lack of proficiency in English is often thought to be a major contributing factor (Li et al., 2009) possibly even through ancillary effects. For example, some studies (Corson, 1997; Fernandez et al., 2007; Long et al., 2008) argue that as current medical, mathematical and scientific terminologies generally have Latin and Greek origin (Dzuganova, 2002), there is a greater difficulty for medical students whose first language does not share these geolinguistic origins, such as the Asian languages. Long et al. (2008) reported that students who had studied Latin obtained significantly
higher test scores than students whose first language was English but who had not studied Latin and further, that students whose parental language was English or of another European background scored significantly higher than others (Corson, 1997). However, worldwide, the language difficulties that overseas medical students experience extend beyond just difficulty with terminologies, to activities such as listening and reading comprehension (Ferris, 1998; Huang, 2005). This suggests that the typological relation of the first language to English may only account for some, but not all problems.

Many institutions (Light et al., 1987) require that overseas students meet stringent language standards via validated assessments such as the International English Language Testing System (IELTS). However, these tests may not adequately evaluate the English skills needed in university study: Cummins (1979), for example, contends that academic language proficiency is very different to the communication skills taught to second language learners and takes considerably longer to be mastered. Therefore, compared with native speakers, international students might be at a considerable disadvantage despite meeting language proficiency requirements for their course. At any rate, there is little direct evidence to show that higher scores in these tests correlate to better language skills or even academic success (Light et al., 1987; Stacey \& Whittaker, 2005).

Consistent with the idea that other factors must also play a role in academic performance, not all international students overall perform less well as the domestic students, with some studies showing overseas students obtaining higher overall scores (Lovell, 2003; Morrison et al., 2005). Thus, international students cannot be treated as a homogenous group.

We have investigated academic performance differences between local and international students in the first two years of the Bachelor of Medicine, Bachelor of Surgery (MBBS) course at an Australian university. This university has a large and diverse international and local student population, with overlapping language roots, and generally requires students to have a high level of English proficiency (evaluated using the IELTS). This goes towards reducing, if not obviating, the issue of language proficiency. This affords a great advantage in examining how the language family roots of a student affects their academic performance in medical studies and whether this depends on whether the student is local or international. Given the multi-racial composition of many countries, including

Australia, Language Family is a broad concept and should provide a novel perspective. Language Family is commonly considered to be a group of languages that have descended from a common ancestor language (proto-language) and which share phonetically similar characteristics, (see Table 2.1 for examples). We hypothesize that academic performance differences between local and international students can be related to Language Family, with international students from an English speaking background performing better than international students from a non-English speaking background. In extension of this hypothesis we expect Indo-European students will obtain higher marks than students with a first language from the Asian Language Families.

### 2.5. Methods

### 2.5.1. Participants and Database

Data were sourced from census data collected annually by our Faculty, at the advent of a new five-year patient-based learning model, undergraduate MBBS curriculum that commenced in 2002. A total of 1142 students were invited to complete a questionnaire on social demographics and a range of psychometric scales such as study habits and perceived stress. Students were categorized as 'Local' if they held a governmentsubsidized place (known as 'HECS' and available only to Australian students) or as "International" if they were either full-fee paying students or held government scholarships or bonds from an overseas country, e.g. MARA Scholarship of Malaysia. Participation was voluntary and anonymous.

For the current study, data were selected only for the 1st and 2nd years of study for those student cohorts commencing studies in 2002 - 2006, with the exception of the 2004 cohort: (relevant data on language use were not collected from this cohort and hence not useable). Therefore, a total of 872 , of a possible 918 , students completed the questionnaire, (response rate of 95\%). Table 2.1 contains details of the composition of the database for this study. From the questionnaire, and after obtaining ethics approval for this study (Appendix C1), information pertaining to personal history, social demographics, and language was utilized. Based on the question "What language do you speak at home?" students were allocated to one of five Language Family categories,
namely 1) English ${ }^{4}$, 2) Indo-European, 3) Sino-Tibetan, 4) Austronesian and 5) Other NonEnglish/Combination (sourced from Katzner, 2002). Of these five categories, it was possible to compare Language Family outcomes for Local and International students only from the first three Families. The Austronesian family contained only five local students (and all in the same year, 2003), compared to 121 international students across all four years, which would likely skew the data and result in a Type II error. However, the last two Language Family categories were included for overall analyses where Language Family was not a variable.

Academic assessments for each student were collated across both semesters of each year as a total 'End of Year' score for Year 1 and Year 2 respectively. Assessments varied from year to year, but all End of Year totals encompassed a combination of multiple choice questions (MCQ), written assignments such as essays and Objective Structured Clinical Examination (OSCE) role plays. For this collation, all group activity assessments were deducted from the final End of Year score in order to gain a true measure of an individual student's scores.

### 2.5.2. Statistical Analysis

Statistical Analysis was carried out using SPSS software version 17.0.0, SPSS Statistics Inc. All statistics are parametric and data were checked for normality of distribution and variation. To eliminate the potential of gender bias, all statistics was carried out with gender as a covariate, but this did not show as significant in any of the analysis of covariance (ANCOVA) tests. Univariate ANCOVA was carried out to test differences in Language Family and Origin (i.e. Local or International) with the dependent variable being the End of year Total Score and the independent variables being Language Family and Origin. To test for significance between the two years of study, repeated measures ANCOVA was also performed with two-factor (year x Language Family) independent variables using the 831 students who completed both Year 1 and Year 2 of the course (referred to as 'Same Student' cohort). In addition, a one-way between-groups ANCOVA

[^2]was conducted to compare the influence of Language Family on the Year 2 end of year scores, with the mean end of year scores for Year 1 and gender as the covariates.

### 2.6. Results

In each of the two years of study the mean end of year scores was greater for the Local students than the International students (Figure 2.1A). A one-way between-groups analysis of covariance (ANCOVA) confirmed that these differences were statistically significant for both years of study (Table 2.3, row 1.1).

We examined whether this effect of origin (Local versus International) occurred across all three main Language Families, as defined here. The results are shown in Table 2.3. A twoway between-groups analysis of covariance showed no statistically significant main effect for Language Family for Year 1 (Table 2.3, row 1.2) but there was a statistically significant interaction between Language Family and Origin (Table 2.3, row 1.4), showing that in Year 1, the effect of origin on end of year outcomes varied with Language Family. (A follow-up one-way between-groups analysis of variance (ANOVA) revealed a significant difference for the English Language Family (Figure 2.1B; Table 2.3, row 1.5a).

In Year 2, a two-way between-groups ANCOVA did not find a statistical significant main effect for Language Family (Table 2.3, row 1.2) nor an interaction effect between Language Family and Origin (Table 2.3, row 1.4), but there was a statistically significant main effect for Origin (Table 2.3, row 1.3). A follow-up one-way between-groups ANOVA showed significant differences for the English and Indo-European Language Families, respectively (Figure 2.1C; Table 2.3, rows 1.5 a \& 1.5b).

We next considered effects of only the international cohorts across the different Language Families. A one-way between-groups ANCOVA of end of year scores (Figure 2.2) found no significant main effect of Language in Year 1 (Table 2.3, row 3.1), or in Year 2 (Table 2.3, row 3.1).

However, pairwise comparisons revealed that the mean score of the Sino-Tibetan was significantly greater than the English Language Family in Year 2 ( $p=.03$ ). In the analyses to date we used data from all students even if they completed only one year of the course. To ensure that no bias was introduced by this procedure, we also analysed data
only from the students who completed both years (the 'Same Students' cohort; $\mathrm{n}=831$ ). Generally, analyses using only the Same Student cohort resulted in similar effects to those seen with the whole database. Thus, for example, there was still a significant difference between Local and International students in both years (Table 2.3, row 2.1), as seen in the overall cohort. With respect to the analyses for the entire dataset shown in Figure 2.1B \& 2.1C, the Same Student cohort yielded the same effects for Year 2; however for Year 1 the Same Student cohort (2-way between-groups ANCOVA) showed no interaction effect for Language Family and Origin (Table 2.3, row 2.4), whereas such an interaction was seen in data from the entire cohort. There was also a statistical difference for Origin in Year 1 (Table 2.3, row 2.3), whereas there was no such effect when the entire dataset was analysed.

Table 2.1 Descriptive statistics for students for Years $1 \& 2$ of MBBS undergraduate degree

| MBBS Cohorts 2002-6 |  |  |
| :---: | :---: | :---: |
|  | Year 1 | Year 2 |
| Total (Loc:Int)* | 872 (558:314) | 832 (523:309) |
| Mean End of Year Totals ( $\pm$ SD) ${ }^{\dagger}$ | 69.44 (6.37) | 73.37 (7.75) |
| Gender (Loc:Int)*: |  |  |
| Males | 350 (211:139) | 333 (195:138) |
| Females | 520 (345:175) | 497 (326:171) |
| Not Known | 2 (2:0) | 2 (2:0) |
| \% Male: |  |  |
| Local | 38 | 37 |
| International | 44 | 45 |
| Language Family (Loc:Int)*: |  |  |
| English | 548 (463:85) | 517 (433:84) |
| Non-English: |  |  |
| Indo-European <br>  <br> Western European <br> languages e.g. <br> German, French, Russian etc. and IndoIranian languages e.g. Hindi, Persian, Sinhalese etc.) | 53 (38:15) | 50 (35:15) |
| Sino-Tibetan <br> (Includes: all Chinese languages <br> e.g. <br> Mandarin, Cantonese etc. and TibetoBurman languages e.g. Burmese and Tibetan etc.) | 103 (37:66) | 100 (35:65) |
| Austronesian <br> (Includes: all Malayo- <br> Polynesian languages <br> e.g. Indonesian, <br> Malay, Fijian, Maori, <br> Samoan, etc.) | 129 (5:124) | 126 (5:121) |
| Other <br> (Includes: all other non- English <br> languages not classified in other groups e.g. Tamil, Japanese, Vietnamese, Arabic, Hebrew, etc. or a combination of two or more language families.) | $39 \text { (15:24) }$ | 39 (15:24) |

*Loc=Locals:Int=Internationals, +Standard Deviation

2.1A: Local vs International Students
2.1B: Year 1
2.1C: Year 2

Local International

Figure 2.1 2.1A: Mean end of year scores ( $\pm$ SD) for Local and International students for Year 1 and Year 2 of a 5-year MBBS course. The end of year scores were calculated only from the tasks in which students were assessed for individual performance (i.e. not including any group activities). 2.1B: Mean end of year scores ( $\pm$ SD) for Local and International students in Year 1, as a function of Language Family. 2.1C: Mean end of year scores ( $\pm$ SD) for Local and International students in Year 2, as a function of Language Family. The Y -axes reflect the minimum (44.4\%) and maximum (95.71\%) range of individual End of Year Scores. *p<.05, **p<.001.

## International Students



Figure 2.2 Mean end of year scores ( $\pm$ SD) for International students for Year 1 and Year 2 by Language Family. The $Y$-axes reflect the minimum (44.4\%) and maximum (95.71\%) range of individual End of Year Scores. p<. 05 between a and b.

With respect to the results shown in Figure 2.2 for the entire dataset, analysis of the international students in the Same Student cohort produced almost identical findings to the previous findings, i.e. no main effect for Language in Years 1 or 2, but, again, there was statistical significance between the English and Sino-Tibetan families.

In our final set of comparisons, a within-subjects ANCOVA was conducted to assess the impact of Language Family on participants' end of year scores across the two years of study in the Same Student cohort. There was no interaction effect between Year and Language Family for international students (Table 2.3, row 4.2), nor was a main effect seen for year of study (Table 2.3, row 4.1). However, all Language Families did show an increase in mean score in the 2 nd year of study. To investigate further these findings, we performed a one-way between-groups analysis of covariance to compare the influence of Language Family on the Year 2 end of year scores, with the mean end of year scores for Year 1 and gender as the covariates. The results showed there was a large relationship between the scores for Year 1 and Year 2 (Table 2.3, row 4.3).

Table 2.2 Mean values for End of Year Scores

|  |  |  | Year 1 |  |  |  |  |  | Year 2 |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | End of Year Scores Mean ( $\pm$ SD) ${ }^{+}$ |  |  |  |  |  | End of Year Scores Mean ( $\pm$ SD) ${ }^{\dagger}$ |  |  |  |
| All Students Cohort: | Total | (Loc:Int)* | Local |  | Intern | tional | Total | (Loc:Int)* | Local |  | Interna | onal |
| All Language Families | 872 | (558:314) | 70.88 | (5.59) | 66.87 | (6.86) | 832 | (523:309) | 75.43 | (7.56) | 69.89 | (6.75) |
| Mean Difference |  |  | 4.01\% |  |  |  |  |  | 5.54\% |  |  |  |
| English | 548 | (463:85) | 71.16 | (5.33) | 68.58 | (7.42) | 517 | (433:84) | 75.52 | (7.45) | 70.21 | (7.12) |
| Indo-European | 53 | (38:15) | 70.25 | (6.55) | 67.33 | (5.97) | 50 | (35:15) | 77.11 | (8.62) | 69.32 | (6.79) |
| Sino-Tibetan | 103 | (37:66) | 69.35 | (7.23) | 70.41 | (6.51) | 100 | (35:65) | 74.62 | (7.44) | 72.76 | (5.73) |
| Total | 704 | (538:166) | 70.97 | (5.59) | 69.19 | (6.99) | 667 | (503:164) | 75.56 | (7.54) | 71.14 | (6.67) |
| Mean Difference |  |  | 1.78\% |  |  |  |  |  | 4.43\% |  |  |  |
| Same Student Cohort: |  |  |  |  |  |  |  |  |  |  |  |  |
| All Language Families | 831 | (522:309) | 71.17 | (5.18) | 66.91 | (6.78) | 831 | (522:309) | 75.44 | (7.57) | 69.87 | (6.75) |
| Mean Difference |  |  | 4.27\% |  |  |  |  |  | 5.57\% |  |  |  |
| English | 516 | (432:84) | 71.40 | (5.02) | 68.78 | (7.23) | 516 | (432:84) | 75.52 | (7.46) | 70.21 | (7.12) |
| Indo-European | 50 | (35:15) | 70.89 | (5.95) | 67.33 | (5.97) | 50 | (35:15) | 77.11 | (8.62) | 69.32 | (6.79) |
| Sino-Tibetan | 100 | (35:65) | 70.22 | (5.94) | 70.21 | (6.37) | 100 | (35:65) | 74.62 | (7.44) | 72.76 | (5.73) |
| Total | 666 | (502:164) | 71.28 | (5.16) | 69.21 | (6.81) | 666 | (502:164) | 75.57 | (7.54) | 71.14 | (6.67) |
| Mean Difference |  |  | 2.07\% |  |  |  |  |  | 4.43\% |  |  |  |

*Loc=Local:Int=International, +Standard Deviation

Table 2.3 ANCOVA \& ANOVA results

|  |  | Year 1 |  | Year 2 |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| row | variable | F, (df), p | effect size (n2) | F, (df), p | effect size ( $\mathrm{\eta} 2$ ) |
| 1 | All Students Cohort (Local \& International Students): |  |  |  |  |
| 1.1 | Comparison of End of Year results of Local vs. International in all students | 87.26, (1,869), .00† | 0.091 | 112.8, (1,829), . $00{ }^{+}$ | 0.12 |
| 1.2 | Main effect for Language in 3 main language families only | 0.64, $(2,697) .53$ | - | 0.44, (2, 660), . 64 | - |
| 1.3 | Main effect for Origin in 3 main language families only | 3.77, (1, 697), . 053 | - | 27.23, (1, 660), . $00 \dagger$ | . 04 |
| 1.4 | Interaction between Language Family and Origin in 3 main language families only | 3.54, (2, 697), .03* | . 01 | 2.88, (2, 660), . 057 | - |
| 1.5 | Interaction follow-up one-way ANOVA: |  |  |  |  |
|  | 1.5a English | 14.75, (1, 546), . $00 \dagger$ | . 026 | 36.12, (1, 515), . $00{ }^{+}$ | . 066 |
|  | 1.5b Indo-European | 2.25, (1, 51), . 14 | - | 9.64, (1, 48), .003* | . 17 |
|  | 1.5c Sino-Tibetan | 0.58, (1, 101), . 45 | - | 1.94, (1, 98), . 17 | - |
| 2 | In Same Student cohort (Local \& International Students): |  |  |  |  |
| 2.1 | Comparison of End of Year results of Local vs. International in all students | 103.23, (1, 828), . $00{ }^{+}$ | 0.11 | 112.92, (1, 828), . $00{ }^{+}$ | 0.12 |
| 2.2 | Main effect for Language in 3 main language families only | 0.62, (2, 659), . 54 | - | 0.44, (2, 659), . 65 | - |
| 2.3 | Main effect for Origin in 3 main language families only | 7.95, (1, 659), .005* | . 012 | 27.24, (1, 659), .00† | . 04 |
| 2.4 | Interaction between Language Family and Origin in 3 main language families only | 2.20, (2, 659), . 11 | - | 2.88, (2, 659), . 057 | - |
| 3 | All Students Cohort (International Students - 3 main language families only): |  |  |  |  |
| 3.1 | Main effect for Language | 1.75, (2, 162), . 18 | - | 3.04, (2, 160), . 051 | - |
| 4 | In Same Student cohort (International Students - $\mathbf{3}$ main language families only): | Across Year 1 \& Year 2 F, (df), p |  |  | effect size ( $\mathrm{\eta} 2$ ) |
| 4.1 | Main effect for year of study | 1.64, (1, 160), . 20 |  |  | - |
| 4.2 | Interaction between Year and Language Family | 0.66, (2, 160), . 52 |  |  | - |
| 4.3 | Relationship to covariate End of Year 1 score | 122.46, (1, 159), . $00+$ |  |  | . 44 |

*p<.05, $\dagger \mathrm{p}<.001$

### 2.7. Discussion

The main result seen here was that the academic performance of international MBBS students was generally - but not always - poorer than that of local students in the first two years of study in the course. Before discussing these results, a number of methodological issues need to be addressed.

### 2.7.1. Methodological issues

Data for this study came from previous collections and records occasionally had anomalies. However, all discrepancies were corrected and all data then multiply rechecked. Also, there were some constraints with data on language as the questionnaire responses do not demonstrate language proficiency or language preference (e.g., students may use that language for reasons such as it being the only common language in a shared accommodation). Next, there were imbalances in sample size in each Language Family, but this was at least accounted for by the type of analyses conducted. Finally, it is reasonable to assume there is a larger variation in English proficiency in the international students compared to the local native speakers, particularly as IELTS is capable of assessing language proficiency to a near-native standard, but it is often not required of the student to be at that level. However, this assumption could not be directly confirmed since we were not allowed access to the IELTS scores of the international students for privacy reasons.

### 2.7.2. Effects seen in this study

The first point of interest in these results is the interaction effect between Language Family and Origin, seen in Year 1. One reason may be the significant difference between the local and internationals in the group identifying English as their Language Family, as noted by the follow-up one-way ANOVA. However, there is also a significant difference in the English language group in Year 2, but there are no interaction effects there, indicating this is probably not the cause. Nevertheless, these results are important as it demonstrates that language, in this instance, is not a major predictor of academic performance as there are statistically significant differences in cohorts of the same Language Family. Therefore, there must be other factors, which influence the students' End of Year scores.

One such factor may be 'acculturation's , the process whereby foreign students are faced with additional stressors beyond the normal challenges of first-year university, such as culture shock, homesickness, and language barriers (Lacina, 2002; Mori, 2000; Ridley, 2004; Sandhu \& Asrabadi, 1994). A recent study by Salamonson et al. (2008) reported a direct correlation between low English acculturation test scores and low academic grades among first year ESL nursing students. However, two separate studies, (Portes, 1999; Yeh \& Inose, 2003), show that acculturation does not impact overseas students equally and that differences vary with first language, with students from Europe experiencing less acculturative stress than their counterparts from Asia, Central/Latin America, and Africa. This may suggest that overall lower grades are due to a combination of language proficiency and acculturation and this is supported by our finding that the local IndoEuropean students also performed overall academically better than their international counterparts.

Within the international students only, there was a significant difference between the English and Sino-Tibetan Language Families, again implying that acculturation rather than language proficiency was the main predictor of academic performance. The IndoEuropean group also had a lower mean End of Year total score than the Sino-Tibetan and English families. While this difference was not statistically significant, (due to the small number of students, $\mathrm{n}=15$ ) it supports the argument that acculturation and not language proficiency is a dominant predictor of academic performance in overseas students. Future studies where detailed information on language skills is collected with equal numbers in each Language Family could provide further clarification.

Another possible reason for the observed interaction effect noted in Year 1 may be due to the Sino-Tibetan, and not English, Language Family. In analysis of the entire database, the international Sino-Tibetan students attain generally higher marks than their local counterparts in Year 1 and an interaction effect is seen. However, in the Same Student cohort, the mean End of Year total scores in the 1st year of study are almost identical between the local (70.22) and international (70.21) Sino-Tibetan students, and no interaction effect is seen. These findings also support our contention for acculturation as

[^3]a major factor here, as these students do almost as well academically, possibly due to language proficiency equal to or on-par with their native counterparts.

### 2.7.3. Future studies

These unanticipated results raise a number of questions we plan to address in future studies. As well as detailed information on English language skills, it would be important to also compare the age of acquisition of English as this impacts on language proficiency (Johnson \& Newport, 1989). It would also be helpful to analyse individual assessment tasks rather than only the End of Year total score. Moreover, it would have been beneficial to have a greater number of students in the Austronesian Language Family to further explore the acculturative stress issue, and collating information from additional Language Families is another factor for investigation in future studies.

### 2.7.4. Conclusion

We investigated academic differences in local and international MBBS students at an Australian university. Our results confirmed the observation that generally, international students do worse academically than local students from the same language family. However, interesting deviations from this observation suggested that the overall poorer performance may probably be due to acculturation rather than English skills.

## CHAPTER 3: MEDICAL

SCHOOL ASSESSMENT IS
AFFECTED BY STUDENT
ORIGIN BUT NOT
LANGUAGE FAMILY AND
VARIES WITH YEAR OF
STUDY

### 3.1. Declaration for Thesis Chapter 3

Declaration by candidate

In the case of Chapter 3 the nature and extent of my contribution to the work was the following:

| Nature of <br> contribution | Extent of <br> contribution (\%) |
| :--- | :--- |
| Study design, data collation and verification, statistical analysis <br> manuscript preparation | $75 \%$ |

The following co-authors contributed to the work. Co-authors who are students at Monash University must also indicate the extent of their contribution in percentage terms:

| Name | Nature of contribution | Extent of contribution <br> (\%) for student co- <br> authors only |
| :--- | :--- | :--- |
| Ramesh <br> Rajan | Conception, supervision, data interpretation <br> and manuscript editing. | N/A |
| Benedict <br> Canny | Overseeing the acquisition and collection of <br> data, statistical advice and comments on <br> manuscript. | N/A |
| Jennifer <br> Lindley | Data acquisition, database and subject <br> knowledge, comments on manuscript. | N/A |

Candidate's
Signature


## Declaration by co-authors

The undersigned hereby certify that:
the above declaration correctly reflects the nature and extent of the candidate's contribution to this work, and the nature of the contribution of each of the co-authors.
they meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
they take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
there are no other authors of the publication according to these criteria;
potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit; and
the original data are stored at the following location(s) and will be held for at least five years from the date indicated below:

| Location(s) | Department of Physiology, Monash University, Clayton Campus, <br> Melbourne, Vic Australia |
| :--- | :--- |

Signature 1

Signature 2

Signature 3 $\square$

### 3.2. Explanatory Note


n the previous chapter it was established that this cohort of international students showed evidence of poorer academic performance compared with their local counterparts, and this was attributed partly to acculturative stress. A subset of the students from this cohort (students from 2002-2005) had been tested for perceived stress and learning styles in another study by researchers in a different department of the same university (Bagot et al., 2005, unpublished data) and it had been found that perceived stress levels were significantly higher in the international students than the local students. They also found that academic performance was significantly poorer in the foreign students and correlated to learning style, with international students favouring the surface approach to learning rather than the deeper strategic approach (Bagot et al., 2005). These findings were not reported in the published data, but could assist in the interpretation of results in Study 1. This finding also raised the question of what other factors could contribute to the poorer performance by the international students.

Comparing the End of Year Totals, as conducted in the previous chapter, provided a broad overview of the situation, but to investigate what other factors could be involved, a thorough examination of the different skill sets evaluated in the course was needed since different assessments call on different cognitive skills and technical knowledge (Bridges et al., 2002), and cultural backgrounds may influence approaches to study (Kusmierczyk, 2011; Niles, 1995). A varied curriculum that assesses for these different skills is important as a set of grades assessed over a number of various subjects will give a better indication of the student's abilities than a single grade (Downs, 2006).

Therefore, the aim of Study 2 was to compare the academic attainment of local and international students in the different assessment types that, combined, made up the end of year total scores, such as examinations, coursework and OSCEs.

Generally, students perform better in in-semester tasks, such as coursework, than in formal examinations (Bridges et al., 2002; Yorke et al., 2000). Therefore, coursework may increase scores in academic performance and reduce variation between students in their overall marks (Downs, 2006). However, many of the studies that have looked at
coursework versus examinations have not compared scores for international and home students. Therefore, it is not known if international students will perform equally well as home students in an assessment type that is more linguistically demanding such as coursework.

Also, whilst academic listening tasks pose problematic challenges for foreign students, regardless of their proficiency in English (Ferris \& Tagg, 1996) and particularly at the commencement of their courses (Zhang \& Mi, 2009), the degree of difficulty with writing is considered to be greater and more linguistically demanding than reading, speaking or listening (Ferris \& Tagg, 1996; Morris \& Cobb, 2004; Sawir, 2005; Silva, 1993; Webb, 2002; Zhang \& Mi, 2009). This is due to writing requiring a reproducible understanding of language grammar and syntactical use rather than passively recognising and absorbing information, as in reading or listening comprehension (Hyland, 2003). Writing is also the main medium of output for assessments, so poor written skills may be misconstrued as poor understanding of the subject or poor cognitive skills of the students (Webb, 2002).

In the study by Zhang \& Mi (2009), the authors found that international students from eight Australian universities had significantly less problems with speaking and listening to English, but still had major difficulties with writing in English despite having spent more classroom time learning English writing skills, when compared with speaking skills, as part of their educational instruction back in their home country. Further, unlike listening and speaking, writing skills did not seem to improve greatly over time mainly due to the coping strategies employed by the students, such as re-listening to online lectures or rereading text books.

Given these considerations, it would be expected that differences may be noted between local and international students in those assessments that contain mainly written components, such as coursework; contrary to the current literature.

Further, it would be expected that those assessments that contain few written components, such as examinations, should result in fewer or no differences in marks between the students. The examinations undertaken in these years are multiple choice or short answer questions that are not as linguistically demanding as written assignments and therefore does not require highly-proficient English language skills (Amin \& Khoo,
2003). Therefore, if there were any differences in examination scores between local and international students, they should not be ascribed to English proficiency per se, but may be more indicative of cognitive rather than behavioural factors such as speed of processing or working memory for the L2, which has been documented to be reduced in second language speakers (Conway, Cowan, Bunting, Therriault, \& Minkoff, 1993).

As stated in the General Introduction, it was noted (Malau-Aduli, 2011) that in medical students one of the most stressful assessments is the OSCEs; international students may find this assessment particularly difficult as it is contingent on all the students' knowledge, verbal communication skills and critical thinking skills in a realtime, highly stressful environment (Hauer, Boscardin, Gesundheit, Nevins, Srinivasan, \& Fernandez, 2010; van Dulmen et al., 2007). The OSCE is also an assessment where cultural differences are most apparent, e.g. attitudes to patients, demonstration of empathy etc. (Fernandez et al., 2007; Liddell \& Koritsas, 2004). Therefore, there may be distinct differences in this assessment type between the two cohort of students.

This Chapter was written as a manuscript submitted to, but not accepted by, the British Medical Journal October 2011. It has been amended slightly for this thesis.

### 3.3. Abstract


edical courses employ various assessments to evaluate student skills. However, few studies have compared scores of local and international students to investigate whether differences occur in specific assessments. The previous study showed that academic performance of MBBS students differed according to Origin and Language Family (LF). Here differences were examined between these cohorts to test subtle effects on performance in varying assessment types to see what additional differences between local and international students can be found, in consideration with acculturative stress.

Data were obtained from a pool of medical students for their 1st and 2nd years of study. Information on social demographics, language spoken at home and academic assessments were collected. Statistics were performed on 707 students, divided into Language Families. Assessment instruments varied, but included examinations, coursework and OSCEs.

Across assessments there were year-specific differences between local and international students, suggesting that varying factors may occur. In the first year, international students showed poorer performance only in communications-based tasks, with significantly lower marks in the OSCE communication assessment. In the second year, international students performed worse than the locals in all assessments; significantly for the English and Indo-European Families but not the Sino-Tibetan, albeit there was a trend.

The 1st year results show poor communications skills impacts on the internationals' performance. In the 2nd year internationals did worse than locals in all assessments. These year specific differences indicate that acculturative stress is not the only influential factor in academic performance. A likely and plausible factor may be reduced verbal working memory capacity and possible greater demands on English language skills. Results indicate that support required to provide international students with opportunity for success will differ as a function of their progression.

### 3.4. Introduction

There is increasing trans-national movement of students to undertake higher education, especially medical training. This has highlighted the issue of the role of linguistic competence in successful attainment of academic skills and fitness for practice, of international students when taught in a language other than their native tongue. A substantial body of evidence, almost exclusively from countries where the lingua franca is English - and hence the medium of academic instruction - shows that there can be considerable differences in academic performance between home country students and their international peers. While a small set of studies report that international students outperform local students (Bienstock et al., 2000; Lovell, 2003; Marshall \& Chilton, 1995), the great majority of studies show the opposite, across a range of disciplines including medical studies (Kay-Lambkin et al., 2002; Li et al., 2009; Liddell \& Koritsas, 2004; Light et al., 1987; Morrison et al., 2005; Sawir, 2005; Wass et al., 2003). Recently this was confirmed to be true in a very large cohort of 873 Bachelor of Medicine/Bachelor of Surgery (MBBS) students in the 1st two years of study over a five year period in a major Australian university (Mann, Canny, Lindley, \& Rajan, 2010).

When studies have attempted to identify the source of the performance differences between international and local students (Logan \& Hazel, 1999; Morrison et al., 2005; Smith, 2011; Treloar et al., 2000), one common problem is a lack of English proficiency in students who have acquired English as a second language (Lun et al., 2010). As linguistic competence is often evaluated in students' work (Webb, 2002), those with poor language skills may be misconstrued as lacking the cognitive capabilities needed for success and be scored lower. Consistent with this notion, Lun et al. (2010) reported that English proficiency, rather than cross-cultural differences, accounted for the significantly better performance by Western university students compared to their Asian counterparts in various critical thinking tasks.

A small number of more-detailed studies suggest that differences between international and local students do not apply uniformly across all assessment modes (De Vita, 2002; Downs, 2006). Modern medical courses employ a variety of assessments to evaluate student skills and often a distinction is made, explicitly or in ethos, when designing assessments between different types of skills, e.g., technical, communication-based,
metacognitive. However, only a few studies have gone beyond comparing the overall academic scores of local and international medical students in the same course to investigate whether differences occur in specific metacognitive skills, pedagogical factors or assessment types that contribute to the overall performance (Fernandez et al., 2007; Hauer et al., 2010; Schoonheim-Klein et al., 2007; Van Zanten, Boulet, \& McKinley, 2003; Wass et al., 2003). Particularly in regards to medical education, the extant literature has examined differences between home and foreign students in only one or two assessment modes (Yorke et al., 2000), instead focusing generally on extenuating factors for global performance differences between such students (e.g. Bridges et al., 2002; Craig, Gordon, Clarke, \& Oldmeadow, 2009; De Vita, 2002; McManus et al., 2008; Yorke et al., 2000). Academic performance differences between domestic and international medical students are widely reported to occur in role-play examinations of Objective Structured Clinical Examinations (OSCEs) but such studies do not mention effects in other assessments (Fernandez et al., 2007; Haq et al., 2005; Hauer et al., 2010; Schoonheim-Klein et al., 2007; Van Zanten et al., 2003; Wass et al., 2003; Woolf et al., 2007). As far as can be ascertained, no single study has systematically examined differences in the same cohort of local versus international students across the wide range of assessment types in a medical curriculum. Further, no study has examined if effects in local versus international students in a medical cohort are similar across more than one year of study. Both of these are very important variables to determine for appropriate curriculum design in medical and other health professional courses, to determine the type of attention and support that needs to be provided to allow international medical students the greatest opportunity for success, and whether this varies with their progression through such courses.

In a previous study (Mann et al., 2010) the poorer overall academic performance of international students compared to local students appeared possibly due to acculturative stress, which can occur in first year university students studying outside of their country who must cope with additional stressors that become overwhelming such as homesickness, culture shock, language barriers etc. (Sandhu \& Asrabadi, 1994; Treloar et al., 2000). However, this is unlikely to be the only contributing factor. In the study by Mann et al. (2010) another important variable was the Language Family (the term used to categorise groups of languages that share common roots and phonetic similarities, see

Table 3.1 for examples) of the students' first language. The differences between local and international students were not uniform across all Language Families, and this was also true between the different groups of international students. For the present study, the aim was to further examine this large cohort of MBBS students for differences between local and international students in the different broad categories of assessments in that course (Coursework, Examinations and OSCEs).

Given the earlier findings that academic performance of these 1st and 2nd year MBBS students differed as a function of Origin (local or international) and Language Family, it was thought that testing these factors may show more subtle effects on performance in the varying assessment types. There was also a desire to see if the effects of Origin and Language Family persisted as the students progressed from Year 1 to Year 2.

### 3.5. Methods

### 3.5.1. Participants and dataset

A detailed account of the participants recruited, and data used in this project can be found in the preceding chapter. To summarize, data were obtained from census data collected annually by the Faculty from students in the undergraduate MBBS course, commencing in 2002. Questionnaires (not available for attachment) were distributed at the commencement of each year to the students and were comprised of social demographics and a range of psychometric scales, such as study habits and perceived stress.

Students were categorized as either 'Local' if they held a government-subsidised place (then known as 'HECS' [Higher Education Contribution Scheme] and available only to Australian students) or as 'International' if they were either private full-fee paying students or held government scholarships or bonds from an overseas country, (e.g. a MARA [Majlis Amanah Rakyat] scholarship from Malaysia). Participation was voluntary and students were able to withdraw at any time without penalty.

As in the previous research, after obtaining ethics approval (Appendix C1), data were selected for the first and second years of study for student cohorts who commenced their studies in 2002-2006. A total of 1142 students were invited to complete the
questionnaires, with 918 returning the survey, giving a response rate of $80 \%$. However, data on language use, relevant to both the current and previous studies, were not collected for the 2004 cohort, and therefore, all data for this cohort was not useable, which left a sum of 873 participants. From the questionnaire information pertaining to personal history, social demographics, and language was used. Students were allocated to one of five Language Families based on the question "What language do you speak at home?" Of these five sets, it was possible to compare Language Family outcomes for Local and International students only from three groups, namely 1) English ${ }^{6}$, 2) IndoEuropean, and 3) Sino-Tibetan Language Families (sourced from Katzner, 2002). Therefore, as Language Family was a key factor for this current research, data were restricted to only the language families that comprised enough students in each group so as to have sufficient power for analysis. Overall, this gave a total of 707 possible candidates with a total end response rate of $62 \%$. Table 3.1 contains the demographic characteristics of the dataset for this study. (Note: student age is not included as this undergraduate degree course maintains strict entrance criteria for this campus, which consequently results in the average age of students being between $18-22$ years old at time of entry to the course).

In addition to the questionnaires, academic assessments for each student were collated across both semesters of each year for Year 1 and Year 2, respectively. The Monash MBBS is a direct-entry five-year program where the first two years comprise integrated applied learning in the medical sciences, basic clinical skills, population health and health sociology. The curriculum focuses on general systems in Year 1, where in Year 2, specific body systems are studied. Assessment instruments varied from year to year, but all assessments included a combination of written examinations, coursework assignments and Objective Structured Clinical Examination (OSCE) role plays. All marks are presented as scores scaled to a pass score determined by standard setting techniques. For this compilation, all group activity assessments were deducted from the final marks in order to gain a true measure of an individual student's scores.

[^4]
### 3.5.2. Statistical Analysis

Statistical Analysis was carried out using SPSS software version 19.0.0, SPSS Statistics Inc. All statistics are parametric and data were checked for normality of distribution and variation. Where necessary the Greenhouse-Geisser correction for sphericity has been used and noted. There were a greater percentage of female students in most groups; however, this did not show as significant in any of the analysis conducted either in this or the previous study. Therefore, mixed-model repeated measures analysis of variance (ANOVA) was performed for Year 1 and Year 2 to test interactions between Assessment Type by Language Family by Origin (i.e. Local or International) with the dependent variable being the assessment types and the independent variables being Language Family and Origin. In addition, one- or two-way ANOVAs were conducted to investigate differences between and within each assessment type. Lastly, Least Significant Differences (LSD) tests were used for post-hoc analysis between Language Families and to examine Local versus International students within each Language Family when required.

Table 3.1 Demographic characteristics of students for Years $1 \& 2$ of MBBS undergraduate degree

| MBBS Cohorts 2002-2006 |  |  |
| :---: | :---: | :---: |
|  | Year 1 | Year 2 |
| Total n (Loc: Int ) ${ }^{\text {* }}$ | 707 (539:168) | 669 (503:166) |
| Gender n (Loc:Int)*: |  |  |
| Males | 281 (203:78) | 264 (186:78) |
| Females | 424 (334:90) | 403 (315:88) |
| Not Known | 2 (2:0) | 2 (2:0) |
| \% Male: |  |  |
| Local | 38 | 37 |
| International | 46 | 47 |
| Language Family n (Loc: ln )*: |  |  |
| English | 549 (464:85) | 517 (433:84) |
| Indo-European ${ }^{\dagger}$ | 53 (38:15) | 50 (35:15) |
| Sino-Tibetan $\ddagger$ | 105 (37:68) | $102(35: 67)$ |

*Loc=Locals: Int=Internationals
†Includes: all Eastern \& Western European languages e.g. German, French, Russian etc. and IndoIranian languages e.g. Hindi, Persian, Sinhalese etc.
$\ddagger$ Includes: all Chinese languages e.g. Mandarin, Cantonese etc. and Tibeto-Burman languages e.g. Burmese and Tibetan etc.

### 3.5.3. Categorizing Assessment Types

The overall end of year scores were sub-divided into the various assessments so as to examine what other factors could be causing the academic performance disparities between the home and foreign students as the range of subjects could denote the underlying skills of the various assessment types.

In the curriculum, the assessment instruments for MBBS Years 1 and 2 were implemented as various in-semester tasks and as end-of-semester examinations. For the first analysis, these instruments were grouped into three common broad categories (see Amin et al., 2006; Amin \& Khoo, 2003). The average marks were calculated for each student for each of these three categories of assessments.

Coursework - a linguistically demanding component involving a number of written assignments. This type of assessment requires the student to use high-level cognitive, analytical and critical thinking skills to analyse, synthesise and evaluate their work (Amin \& Khoo, 2003; De Vita, 2002; Downs, 2006). Assignments include:

- Case Commentaries. Students are required to locate and interview a patient in relation to his/her experience of a medical condition and submit a 2500 word assignment from a number of perspectives such as ethical, legal, biological, medical, sociological, the patient, and the student as a future practitioner.
- Evaluating Popular Information. Students must choose a non-journal article and a corresponding medical article on a popular health issue and evaluate using given questions from the course convenors.
- Portfolio. Students reflect on their learning over the last two years. These can include journal entries, essays, media cuttings, etc.
- Essays. Written essays where the topic may change from year to year.
- Presentations. PowerPoint presentations on varying topics. Mostly these are presented in groups, but may be solo also.

Examinations - these are timed, closed-book, written examinations that mainly assesses technical knowledge and are critically dependent on fast thinking, i.e. speed of information processing, and therefore do not rely on strong language proficiency or
communications skills (Amin \& Khoo, 2003; Bridges et al., 2002; Yorke et al., 2000). In the first two years of the course, examinations are restricted to:

- Multiple Choice Questions (MCQs).
- Short Answer Questions (SAQs) of 1-2 paragraphs.

Objective Structured Clinical Examinations (OSCEs). Depending on the station, this assessment type measures technical knowledge and competence, behavioural, communication and higher order cognitive skills (Newble, 2004; Silva, Lunardi, Mendes, Souza, \& Carvalho, 2011; Wass, Van der Vleuten, Shatzer, \& Jones, 2001) all of which the student must demonstrate in a timed, real-time environment:

- Students perform varying simulated clinical scenarios at each of a number of timed stations (approximately 10) with a staff member evaluating their performance.


### 3.6. Results

To a large extent the assessment formats for the first two years were similar and were designed to flow coherently in terms of desired outcomes in the early years of medical study. In these years, student instruction occurs predominantly on campus. From the 3rd year and onwards, this changes and almost all teaching and learning are in clinical surroundings outside the university. Thus, there is good reason for first examining the effect of student origin (i.e. Local versus International) on academic performance pooled across the first two years of study, which is discussed in section 3.6.1. below. Subsequently, results are investigated for the two years separately and in the following sections, 3.6.2.-3.6.2.3., analyses are presented for data from the students from only their 1st year of study from 2002-2006, followed in sections 3.6.3.-3.6.3.2. with analyses for data obtained from the same cohorts for only their 2nd year of study (from 2003-2007). The latter analysis excludes students who had dropped out or deferred their studies between 1st and 2nd years. Lastly, in section 3.6.4 the differences found between the two years are summarized.
3.6.1. Student Origin, but not Language Family affects academic performance for the different Assessment Types.

Initial analysis of the effect of Language Family and student Origin on academic performance over the first two years was carried out using a $3 \times 3 \times 2$ ANOVA ( 3 Assessment Types (AT) x 3 Language Families (LF) x 2 Origins (OR)). The results showed there were significant differences between the two student cohorts for each AT (F (2, $2740)=294.766, \mathrm{p}<0.001$ ) and that local students performed better than their international peers $(F(1,1370)=38.71, \mathrm{p}<0.001)$. Academic performance was not primarily influenced by LF ( $\mathrm{p}=0.645$ ), but there was an interaction effect between LF and OR ( $F(2,1370$ ) $=3.928, p=0.02$ ). Students' scores for each AT were also influenced by OR, with an interaction effect between these two parameters $(F(2,2740)=3.593, p=0.028)$. However, scores were not affected by LF, with no interaction effect for AT x LF ( $p=0.137$ ), nor an overall interaction between all three factors ( $\mathrm{p}=0.257$ ).

To investigate these interactions a Univariate analysis was then conducted for each AT for all students together (All Students), and then one-way ANOVAs for each LF. The results are shown in Figure 3.1.


Figure 3.1 Mean scores ( $\pm$ SEM) of combined results for Years $1 \& 2$ for Local and International students for a) Examinations, b) Coursework and c) OSCE assessment types. *p<0.05, $\dagger p<0.001$.

The most straightforward outcomes were seen in the Coursework category (Figure 3.1b). An analysis of All Students showed a significant effect only for student OR ( $F(1,1370)=$ 14.213, $p<0.001$ ), with no main effect for LF ( $p=0.895$ ) nor any LF $x$ OR interaction ( $\mathrm{p}=0.539$ ). The significant differences between the local and international students were seen in the English LF $(F(1,1064)=12.747, p<0.001)$ and Indo-European LF $(F(1,101)=$
$5.275, \mathrm{p}=0.024$ ), and, whilst not significant, there was a trend for this effect in the SinoTibetan LF ( $\mathrm{p}=0.071$ ). Overall, these results show that in this assessment, local students generally outperformed international students, and there was no significant performance difference between the three language groups.

Interestingly, the other two categories, Examinations and OSCEs, produced the same results, but arising from different sources.

For the Examinations category, and for All Students (Figure 3.1a), there was a significant main effect of $\operatorname{OR}(F(1,1370)=16.205, p<0.001)$, but no main effect for $L F(p=0.38)$. However, there was an interaction effect for the two ( $F(2,1370)=5.668, p=0.004)$, indicating that student performance varied with LF, with the international and local students of the Sino-Tibetan LF performing equally well whereas, in the other two language families, local students outperformed their international counterparts (English LF: $(F(1,1064)=34.077, p<0.001)$ and Indo-European LF: $(F(1,101)=7.89, p=0.006))$.

Similarly, in the OSCE assessment, there was a main effect of OR for All Students ( F (1, $1370)=44.727, p<0.001$ ) and no significant differences for LF ( $p=0.125$ ), but there was an interaction effect between LF and $\operatorname{OR}(F(2,1370)=3.171, p=0.042)$. However, in this case, it was due to the local students in all three language groups performing significantly better than their international language group counterparts.

In summary, generally local students performed better than their international peers, across most Language Families. However, the differences in performance between the two cohorts are dependent on which Language Family the student belongs to, with significant differences between the English and Indo-European language groups for all three assessments, but significant differences between local and foreign Sino-Tibetan students only in the OSCE assessment

### 3.6.2. Year 1

### 3.6.2.1. Assessment Type affects differences between 1st year local and international students' academic outcomes

Given that various factors (such as stress) may predict different effects between local and international students in Year 1, in subsequent analyses, the individual years of study
were analysed separately, commencing with Year 1. Firstly, the influence of Language Family and Origin on student performance was analysed by conducting a $3 \times 3 \times 2$ mixedmodel ANOVA (3 Assessment Types (AT) x 3 Language Families (LF) x 2 Origins (OR)). Overall, there were performance differences between local and international students but this varied with AT and with LF, as indicated by significant interactions for AT $\times$ OR, and for AT x LF (main effect for AT $(F(2,1402)=149.867, p<0.001)$ and for $\operatorname{OR}(F(1,701)$ $=7.381, p=0.007)$; no main effect for LF ( $p=0.138$ ); interaction effects for AT $\times \operatorname{OR}(F(2$, $1402)=7.314, p=0.001)$ and $\operatorname{AT} \times \operatorname{LF}(F(4,1402)=4.179, p=0.003)$. While there was no significant interaction between LF $\times$ OR ( $p=0.427$ ) there was a significant interaction between all three factors $(F(4,1402)=2.554, p=0.041)$. Consistent with the current literature (Bridges et al., 2002; Downs, 2006), students did not perform as well in the Examinations than in Coursework ( $p<001$ ). OSCE scores were also significantly less than Coursework ( $p<0.001$ ), and although OSCEs are posited to be the most challenging assessment type (Joyner \& Young, 2006; Liddell \& Koritsas, 2004; Mavis, 2001), the students still performed significantly worse in Examinations than in the OSCEs ( $\mathrm{p}<0.001$ ).

These effects are shown in Figure 3.2. Figure 3.2a shows the effect of Origin across all Language Families: local students had significantly higher marks than international students in the OSCE assessment (right columns in Figure 3.2a) (F (1, 701) 21.248, p<0.001), but not in the Examinations or Coursework assessments (left and middle columns in Figure 3.2a).

The influence of Language Family is shown in Figures $3.2 \mathrm{~b}-\mathrm{d}$. The simplest effects were seen in the Coursework category (middle columns of Figure $3.2 b-d$ ) and in the OSCE category (right columns of Figure 3.2b-d), though the details of effects were not identical between these two assessment categories. For the Coursework assessments there were no main effects of OR ( $\mathrm{p}=0.785$ ) or LF ( $\mathrm{p}=0.981$ ) or any interaction between OR and LF ( $\mathrm{p}=0.719$ ). Thus, mean scores for this assessment category did not depend on student Origin or Language Family. For the OSCE assessments category, student OR did influence academic scores $(F(1,701)=21.248, p<0.001)$ and local students consistently performed better than their international counterparts, and this was true for all Language Families (Figures 3.2b-d).

## Year 1






Figure 3.2 Overall mean scores ( $\pm$ SEM) for Local versus International 1st year MBBS students for each Assessment Type: a) all students (n=707); and for each Language Family: b) English (n=549), c) IndoEuropean ( $\mathrm{n}=53$ ) and d) Sino-Tibetan ( $\mathrm{n}=105$ ). ${ }^{*} \mathrm{p}<0.05$, $\dagger \mathrm{p}<0.001$.

The most complex effects were seen in the Examinations assessment category (left columns of Figure $3.2 b-d$ ). There were no main effects for OR ( $p=0.141$ ) or LF ( $p=0.479$ ), but there was a highly significant interaction between these two factors ( $F(2,701$ ) $=$ 4.918, $p=0.008$ ) showing that the performance difference between local and international students depended on LF. Thus, there is a significant difference between the local and international students of the English LF (Figure 3.2b), but no statistical differences seen between domestic and foreign students in the other two language groups (Figures 3.2c \& d) indicating that these results, as noted from current literature, are unlikely to be due to language-based factors and may be indicative of differences in cognitive skills or behavioural issues.

In summary, the most consistent difference between local and international 1st year MBBS students is a poorer performance by international students in the OSCE
assessments. Additionally, international students in the English Language Family did worse than their local counterparts in the Examinations assessments.

### 3.6.2.2. Effects as a function of skills being evaluated

The finding of a uniformly poorer performance in the OSCEs by international students independent of Language Family is consistent with previous reports that international students do worse than local students in this assessment type (Fernandez et al., 2007; Haq et al., 2005; Hauer et al., 2010; Liddell \& Koritsas, 2004; Schoonheim-Klein et al., 2007; Van Zanten et al., 2003; Wass et al., 2003; Woolf et al., 2007). However, to fully understand what other factors may be influencing the poorer performance of the foreign students, it was necessary to further divide the OSCE scores (Silva et al., 2011). Consultation with staff involved in the design and implementation of the MBBS course suggested that the OSCE scenarios could be re-classified into two broad categories according to the skills being evaluated, unlike the other two discreet Assessment Types. One category consisted of OSCE scenarios in which the emphasis was primarily on technical skills (OSCE-Tech; e.g. injecting technique or taking vital signs). This component does not require the students to have strong language proficiency or communication skills, but rather aims to test the students' practical knowledge (e.g. Newble, 2004; Silva et al., 2011). The other category consisted of scenarios in which the emphasis was primarily on communication skills (OSCE-Comms; e.g. taking a patient's history or providing bad news to a simulated patient). This component does require students to have good use of language discourse (Silva et al., 2011; Wass et al., 2003). Five staff members were asked to complete an assessment sheet and give percentage scores for each scenario along the two dimensions (OSCE-Tech vs. OSCE-Comms: Appendix F). Differences between local and international students in these sub-categories were then examined.

### 3.6.2.3. Differences between local and international students vary according

 to the skill being measured in the OSCE Assessment Types and Language FamilyThe new sub-categorisation of OSCE scenarios were used to examine differences between local and international students, and the effect of Language Family in a $2 \times 3 \times 2$ mixed-
model ANOVA (2 OSCE Assessment Types (OAT) $\times 3$ Language Families (LF) $\times 2$ Origins (OR)).

Students performed better in the OSCE-Tech than in the OSCE-Comms (OAT: F (1, 701) = 243.01, $p<0.001$ ), local students did better than international students (OR: $F(1,701)=$ 20.27, $p<0.001$ ), and there were significant differences between the different LF ( $\mathrm{F}(2$, 701) $=7.122, p=0.001$ ). There was no interaction between the three factors ( $p=0.21$ ), between LF and OR ( $p=0.283$ ), or between OAT $\times$ LF ( $p=0.698$ ). However, there was a significant OAT x OR interaction $(F(1,701)=9.093, p=0.003)$.

Thus there were performance differences between local and international students, between the two OSCE types, and between the different Language Families. Further, the performance difference between the two OSCE types varied according to student Origin. These effects are illustrated in Figure 3.3.

The global effects of student Origin across all Language Families are illustrated in Figure 3.3a, which shows that, overall, local students had significantly higher marks than international students for both the OSCE-Comms ( $F(1,701$ ) $=31.20, p<0.001)$ and OSCETech $(F(1,701)=4.315, p=0.038)$ assessments. The effects within each Language Family are shown in Figure 3.3b-d. Consistent with the global effects, for the OSCE-Comms Assessment (left columns in Figure 3.3b-d), local students consistently performed significantly better than international students and this is true across all Language Families. This category of the OSCEs requires the students to have strong language skills and on its own, this may be considered evidence for a lack of English proficiency in the international students. However, as only the students of the English Language Family had significantly higher scores than their international counterparts ( $F(1,547$ ) $=8.843$, $\mathrm{p}=0.003$ ) in the OSCE-Tech Assessment (right columns in Figure 3.3b-d), this assumption is not likely to be correct.

In summary, across all Language Families, local students did better than international students for the OSCE-Comms Assessments. In contrast, for the OSCE-Tech Assessments the global difference between local and international students was driven solely by the difference between the two cohorts of students in the English Language Family (the largest cohort of international students).


Figure 3.3 Overall mean scores ( $\pm$ SEM) for Local versus International 1st year MBBS students for each OSCE Assessment Type: a) all students ( $\mathrm{n}=707$ ); and for each Language Family: b) English ( $\mathrm{n}=549$ ), c) Indo-European $(\mathrm{n}=53$ ) and d$)$ Sino-Tibetan ( $\mathrm{n}=105$ ). OSCE-Comms $=$ OSCE Communication skills, OSCE-Tech $=$ OSCE Technical skills. ${ }^{*} p<0.05, \dagger p<0.001$.

### 3.6.3. Year 2

### 3.6.3.1. Assessment Type by Origin, but not by Language Family, influences 2nd year MBBS students

In the previous chapter, the overall scores obtained by the students in their 2 nd year of study from 2003-2007 were analysed and found no interaction effects of Language Family and Origin. Here further examination was undertaken to determine whether more subtle effects may be seen when the scores for the separate assessments were considered. With assessments classed using the initial model of Examinations, Coursework and OSCEs, there were main effects of $\operatorname{AT}(F(2,1326) 163.429 p<0.001)$ and $O R(F(1,663) 47.613$, $p<0.001$ ) but not for LF ( $\mathrm{p}=0.507$ ). As illustrated in Figure 3.4a, in Year 2 local students performed significantly better than their international peers in all Assessment Types. As in the first year and consistent with the extant literature (Bridges et al., 2002; Downs, 2006),
the students performed better in Coursework than in Examinations ( $p<0.001$ ) or in OSCEs ( $p<0.001$ ). Additionally, as in the first year, the OSCE results were significantly better than the Examinations ( $p<0.001$ ). There were no interaction effects between AT and LF ( $p=0.931$ ), AT and OR ( $p=0.355$ ), or the three factors of AT by LF by OR ( $p=0.624$ ). However, there was an interaction effect of LF by OR (F (2, 663) 4.415, p=0.012), indicating that the differences between local and international students actually also varied with LF. This is shown in Figure 3.4b-d where there are significant performance differences between local and international cohorts of the English and Indo-European language groups for each assessment type, but no significant difference between the two student cohorts of the Sino-Tibetan Language Family for any Assessment Type.

Next a detailed analyses was conducted for each Assessment Type separately. For Examinations (left columns of Figure 3.4b-d) the difference between local and international students was independent of LF (OR main effect: F $(1,663)=17.662$, $p<0.001$; no main effect for $L F(p=0.547)$ nor an interaction between the two ( $p=0.125$ )). This was also the pattern for Coursework (middle columns of Figure 3.4b-d), i.e. a main effect of $\operatorname{OR}(F(1,663)=31.335, p<0.001)$, but no main effect for $L F(p=0.866)$ nor a significant interaction between the two ( $\mathrm{p}=0.139$ ).

The OSCE assessment showed more complex effects. Again there was a main effect of OR ( $F(1,663)=32.319, p<0.001)$ with no main effect for $L F(p=0.483)$. However, there was an interaction between $\operatorname{LF}$ and $\operatorname{OR}(F(2,663)=4.472, p=0.012)$, indicating that the performance differences between local and international students varied with this factor.

## Year 2






Figure 3.4 Overall mean scores ( $\pm$ SEM) for Local versus International 2nd year MBBS students for each Assessment Type: a) all students ( $n=669$ ); and for each Language Family: b) English ( $\mathrm{n}=517$ ), c) Indo-European ( $\mathrm{n}=50$ ) and d) Sino-Tibetan (102). ${ }^{*} \mathrm{p}<0.05, \dagger \mathrm{p}<0.001$.

In summary, in the $2 n d$ year of study, for two Language Families, local students performed better than their international counterparts, and did so across all assessment types. Although the direction of effects was similar for the Sino-Tibetan Language Family, the effects were not significant for any assessment type. This suggests that in 2 nd year, the main factor causing international students to do worse than their local counterparts may not be language skills and/or communication skills alone: poorer performance by international students occurred even in the Language Family which reported English as the first language of the international students; it did not occur in a major Language Family identifying English as a second language, and when poorer performance did occur, it occurred across all assessment types.

To examine this issue in greater detail, performance in the OSCEs were then examined where assessments conducted under the same conditions could be segregated for Technical or Communication skills.

### 3.6.3.2. OSCE Assessment types vary between 2nd year local and

 international studentsAs with the 1st year, the performance of the 2nd year students were examined in the two categories of OSCE assessments, OSCE-Comms and OSCE-Tech, classified using the same methods as for the 1st year OSCEs. The data were analysed using a $2 \times 3 \times 2$ mixed-model ANOVA (2 OSCE Assessment Types (OAT) x 3 Language Families (LF) x 2 Origins (OR)).

As in 1st year, students performed better in the OSCE-Tech than in the OSCE-Comms (OAT: $\mathrm{F}(1,663)=83.1, \mathrm{p}<0.001)$ and local students performed better than international students (OR: $\mathrm{F}(1,663)=34.678, \mathrm{p}<0.001)$ (Figure 3.5a).

There was no main effect of LF ( $p=0.322$ ), no interaction of OAT $x$ OR ( $p=0.07$ ) or OAT $x$ LF $x$ OR ( $p=0.328$ ). However there was an interaction between LF and $\operatorname{OR}(F(2,663)=4.851$, $\mathrm{p}=0.008$ ) indicating that the difference between local and international students differed according to Language Family of the students home language. There was also an interaction effect for OAT $\times \operatorname{LF}(F(2,663)=3.353, p=0.036)$, indicating that the Language Family-dependent difference between local and international students also varied with Assessment Type.

To explore these complex Language Family and Assessment Type effects on differences between local and international students, the data were examined separately for each Language Family. These data are illustrated in Figures 3.5b-d; one-way ANOVAs were carried out to examine these effects further. For each of the two OSCE assessment types, there was a main effect of Origin consistent with the fact that local students do better than international students for both types of OSCE assessments (OSCE-Comms AT: main effect of $\operatorname{OR~} F(1,663)=17.138, p<0.001$; OSCE-Tech AT: main effect of $\operatorname{OR~} F(1,663)=$ 33.601, $\mathrm{p}<0.001$ ). Post-hoc analysis showed that in both assessment types, there was no difference between students of the Sino-Tibetan LF (OSCE-Comms $\mathrm{p}=0.299$; OSCE Tech $\mathrm{p}=0.274$ ), confirming the absence of effect reported above across all assessment types. In both assessment types, there were significant differences between the local and international students of the English LF (OSCE-Comms: F (1, 515) = 48.525, p<0.001; OSCE-Tech AT: $F(1,515)=57.706, p<0.001)$ as seen in Figure 3.5b. Finally, for the IndoEuropean LF, there was no difference between local and international students for the


Figure 3.5 Overall mean scores ( $\pm$ SEM) for Local versus International 2 nd year MBBS students for each OSCE Assessment Type: a) all students ( $\mathrm{n}=669$ ); and for each Language Family: b) English ( $\mathrm{n}=517$ ), c) Indo-European $(\mathrm{n}=50)$ and d$)$ Sino-Tibetan ( $\mathrm{n}=102$ ). OSCE-Comms $=$ OSCE Communication skills, OSCE-Tech $=$ OSCE Technical skills, $\dagger p<0.001$.

OSCE-Comms ( $\mathrm{p}=0.052$ ) whereas there was significantly poorer performance for the OSCE-Tech ( $\mathrm{F}(1,48$ ) $=18.812, \mathrm{p}<0.001$ )

### 3.6.4. Differences between 1st and 2nd year

As noted previously, the rationale for examining separately the performance in Year 1 and then in Year 2 was that factors such as acculturative stress may have differential effects over the two years. Then, as a final point, it was necessary to see if there were any differences between the two years of study. As there are many confounding variables, it is not feasible to simply compare 1st and 2nd year results. Therefore, the change in academic performance was investigated for each individual student between the two years, by subtracting Year 1 scores from Year 2 scores for each assessment type for each student. This method restricts comparison to only students who have completed both years of study, and shows the improvements for each student for each assessment type. Univariate ANOVAs for each Assessment Type were conducted, with Language Family and
student Origin as independent variables. Then one-way analysis for each Language Family was performed to establish differences between the local and international students for each group.

The results for the Examinations and Coursework Assessment Types (Figures 3.6a \& 3.6b, respectively) were similar: for the All Students category (i.e. all Language Families together), local students improved significantly more than did international students (Exams: $(F(1,663)=9.241, p=0.002)$; Coursework: $(F(1,662)=16.478, p<0.001))$. This is reflected in the results of the academic performance for each year; in Year 1, there were no significant differences between local and foreign students for either Examinations or Coursework assessments (see Figure 3.2a). However, in Year 2 both these assessments showed significant differences between the local and international students (see Figure 3.4a). However, for the OSCE assessments, local and international cohorts improved by similar amounts over the two years $(p=0.552)$ of study. Therefore, the overall results did not change from Year 1 to Year 2 and local students performed significantly better than their foreign peers (see Figures 3.2a \& 3.4a).


Figure 3.6 Difference of mean delta scores ( $\pm$ SEM) for All Students and each Language Family for each assessment type; a) Examinations, b) Coursework and c) OSCEs. ${ }^{*} \mathrm{p}<0.05, \dagger \mathrm{p}<0.001$.

Within Language Families for the Examinations assessment, only the local Indo-European students had a significantly greater improvement in marks than their international counterparts $(F(1,48)=4.368, p=0.042)$, culminating in a significant difference between local and international students in Year 2 (see Figure 3.4c), improved from no difference in Year 1 (see Figure 3.2c).

In Coursework, both the local English ( $F(1,514$ ) $=31.952, p<0.001$ ) and Indo-European ( $F$ $(1,48)=7.164, p=0.01)$ language cohorts had significant improvements in marks, which resulted in significant Year 2 differences between local and international students (see Figures 3.4b and 3.4c) in this assessment for both Language Families.

Interestingly, the OSCEs, once again, have generally contrary results to the other two assessment types. The local students in the English Language Family have significantly improved their marks compared with the international students $(F(1,514)=7.735$, $\mathrm{p}=0.006$ ), maintaining the better performances of Year 1 (see Figure 3.2b) and Year 2 (see Figure 3.4b). For the local Indo-European students, there was no improvement in performance between Year 1 and Year 2, $\mathrm{p}=0.635$ (see Figures 3.2 c \& 3.4c). While international Sino-Tibetan students showed the greatest improvement in marks for the OSCE assessment (8.87), this increase was not significantly greater than that achieved by their local counterparts ( $p=0.255$ ). This did result, however, in the significant Language Family-based difference noted in Year 1 (see Figure 3.2d) not continuing into Year 2 (see Figure 3.4d). Importantly, this is the only significant result of all the results in Year 1 that do not carry into Year 2.

In summary, these analyses confirm an overall significant improvement of marks for the MBBS students from the 1st to 2nd year of study and that, generally, local students improved more than did the international students. While these results showed that, in some cases, this improvement was influenced by Language Family, the overwhelming and consistent finding is that Origin provenance is the dominant influence on scholastic improvement.

### 3.7. Discussion

Using a very large database of academic performance for students in the 1st and 2nd years of their MBBS studies from 2002-2007, academic outcomes for local and international medical students were investigated, expanding on differences across the different types of assessments making up their overall yearly score.

The most robust findings were that while local students did better than international students overall, different effects occurred in the 1st and 2 nd years as to which
assessments showed the greatest effects. The differences also varied with the Language Family (Mann et al., 2010) of the students' home language.

In the 1st year of study, all students did significantly worse in the Examinations than in both Coursework and OSCEs. It is well documented that time-restricted and closed-book written examinations are often more difficult for students than Coursework (Bridges et al., 2002; Downs, 2006; Yorke et al., 2000). However, as far as can be ascertained, no study has compared academic differences between OSCEs and other assessment types. Considering that OSCEs have been noted as probably the most challenging or stressful assessment for students (Allen, Heard, Savidge, Bittergle, Cantrell, \& Huffmaster, 1998; Joyner \& Young, 2006; Liddell \& Koritsas, 2004; Malau-Aduli, 2011; Mavis, 2001), it is surprising that the Examination scores were significantly lower than OSCEs.

When comparing local versus international students, it was found that there was no difference between these students in Examinations or Coursework in the first year, but international students did worse than local students only in the OSCE assessments, and this was true across all three major Language Families making up this MBBS course. Although overall, international students did worse than local students in both categories of OSCEs, the difference for the OSCE-Tech was due solely to the international English Language Family students; international students of the other two Language Families did not perform worse than their local counterparts. However, international students of all three Language Families performed worse than their local counterparts in the other OSCE sub-category, OSCE-Comms, where scenarios depended primarily on communication skills, e.g. informing a patient of bad news.

In contrast to these communication skills difficulties across 1st year international students of all Language Families, a different pattern of effects emerged in 2nd year. Here, international students did worse than local students in all assessment categories and this was true for both the English and Indo-European Language Families, but there were no significant differences for the Sino-Tibetan Language Family (for which the same trend occurred). As in the first year, students performed best in Coursework, then OSCEs and lastly, Examinations.

These year-specific differences in performance between local and international students suggest that different or multiple factors come into play in the two years and are unlikely to be solely due to acculturative stress (as posited in the preceding chapter), as acculturative stress is more likely to manifest in the first, transitional year (Zhang \& Mi, 2009). These differences also suggest that influencing factors may vary within Language Families as the Sino-Tibetan Language Family very often differed to the English and IndoEuropean language groups, particularly in the 2nd year of study.

### 3.7.1. Communication skills as a factor constraining academic performance

A novel and important finding in this study is that in the first year, the only major difference between international and local students in a medical curriculum using a variety of assessment modes, was in a mode based on good verbal communication skills; skills that are essential for the medical profession (Hawken \& Henning, 2012). This is consistent with a large literature, detailed in the General Introduction, that international students often have language barriers in the medium of instruction in their host country (Lacina, 2002), despite proficiency in that language (Malau-Aduli, 2011; Yeh \& Inose, 2003; Zhang \& Mi, 2009). The fact that the international students performed equally well in the Coursework component, which also requires good communication, but via written language skills, is evidence that language proficiency cannot be the only factor in the noted poorer performance. Poorer performance by international students in communications-based assessments is not a novel finding and the effect has been variously attributed to poor language proficiency (Webb, 2002), cultural differences in learning styles (Confucian-Socratic) (Ferguson, James, \& Madeley, 2002; Huang, 2005), cultural inequality (De Vita, 2002), examiner bias (Bienstock et al., 2000) and discrimination (Wass et al., 2003). In the students of this study, the poorer performance in communications-based assessments occurred despite the quite rigorous screening procedures for English proficiency for entry into Australian study, especially in the MBBS course and despite their communication skills acknowledged as competent at the time of enrolment. This occurred even for the international students who spoke predominantly English at home, and only for the OSCE scenarios based on communication skills but not for other assessment types which did include some communication skills assessments (e.g., various components of the Coursework assessment category).

One rationale for the poorer performance observed here could be partly due to acculturative stress. The OSCE examination is performed in real-time and is one of the most stressful components of the course faced by all the students and which could impact on their scores (Allen et al., 1998; Joyner \& Young, 2006; Liddell \& Koritsas, 2004; MalauAduli, 2011; Mavis, 2001; Silva et al., 2011). The international students face additional cultural differences that compound and add to the stress; culturally learnt non-verbal cues such as body language, facial expressions and eye-gaze may be misconstrued as uncaring or disrespectful and marked lower as a consequence (Kusmierczyk, 2011). Lack of self-confidence in language use or initiative (the Eastern passiveness versus the Western assertiveness) may also be misinterpreted by the examiner as the student lacking knowledge in the subject (Tavakol \& Dennick, 2010). In a subset of this cohort (1st year data for years 2002-2005 and 2nd year data for years 2002-2004), the international students showed significantly higher rates of perceived stress than the local students (Bagot et al., 2005, unpublished data), providing more direct evidence for elevated stress levels in these international students.

Another possibility for these effects is proposed by Tyler (2001), who posits that experienced non-native speakers with a high degree of language competency rely heavily on topic knowledge. However, experienced non-natives do just as poorly as inexperienced non-natives when the topic is unknown or unfamiliar, as demonstrated by the international students in the English Language Family.

### 3.7.2. Poorer Communication Skills Not the Sole Factor in 2nd year

Another novel finding was that although there was an improvement in academic performance in the 2nd year for both groups, internationals performed worse than local students in all assessments. This suggests the uniform across-Language Family and acrossAssessment Type poorer performance may no longer be due solely to poorer communication skills or acculturative stress. This is somewhat supported by these findings occurring in the international English Language Family but not in groups where English was the second language. Further when poorer performance did occur, it occurred across all assessments.

As noted earlier, the 2nd year curriculum is more complex than basic first year outlines, and although the students' perception of the difficulty of studies in Year 2 compared with Year 1 has not been formally assessed, responses to standard university evaluations find the Year 1 workload significantly ( $\mathrm{p}<0.05$ ) more appropriate than that for the second year units. However, whether or not this is responsible for greater demands on English language skills and consequent poorer performance by the ESL students cannot be determined from these results and further research in this area is warranted. Henning et al., (2012b) suggests that overseas students may do worse in their second year as their workload becomes more stressful and therefore the students are prone to more health problems. If so, then the indirect effects of acculturative stress may still be apparent.

Although in the 2nd year Sino-Tibetan family there were no longer any significant differences in performance between local and international students in any assessment type, for the English and Indo-European Language Families differences between local and international students persisted into the 2nd year. Furthermore, there were then significant overall differences between the two student groups in the Examinations and Coursework Assessments, which were not seen in the 1st year.

As stated earlier, Examinations consist of multiple choice or short answer questions and measure technical knowledge and therefore do not require strong language proficiency (Amin \& Khoo, 2003). Thus, this would be one assessment type where one might expect that international students would perform equally well as the local students. In the Coursework assessment, there are more written skills involved, so ordinarily it would not be unexpected that the international students do worse in this assessment type than their local peers. Current literature shows that most students do better in this assessment type than in Examinations (Bridges et al., 2002; Yorke et al., 2000) as the students have ample time to complete the assignments and to seek aid through tutors or in study groups. The fact that the foreign students performed worse in the second year than the locals in both assessment types is a strong indication that the students' metacognitive abilities may also be influencing marks in their assessments (perhaps through either heavier workloads or more demanding challenges on metacognitive processes in the L2) and one major cognitive process that has been proposed to impact on processing in a non-native language, namely Working Memory, will now be considered.

The Sino-Tibetan Language family is worthy of a separate discussion, as detailed in the end note on page 138. In brief, the Asian students in these studies come from a unique cultural background that values education extremely highly (Sue \& Okazaki, 1990). Upon examination of the first year results, the Sino-Tibetan international students performed worse than their local counterparts in several areas and this may be due to the first year being transitional and these undergraduates being more prone to acculturative stressors. However, by the second year, although overall the locals outperformed the foreigners in all assessments, in the Sino-Tibetan LF, the internationals always performed on par with their local peers. Therefore, these students may have developed coping strategies to help overcome any academic or cultural obstacles, such as smarter study habits (Rosenthal et al., 2007). This does not mean that they do not suffer hardship, but that they work extremely had to overcome them (Niles, 1995).

### 3.7.3. Working Memory Load as an influencing factor

An influencing factor of poorer academic performance in the international students could be due to working memory (WM) capacity. The role of working memory, and in particular verbal Working Memory, in language processing and its critical role during effortful language processing (reviewed by Rudner \& Rönnberg, 2008) is consistent with studies showing that WM span and decision accuracy are better in a native language than in a well-mastered second language (Andersson, 2010; DeDe, Caplan, Kemtes, \& Waters, 2004; Kroll et al., 2002; Mackey et al., 2002; McDonald, 2006; Miyake \& Friedman, 1998; Service, 1992; Service et al., 2002; Sunderman \& Kroll, 2009; Tokowicz et al., 2004; Waters \& Caplan, 2005). Another aspect of WM capacity is the generally-accepted relationship between speed of information processing and measures of intelligence (Conway et al., 1993). International students may not have as great a capacity in WM or speed as local students when foreign language processing demands are involved, and particularly in timed tasks (De Vita, 2002). This was strongly evident in the Examinations, the assessment type that was the most difficult for the students. This is unremarkable in itself as in the first year all students performed equally poorly in this assessment mode, but in the second year, the locals did better than the internationals. Given that this type of assessment does not require the students to have highly proficient language skills, this indicates that cognitive factors must also come into play to account for these effects.

Takano and Noda (1993) found that participants in psychometric testing using a foreign language showed a temporary decline in thinking ability because the demanding processing load involved caused strong interference in their thinking, beyond the normal foreign language processing difficulties per se, experienced by non-native speakers. In a later study the authors demonstrated that these differences were greater the more the foreign language was dissimilar to the native language (Takano \& Noda, 1995) with greater performance differences between, for instance, Japanese and English than German and English, which share similar language roots.

However, interpretation of these studies should be regarded with caution as the literature also shows that these discrepancies may be more task-dependent than language dependent (De Vita, 2002; Juffs \& Harrington, 2011).

### 3.7.4. Implications for future pedagogical design of MBBS courses

The results of this study have important implications for the training of medical and, presumably, other health professional students from diverse language and country of origin backgrounds. While the results are somewhat complex, and there are a number of nuances, a strong and consistent message is apparent. In the first year of education in a medical program, there is an interaction between origin and language background that means that students from offshore and non-English backgrounds do not perform as well as those from local, English-speaking backgrounds. These effects are primarily seen in OSCE examinations, with performance in communication stations being most markedly affected. These results are not surprising, as it is reasonable to hypothesize that translocation from home and supports, along with adjusting to a new language and idioms, are likely to result in attenuated academic performance and may also lead to acculturative stress. Conversely, by the second academic year, the effect of Language Family was no longer apparent, but effects of Origin persisted.

These results indicate that the attention and support required to provide international medical students with the greatest opportunity for success will differ as a function of their progression through the course. Initially, both language and personal support are probably necessary to best help a student as regardless of language proficiency, there may still be other language barriers such as unfamiliar accents and local slang e.g. Treloar
et al. (2000) found that international medical students at an Australian university reported that they were familiar with the Queen's English, but they had difficulty understanding the Australian English spoken in the university.

There are some important caveats to consider. First, it is clear that differences may exist between students from different Language Family backgrounds, with those international students from a Sino-Tibetan background apparently more effectively adapting and improving their academic performance when compared with other international students, including those from an English language background. This study was not designed to identify what factors are critical for students of different language backgrounds, nor does it possess the necessary statistical power to enable specific recommendations for different Language Family group students. Nevertheless, the performance of Sino-Tibetan students does indicate that international students are capable of achieving similar results to local students, suggesting that observations in this study are also not a simple reflection of differences in selection at the time of admission to the program. Further, this study looks at the first two years of a medical course, where a student is engaged in campus-activities, rather than learning predominantly in a clinical context. It is important to note that to extend the implications of these findings to a clinical learning environment may not be appropriate. Taken together, however, these findings provide important guidance for those administering medical education to diverse groups of students from international backgrounds.

### 3.7.5. Study Limitations

Whilst the results of this study were robust, there were some limitations that should be considered. A detailed account of these limitations can be found in a previous study (Mann et al., 2010). The most important was the constraints with data on language as the questionnaire completed by all students did not establish language preference or fluency (e.g. students may have used a language at home as it was the only common language among students in shared accommodation). Also, there were imbalances in the sample size in each Language Family, although this was controlled for by the type of analyses carried out.

As stated in the Methods, the assessment instruments varied from year to year, and subject weightings also differed with each student cohort (see Appendix A). Whilst there were no standardized statistics collated for each year, reliability scores were calculated for each assessment for each year. The overall reliability scores over the total years of this study for all written papers, examinations and OSCEs exceeded 0.8 and, therefore, within the acceptable parameters. Further, point biserials for individual marks were all above 0.15. Calculated for quality of assessment, rather than reliability, the point biserial is the coefficient correlation between the correct or incorrect scores that the students receive on a given item (e.g. multiple choice tests) and the total scores that the students receive when totalling their scores across the remaining items.

### 3.7.6. Conclusions

It was shown previously that academic performance in these 1st and 2nd year MBBS students differs as a function of Origin and Language Family for the overall end of year score. It has now been shown to be true in the different Assessment Types that make up the overall score with the OSCE assessment particularly impacting on mean scores in the 1st year. The categorization into different assessment types was crucial in identifying other contributing factors to the disparities in academic achievement seen between the international and home students. Moreover, in the 2nd year, Language Family no longer influenced student performance, but Origin continued to highlight the differences between local and international students.

The 1st year results clearly show a lack of communications skills impacts on the international students' poorer academic performance. However, the 2nd year results indicate that more global effects must contribute to the underlying underperformance seen across each Language Family and for each Assessment type in the overseas undergraduates. (Note this was true statistically for two of the Language Families and, while not statistically significant for one Language Family, showed the same trends). This may be due to the 2nd year curriculum being more difficult than basic first year outlines, and therefore the greater demands on English language skills, and in turn, cognitive resources, consequently resulting in poorer performance by the ESL. This is quite possible as Collier (1992) has stated that growth curves on normalized tests tend to flatten as students' progress in age and grade level and as the school load becomes academically
more complex. Reduced verbal working memory capacity may also be a contributing factor, although, more investigation in this area is warranted and this research is undertaken in the next chapter.

# CHAPTER 4: POORER 

 VERBAL WORKING MEMORY FOR A SECONDLANGUAGE SELECTIVELY
IMPACTS ACADEMIC
ACHIEVEMENT IN
UNIVERSITY MEDICAL
STUDENTS

### 4.1. Declaration for Thesis Chapter 4

Declaration by candidate

In the case of Chapter 4 the nature and extent of my contribution to the work was the following:

| Nature of <br> contribution | Extent of <br> contribution (\%) |
| :--- | :---: |
| Study design, data collection and interpretation, neurophysiological <br> testing, statistical analysis, manuscript preparation | $80 \%$ |

The following co-authors contributed to the work. Co-authors who are students at Monash University must also indicate the extent of their contribution in percentage terms:

| Name | Nature of contribution | Extent of contribution <br> (\%) for student co- <br> authors only |
| :--- | :--- | :--- |
| Ramesh <br> Rajan | Conception, supervision, SiN testing advice and <br> manuscript editing. | N/A |
| Benedict <br> Canny | Knowledge of MBBS course and manuscript <br> editing. | N/A |
| David Reser | Manuscript editing | N/A |


| Candidate's | $\square$ |  |
| :--- | :--- | :--- |
| Signature |  |  |
|  |  |  |

## Declaration by co-authors

The undersigned hereby certify that:
the above declaration correctly reflects the nature and extent of the candidate's contribution to this work, and the nature of the contribution of each of the co-authors.
they meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
they take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
there are no other authors of the publication according to these criteria;
potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit; and
the original data are stored at the following location(s) and will be held for at least five years from the date indicated below:

| Location(s) | Department of Physiology, Monash University, Clayton Campus, <br> Melbourne, Vic Australia |
| :--- | :--- |

Signature 1

Signature 2

Signature 3

|  |  |
| :--- | :--- |
|  |  |
|  |  |

### 4.2. Explanatory Note

### 4.2.1. Introduction


$t$ was noted in the two preceding chapters that significant differences in academic performance between the local and international students, even in the English language family, could be due to acculturative stress and other, perhaps metacognitive language processes independent of English language proficiency. This finding was supported partly by the poorer performance of the SinoTibetan international students in the first, but not second year; by the poorer performance of the other two LF in all assessments in the second year; and by the poorer performance in communication skills by the international students in both years.

As discussed in the General Introduction, age of acquisition of a language may affect language processing, regardless of proficiency (Mayo et al., 1997; Shi, 2010). However, this was one aspect that could not be investigated in the 2002-2006 cohort as information on language acquisition had not been collected in the original questionnaire and at this late stage of these doctorate studies most of the students had completed the MBBS degree and follow up with individual students was not possible. Fortunately, the students who had enrolled first year in 2006 were completing their final year and it was possible to obtain information pertaining to English acquisition via a short online questionnaire as described in the following section. It was hypothesised in Section 1.9.3., page 31, that students (local or international) who had learnt English at an early age, i.e. before 5 years old, would outperform those students who had learnt English later. If this hypothesis was true and could be ascertained in a brief study with the 2006 cohort, then it would provide the impetus for the next larger study, which investigates academic differences in these students due to cognitive processes related to age of acquisition of English and, which is discussed in the main body of this chapter.

### 4.2.2. Methods

After obtaining ethics approval for an amendment to the original ethics application (Appendix C2), 261 students who had enrolled first year in 2006 and completed the original questionnaire were emailed a request to complete an online survey via Survey Monkey ${ }^{\text {© }}$.

The survey was totally voluntary and asked four questions relating to age of English and other language acquisition (Appendix B3). A total of 148 responses were captured, with some duplicates and one response from a student who had not completed the original questionnaire and so could not be included. After deleting these, the remaining 140 records resulted in a total response rate of approximately $54 \%$, which was above expectations, given the time lag and the busy schedule of final year MBBS students.

The descriptive statistics are presented below in Table 4.1, showing that there are no statistical differences between the end of year total academic scores for the larger group of all the students enrolled first year in 2006 (All students) and the smaller subgroup of students who responded to the additional online questionnaire (Subgroup). The smaller subgroup of 140 students was comprised of 85 local and 55 international students in the 1st year; and 134 students in the 2 nd year was comprised of 80 local and 54 international students, i.e. there was a difference of 6 students due to attrition from the course. The students were also categorised into one of two groups according to the age that they learnt English; either 5 years or younger, or 6 years or older, with 112 and 28 students in each group, respectively for the 1st year and 106 and 28 students in each group respectively in the $2 n d$ year.

All statistical analysis was performed using SPSS v19.0.0 as reported below. For the analysis, Student's t-tests were carried out to test differences between the local and international students in their end of year total scores for the 1st and 2nd years of study. Student's t-tests were also carried out to test differences between the two age groups defined by when the students learnt English, i.e. 5 years or younger, and 6 years or older.

### 4.2.3. Results

As can be seen in Table 4.1, there was no significant difference in academic performance outcomes between the larger and smaller subgroup for either Year 1 (Students-t (399) = 1.97, $\mathrm{p}=0.57$ ) or Year 2 ( $\mathrm{t}(384)=1.97, \mathrm{p}=0.35$ ), so subsequent analysis was then conducted for only the subgroup with confidence it was reasonably representative of the larger sample of the 2006 students. However, it cannot be assumed to be representative of the wider 2002-2006 cohort examined in previous studies in Chapters 2 and 3.

Table 4.1 Descriptive statistics for MBBS students enrolled in years 1 and 2, 2006

| End of Year Total Scores | N | Minimum | Maximum | Mean | Std Dev | t-test | p score |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| Year 1: |  |  |  |  |  |  |  |
| All students | 140 | 44.73 | 83.21 | 69.14 | 6.54 |  |  |
| Subgroup |  |  |  |  |  |  |  |
| Year 2: | 252 | 50.73 | 88.33 | 73.26 | 6.56 | 1.97 | 0.35 |
| All students | 134 | 50.73 | 88.00 | 72.62 | 6.24 |  |  |
| Subgroup |  |  |  |  |  |  |  |

The first analysis performed was an independent sample Student's t-test to compare the End of Year Total scores between the local and international students in the 1st year. There was no significant difference for academic performance (t (138) $=-1.76, p=0.08$ ) as seen in Figure 4.1A. However, there was a significant difference of academic outcome when Age of Acquisition of English was compared between those students who had learnt English at the younger age of 5 or less and those who had learnt English after the age of 6 years old $(\mathrm{t}(138)=3.47, p=0.001)$, shown in Figure 4.1B.


Figure 4.1 End of Year Total (4.1A) and Age of Acquisition of English (4.1B) in the first year

In the 2nd year, there was a difference between local and international students, with the foreign students performing significantly worse than their host peers ( $\mathrm{t}(132)=-2.54$, $p=0.012$ ). This is illustrated in Figure 4.2A. Figure $4.2 B$ shows the younger age group again also performed significantly better, academically, than the students who were in the older category when they first acquired English ( $\mathrm{t}(132$ ) $=2.27, \mathrm{p}=0.025$ ).


Figure 4.2 End of Year Total (4.2A) and Age of Acquisition of English (4.2B) in the second year

### 4.2.4. Discussion

The main finding from this study was that the age when the students first learnt English impacted on the academic outcomes. Students who learnt English at the age of five or younger performed significantly better, academically, than students who acquired English at a later age, regardless of whether the student was of local or foreign origin.

This may go some way to explaining why some international students outperform their local peers and why some local students do not present as well as the international students. It may also explain why language proficiency per se is not a significant predictor of academic achievement (Bayliss \& Ingram, 2006; Dooey \& Oliver, 2002; Elder, 1993; Gunn-Lewis, 2000; Kerstjens \& Nery, 2000; Stacey \& Whittaker, 2005). At the least, it may show that earlier second language acquisition may be more beneficial for academic performance in a university or educational setting (Collier, 1987; Demie \& Strand, 2006; Hakuta, 2000), and may lead to less language barriers or stressors leading to greater social interaction with English-speaking students (Yeh \& Inose, 2003).

### 4.2.5. Conclusion

Whilst the sample cannot be assumed to represent the entire 2002-2006 cohort, the findings from this short study and both previous studies have been invaluable in establishing that there may be multiple factors involved in academic performance involving behavioural and neurophysiological processes that determine how well an ESL student may perform, which paves the way for the next phase of this research, viz: is working memory capacity, a predictor of academic achievement in international students? Working memory capacity in an L2 is a topic that has been under-researched, particularly in regards to how it may impact on academic achievement. The mechanisms governing good WM capacity are complex and thought to involve speed of language processing (which in turn may be dictated by age of language acquisition and hence this smaller linking study), intelligence and strong recall skills (Baddeley, 1992; Conway et al., 1993).

### 4.2.6. Study 3

As the hypothesis of this short study seemed to be correct, it confirmed that measuring working memory in the local and international students who had acquired English at varying ages was an important next step to see if working memory affected academic performance in ESL students who had learnt English later in life. However, as mentioned earlier, the 2002-2006 cohorts had (mostly) completed their degree and, therefore, new data had to be collected from a later cohort of students (2008-2010), and from which neurophysiological results could be obtained.

The aim of this next study was to determine if the relevant information could be used to develop a model to predict the academic outcomes of the local and international students. This was an important study because as mentioned, to date, the current literature is lacking in research that relates cognitive measures (psychophysical, psychometric etc.) directly to academic outcomes in students, particularly older age groups such as university students.

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### 4.3. Abstract


orking memory (WM) is often poorer for a second language (L2). In low noise conditions, people listening to a language other than their first language (L1) may have similar auditory perception skills for that L2 as native listeners, but do worse in high noise conditions and this has been attributed to the poorer WM for L2. Given that WM is critical for academic success in children and young adults, these speech-in-noise effects have implications for academic performance where the language of instruction is L2 for a student. We used a well-established Speech-in-Noise task as a verbal WM (vWM) test and developed a model correlating VWM and measures of English proficiency and/or usage to scholastic outcomes in a multi-faceted assessment medical education program. Significant differences in Speech- Noise Ratio (SNR $5_{50}$ ) values were observed between medical undergraduates who had learned English before or after five years of age, with the latter group doing worse in the ability to extract whole connected speech in the presence of background multi-talker babble (Student-t tests, $p<0.001$ ). Significant negative correlations were observed between the $\mathrm{SNR}_{50}$ and seven of the nine variables of English usage, learning styles, stress, and musical abilities in a questionnaire administered to the students previously. The remaining two variables, Perceived Stress Scale (PSS) and the Age of Acquisition of English (AoAoE) were significantly positively correlated with the SNR $_{50}$, showing that those with a poorer capacity to discriminate simple English sentences from noise had learnt English later in life and had higher levels of stress - all characteristics of the international students. Local students exhibited significantly lower SNR $_{50}$ scores and were significantly younger when they first learnt English. No significant correlation was detected between the $\mathrm{SNR}_{50}$ and the students' Visual/Verbal Learning Style ( $r=-0.023$ ). Standard multiple regression was carried out to assess the relationship between language proficiency and verbal working memory ( $\mathrm{SNR}_{50}$ ) using 5 variables of L2 proficiency with the results showing that the variance in $\mathrm{SNR}_{50}$ was significantly predicted by this model $\left(r^{2}=0.335\right)$. Hierarchical multiple regression was then used to test the ability of three independent variable measures ( $\mathrm{SNR}_{50}$, age of acquisition of English and English proficiency) to predict academic performance as the dependent variable in a factor analysis model which predicted significant performance differences in an assessment requiring communications skills $(p=0.008)$, but not on a companion
assessment requiring knowledge of procedural skills, or other assessments requiring factual knowledge. Thus, impaired vWM for an L2 appears to affect specific communications-based assessments in university medical students.

### 4.4. Introduction

In medical education, most information is communicated verbally, often to large groups of students. Consequently, listening abilities and language comprehension are critical to learning and require both auditory perception and auditory working memory (WM) skills. WM is defined as "the system for the temporary maintenance and manipulation of information, necessary for the performance of such complex cognitive activities as comprehension, learning, and reasoning..." (Baddeley, 1992, p. 281). One core element of WM, and in particular verbal Working Memory (vWM), is the "phonological loop", which has been shown to be critical for language acquisition during development, as well as language processing in daily life (Baddeley, 1992). However, it has been widely reported that WM capacity may be limited for students who are learning in an environment where the language of instruction is not their native language (Andersson, 2010; Kroll et al., 2002; Mackey et al., 2002; McDonald, 2006; Miyake \& Friedman, 1998; Service, 1992; Service et al., 2002; Sunderman \& Kroll, 2009; Tokowicz et al., 2004) and this appears to be due to demands on WM resources in the second language (L2) (Service et al., 2002).

The relationship between WM capacity and academic achievement has been well studied in children (Alloway \& Elsworth, 2012; Gathercole \& Pickering, 2000a, 2000b; Gathercole et al., 2004b; Vock \& Holling, 2008) and in university students and adults (Daneman \& Carpenter, 1980; Daneman \& Hannon, 2001; Swanson, 1994; Tolar et al., 2009). Whilst the studies in younger learners have shown strong correlations between WM and high academic attainment (Alloway \& Alloway, 2010; Gathercole et al., 2004b; St ClairThompson \& Gathercole, 2006), studies of university science students have reported that WM has only weak or indirect effects in predicting academic performance (Krumm et al., 2008; Rohde \& Thompson, 2007). Tolar, et al. (2009) found WM strongly related to the adults' ability on Scholastic Aptitude Test (SAT) scores, but effects were reduced when other cognitive factors were controlled for, such as spatial ability. Further, some studies suggest that vWM may not have as great an effect on the students' processing abilities as the direct effects of the students' first language (L1), including the ability to suppress L1
influences or the level of L1 proficiency and general language aptitude (for review see Juffs \& Harrington, 2011).

In addition or in consequence of the poorer vWM for L2, the acoustic environment to facilitate ideal listening conditions may also be crucial for effective learning by L2 medical undergraduates. It has been noted that non-native listeners may have similar speech perception skills as native listeners in low noise conditions, but that these abilities significantly decrease in high noise conditions (Buus et al., 1986; Florentine et al., 1984; Lin et al., 2004; Mayo et al., 1997; Tabri, Abou Chacra, \& Pring, 2011; Takata \& Nabelek, 1990). Using the Speech-in-Noise (SiN) task, Mayo, et al. (1997) showed that not only was speech perception in noise poorer in L2 learners, but that it was also dependent on the age the L2 was acquired; bilinguals who learnt English after 14 years of age had the worst performance in the SiN task compared to monolinguals and bilinguals who learnt English before 6 years of age. Further, in contrast to the monolinguals, the late bilinguals did not benefit from contextual cues in those sentences that were highly predictive (i.e. sentences in which the subjects could easily guess the target word). Similarly, Buus, et al. (1986) found that the noise tolerance level of non-native listeners to understand $50 \%$ of the test sentences, increased with years of exposure to English, but never reached the level of tolerance (and achievement) of a native English speaker.

There is evidence that the ability to process speech in noise influences the ability to recall academic material. Ljung, et al. (2010) tested 48 native Swedish university students with open-ended questions about the content of spoken lectures of up to eight minutes duration presented in broadband noise or quiet, or presented students with 10 paragraphs of lectures in classrooms of differing reverberation times. The subjects' memory performance was significantly worse under both adverse conditions compared with the quiet condition, even when the students had heard correctly the spoken lectures.

Given the relationship between vWM capacity, academic achievement and the impairment of speech comprehension in noisy environments by L2 learners, such effects are likely to be even stronger for these students. Thus, a potential disadvantage exists for medical students learning a course in their L2. This is particularly relevant to the many international medical students that travel to mainly English-speaking western universities
in, e.g., Australia, the UK or the USA (Brisset et al., 2010) especially those for whom the L2 was not acquired at an early age. Our study has important implications in identifying another significant factor impacting on the academic performance in the early years of a medical undergraduate course, the period of greatest stress and of greatest likelihood of drop-outs/failures (Baker, 2004).

In the present study, we examined the relationships between vWM for L2, the age at which the L2 was acquired, and students' scholastic outcomes. In a previous study (Mann et al., 2010), we showed that international students in a Bachelor of Medicine/Bachelor of Surgery (MBBS) course in an Australian university performed worse than their local peers, but that this was significantly influenced by the students' L1. This is consistent with the idea that L1 influences may affect academic outcomes for instruction in an L2. Building on this, we now explore whether verbal WM plays a role in the academic achievements of a cohort of international and local medical undergraduates in the same course. Specifically, we hypothesise that 1) students with English as a Second Language (ESL students) will have lower scores than students with English as a First Language (EFL students) in the SiN test (reflecting poorer vWM); and 2) that the students with lower SiN results will also have lower academic scores in their different assessments.

As well as having a high secondary school result (a pre-requisite also for local students), international medical students must pass stringent measures of English proficiency prior to enrolment and must also attend and pass an interview to demonstrate high motivation and self-expectations. To a major extent these requirements obviate the confounding effects of English proficiency skills often suggested (Lun et al., 2010; Webb, 2002) to account for the fact that, generally, international medical students do not perform as well academically as their local counterparts (Bagot et al., 2005; Liddell \& Koritsas, 2004; Wass et al., 2003). We used a well-established auditory test paradigm as a vWM test, free of L2 proficiency concerns that have been raised against such tests as the Reading Span Test (RST) when applied to L2 learners (Juffs \& Harrington, 2011). The SiN task tests vWM via the phonological loop through storing, processing and recall of speech in background noise.

### 4.5. Material and Methods

### 4.5.1. Participants

All participants in this study were students enrolled in the MBBS program from 2008-2010 at Monash University. The students were informed that this project was biphasic and participation involved both completing a questionnaire and an invitation at a later date to undergo an audiometry test. The questionnaire asked for information on the students' personal demographics, English acquisition and usage, musical abilities and two psychometric measures: Perceived Stress Scale (Cohen, 1994) and the Index of Learning Styles Questionnaire (Felder \& Soloman, 1994) (Appendix B1). Stress has been found to have a negative impact on the academic performance of first year medical students, particularly international students (Bagot et al., 2005; Baker, 2004; Lacina, 2002; Mori, 2000) as well as the style of learning adopted by international versus local students, such as deep vs. surface learning styles (Bagot et al., 2005; Newble \& Entwistle, 1986; Volet et al., 1994; Zeegers, 2001). As mentioned in the Introduction, the international medical students of this course must pass stringent measures of English proficiency prior to enrolment, such as the International English Language Testing System (IELTS) or the Test of English as a Foreign Language (TOEFL). Therefore, the questions on the survey pertained mainly to measurable English attributes such as 'In what order did you learn English and your other language'? There was one question on the students' perceived English and Language Other Than English (LOTE) proficiency which was purely self-rated from a score of ‘ $0=$ poor' to ‘ $4=$ excellent'.

The surveys were distributed at the commencement of each university year in the 1st year of the medical undergraduates' course. Of the 791 questionnaires distributed over the three years, 582 were returned giving a response rate of $73.6 \%$. Participation was voluntary and students could withdraw at any stage.

In the second phase of the project, students were asked to participate in a SiN test (described below). As it was not feasible to submit all 582 subjects to this test, we performed a power analysis using GPower 3.0.10, which calculated that we would require 15 subjects in each group to give us an effect size of 0.8 at a power level of $90 \%$. We then emailed all 582 students inviting them to attend the audiometry test at a mutually
convenient time. From these emails, we had a total of 113 subjects that came in to be tested on the speech-in-noise task. Of these 113, ten participants were excluded from data analysis: one subject was excluded due to hearing impairments and nine candidates were classed as outliers with means more than two standard deviations from the sample mean (at $\alpha=0.05$ ), leaving a total of 103 subjects tested and analysed, which still gave us ample power for this particular study. Analysis and findings relevant to all 582 students (including the 113 who participated in the audiometry tests) are currently being researched by the authors, and will be reported elsewhere; the emphasis of this report is on the outcomes of the 103 subjects undertaking the SiN test.

Demographic characteristics are set out in Table 4.2.

Students were classed as 'local' if they were Australian or New Zealand citizens, or if they held permanent residency for more than three years; or students were classed as 'international' if they held temporary entry visas, in accordance with the option chosen by the students on their questionnaires. Only one student held permanent residency status and had been living in Australia for over five years; all other students were citizens or held temporary entry visas.

All ethics for this study were approved by the Monash University Human Research Ethics Committee (MUHREC) (Appendix C3 \& C4).

### 4.5.2. Audiometry Testing

At the outset, hearing sensitivity in each subject was measured with audiometry using a Beltone Model 110 Clinical Audiometer, calibrated to present pure tones through calibrated TDH headphones. Hearing was tested one ear at a time at $500 \mathrm{~Hz}, 1000 \mathrm{~Hz}$, $2000 \mathrm{~Hz}, 4000 \mathrm{~Hz}, 6000 \mathrm{~Hz}$ and 8000 Hz . The minimum sound level at each frequency was recorded as the threshold in decibels Hearing Level ( dBHL H ) relative to normal hearing sensitivity (ISO, 1989). We then calculated the bilateral four tone threshold average from thresholds at $500 \mathrm{~Hz}, 1000 \mathrm{~Hz}, 2000 \mathrm{~Hz}$ and 4000 Hz . Generally, only subjects with binaurally normal hearing (thresholds $\leq 20 \mathrm{~dB} \mathrm{HL}$ ) were included in data analysis. However, two subjects had small hearing losses in one ear only ( $<5 \mathrm{~dB}$ ) and one subject had a middle ear infection in one ear. Previous unpublished research in our laboratory (and the fact that these data did not manifest as outliers), has found that isolated unilateral cases such as
these do not affect end results and therefore, data from these subjects were included in analysis.

### 4.5.3. Speech-in-Noise (SiN) Discrimination Task

The SiN discrimination task consisted of subjects being asked to identify sentences presented in a background of multi-talker babble noise (details below). This task was administered from an HP Omnibook 4150 computer, using a program developed in-house to set noise and sentence level, to control presentation of sentences and noise, and to record, display and store results. The sentences and noise were streamed from the PC to Sennheiser HD353 headphones binaurally. Calibration of the sound stimuli was performed by coupling the headphones to a Brüel and Kjær Artificial Ear Type 4152 containing a Brüel and Kjær 1-inch Condenser Microphone Type 4145. The microphone output was connected to a Brüel and Kjær Precision Sound Level Meter Type 2203 on which sound pressure levels (SPLs) were read off (using the A-weighted scale on a slow time setting). The sentence level was standardized using a reference 1 kHz signal, with average RMS level set to the same value as for the sentences and stored on the computer as a .WAV file. Calibration of the background masking noise was done by playing the noise out of the headphones and again using the slow time settings to measure output level.

### 4.5.4. Test Sentences

Test sentences came from a standard battery of clinically-used sentences (Bench, Kowal, \& Bamford, 1979) adapted for Australian use (the BKB(A) list of sentences: Appendix D). The BKB list contains 192 sentences, each of 4-6 words of no more than two syllables. They are short, simple words and phrases imitating everyday speech and do not include questions or explanations open to interpretation. Also, these sentences contain words that have been shown to be very familiar to non-English speakers (Brouwer et al., 2012). Each sentence consists of three keywords critical for comprehension of that sentence (Figure 1 Appendix D). The sentences are pre-recorded in a female voice with an Australian accent in a neutral tone and stored as .WAV files on the computer.

Sixty sentences with similar speech reception thresholds (SRTs: the signal-to-noise ratio (SNR) at which $50 \%$ of the subjects could correctly detect the sentence in background
noise) were selected for use in this study. Selection and validation of these sentences have been detailed previously (Burns \& Rajan, 2008; Cainer, James, \& Rajan, 2008; Rajan \& Cainer, 2008). The sentences were randomly allocated to one of three lists classed as 'Low', 'Moderate' or 'High' to denote the level of the masking noise in which they were presented; sentence level was always set to 80dBA.

### 4.5.5. Masking Noise

The masking noise was 'babble noise' (BN), created as described previously (Burns \& Rajan, 2008; Cainer et al., 2008; Rajan \& Cainer, 2008) to give the illusion of eight voices speaking at once, known as the 'cocktail party' effect, digitized and stored as .WAV files. Sentences were presented to subjects in a background of one of three noise levels: 1) Low noise level at 78dBA (SNR of +2 dB ); 2) Moderate noise level at 81dBA (SNR of -1 dB ); and 3) High noise level at 84dbA (SNR of -4dB). The noise was played continuously throughout each test list and was turned off at the end of each list until just before the start of the next list.

### 4.5.6. General Procedures

For the SiN discrimination task, each subject was instructed that they would be presented with three lists of sentences in noise, in succession. Each list would consist of 20 different sentences in a fixed background noise level of low, moderate or high. The order of lists, i.e., test SNRs was randomised between subjects except that the high noise level list was never presented first to ensure subjects did not start with the most difficult condition. The subject was asked to repeat each sentence after it was played to the best of their ability, or to indicate if they were unable to identify it at all, with no time limit imposed on giving the response. The experimenter would score the response and then play out the next sentence. After all 20 sentences in a list had been played, this procedure would be repeated twice more, with a different list of sentences and a different noise level, until all three lists had been tested.

Upon confirmation that the subject understood the instructions and was ready to commence, the masking noise appropriate for the first test list was switched on and played by itself for 5 s before the first sentence was played. Each sentence was scored as correct only if all three keywords were identified correctly and in correct order. Once the
experimenter had scored the response, the next sentence was automatically played 1.5 s later, and the test continued until all 20 sentences had been presented. Subjects were given a short break between lists. The order of presentation of sentences in each list was randomised by the software so it was unique for each subject. Scoring of performance in each list consisted of recording the percentage of sentences they were able to recall in each list.

### 4.5.7. Indexing performance in the SiN task: calculating the $S N R_{50}$

For data analysis, the first step was to calculate the percentage of sentences identified correctly by a subject for each list. This was done using only the middle ten sentences for each noise level for the following reasons: The first five sentences were discarded as training sentences as in our previous studies (Burns \& Rajan, 2008; Cainer et al., 2008; Rajan \& Cainer, 2008), and the last five were discarded as some subjects showed signs of fatigue or loss of concentration.

Then data from each subject were fitted with a linear function using regression analysis and from the regression equation the midpoint of the function - the SNR at which $50 \%$ of the sentences would be detected correctly $\left(\mathrm{SNR}_{50}\right)$ was determined. These $\mathrm{SNR}_{50}$ data represented the measure derived from the $\operatorname{SiN}$ task as a measure of verbal working memory. We also calculated SNR $_{50}$ using only the last 10 sentences of each list and found generally similar SNR $_{50}$ effects. We therefore chose to use the middle 10 sentences as least likely to be affected by either training effects or loss of concentration.

### 4.5.8. Academic Assessment

As well as the SiN test and questionnaire, the students' academic marks were also collected from the standard academic assessments faculty databases for data analysis. This included the first and second year data for the 2008 \& 2009 cohorts, but only the first year data was collated for the 2010 cohort due to time limitations. Therefore analysis for the first year results were performed using the 103 students mentioned earlier; for the second year, analysis could be performed only on 54 (from the 103) students who had completed both years of study, i.e. students from the 2008-2009 cohorts only.

Course assessments varied from year to year, however all students' marks consisted of a combination of written examinations, individual coursework and objective structured clinical examination (OSCE) simulations. For data analysis nomenclature, these assessments were termed 'End-of-Year Totals' (Year 1 or Year 2); 'Coursework', comprising of essays, oral presentations and portfolios; 'Examinations', comprising of Multiple Choice and Short Answer Questions; and 'OSCEs' whereby the students undergo simulated clinical/patient scenarios at various timed stations whilst being assessed. The OSCEs were further subdivided into two categories according to the skills that were being evaluated: those in which the emphasis was primarily on technical skills ('OSCE Technical', e.g., injecting techniques or taking vital signs) or those in which the emphasis was primarily on communication skills ('OSCE Communications', e.g., taking a patient's history or providing an explanation to a simulated patient).

### 4.5.9. Statistical Analyses

Statistical analyses were performed using SPSS v19.0.0 (SPSS Statistics Inc.) for Windows. All statistical tests were parametric, and data were checked for normality of distribution and variation. Pearson's correlation was conducted to investigate the relationship between items from the questionnaire, Perceived Stress Scale, Index of Learning Style (the visual/verbal component only was analysed as the other components are not pertinent to this particular study) and Signal to Noise Ratio (SNR ${ }_{50}$ ). Standard multiple regression was carried out to assess the relationship between language proficiency and verbal working memory ( $\mathrm{SNR}_{50}$ ) and hierarchical multiple regression was used to test the ability of three measures (SNR ${ }_{50}$, age of acquisition of English and English proficiency) to predict academic performance. Student's t-tests were also used when comparing independent groups.

Table 4.2. Demographic characteristics of students for Years $1 \& 2$ of MBBS undergraduate degree

| MBBS Cohorts 2008-2010 |  |
| :---: | :---: |
| Total | N |
| Year 1 | 103 |
| Year 2 | 54 |
| \% Local:International |  |
| Year 1 | 63:37 |
| Year 2 | 59:41 |
| \% Gender |  |
| Males | 46 |
| Females | 54 |
| Age of Acquisition of English |  |
| < 5 years old | 88 |
| > 5 years old | 15 |
| Range | 1-12 years |
| Age (years) |  |
| Mean (SD) | 19.94 (1.19) |
| Range | 18-24 |

### 4.6. Results

### 4.6.1. Speech in Noise performance and relationship to English proficiency

We used the SiN task to assess the presence of vWM deficits in L2 in our medical student population. In comparing across groups, students who had learnt English as a first language, had significantly smaller SNR $_{50}$ values than the students who had learnt English as a second language (Student's-t 76 ) $=-4.208, p<0.001$ ) as seen in Figure 4.3. Twenty-five students were not included in this analysis, as they were bilingual ${ }^{7}$.

[^5]
## Difference in SNR ${ }_{50}$ scores between EFL and ESL students



Figure 4.3 SNR ${ }_{50}$ scores for students with English as first or second language. EFL: English as First Language $N=47$. ESL: English as Second Language $N=31$. Bilingual students were excluded $N=25$. ** $p<0.001$

These observations established that the point of subjective performance (the SNR ${ }_{50}$ ) from our SiN task is a good index of verbal working memory for L2 in our medical student population.

We then used correlational analysis to assess the relationship between $\mathrm{SNR}_{50}$ and English usage items from the questionnaire, as outlined in Table 4.3.

Table 4.3 Descriptive statistics and Correlations table of $\mathrm{SNR}_{50}$ and items from the questionnaire used in this study

|  | Mean (SD) | I prefer to speak English... | In the last month, how often did you speak English at home? | Perceived English proficiency | Self-rate of musical skills | Perceived Stress Scale | Visual/Verbal Learning Style Score | Age when first began playing music | Age when first learnt English | SNR ${ }_{50}$ score |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| When I was growing up my Mother spoke English at home... | 3.78 (1.41) | .485** | .677** | .366** | . 150 | -.236* | -. 158 | -. 177 | -.676** | -.465** |
| I prefer to speak English... | 4.55 (0.75) | - | .611** | .575** | . 093 | -.287* | -.226* | -.238* | -.528** | -.276* |
| In the last month, how often did you speak English at home? | 4.42 (1.06) |  | - | .554** | . 142 | -.313* | -. 120 | -.203* | -.654** | -.409** |
| Perceived English proficiency | 4.54 (0.78) |  |  | - | .279* | -.398** | -.235* | -.341** | -.483** | -.471** |
| Self-rate of musical skills | 1.89 (0.95) |  |  |  | - | -. 174 | -. 071 | -.562** | -.222* | -.274* |
| Perceived Stress Scale | 13.78 (5.53) |  |  |  |  | - | -. 072 | . 003 | .268* | .314* |
| Visual/Verbal Learning Style Score | 4.18 (4.52) |  |  |  |  |  | - | . 131 | . 133 | -. 023 |
| Age when first began playing music | 10.49 (5.85) |  |  |  |  |  |  | - | .371** | . 188 |
| Age when first learnt English | 2.87 (2.37) |  |  |  |  |  |  |  | - | .394** |

SNR 50 $_{0}$ score $\quad-0.30(1.12)$

Bolded figures are all significant at ${ }^{*} p<0.05$ or ${ }^{* *} p<0.001$

Significant negative correlations were observed between seven of the nine variables on the questionnaire and the SNR $_{50}$. The remaining two variables, Perceived Stress Scale (PSS) and the Age of Acquisition of English (AoAoE), were significantly positively correlated with the $\mathrm{SNR}_{50}$, indicating that those with a higher $\mathrm{SNR}_{50}$ ratio (poorer capacity to discriminate simple English sentences from noise) had learnt English later in life, i.e. more likely the international medical students, and had higher levels of stress (as noted in the current literature). Local students exhibited significantly lower SNR $_{50}$ scores than the international medical undergraduates $(t(101)=6.23, p<0.001)$, as well as being significantly younger when they first learnt English ( $t(101)=3.33, p=0.001$ ).

No significant correlation was detected between the $\mathrm{SNR}_{50}$ and the students' Visual/Verbal Learning Style (r=-0.023), suggesting that the possible cultural variability in this factor was not a substantial confound in our findings.

On the basis of these observations, we then conducted multiple regression analyses using the five items significantly correlated to $\mathrm{SNR}_{50}$ that pertained to English proficiency and/or usage. These variables were: Age of Acquisition of English (AoAoE); Perceived English Proficiency (PEP); how often their mother (primary caregiver) spoke English when the student was growing up (MSE); the students' own preference for speaking English (PSE); and how often the student spoke English in the last month (ESLM). All variables were entered simultaneously using the Enter method.

The results showed that the variance in $\mathrm{SNR}_{50}$ was significantly predicted by this model of L2 proficiency $\left(F(5,93)=9.37, p<0.001, r^{2}=0.335\right)$, with the five variables altogether explaining $33.5 \%$ of the total variance in $\mathrm{SNR}_{50}$. There were two variables that significantly contributed to this overall variance. The first, Perceived English Proficiency (PEP), had the highest beta coefficient of -0.409 ( $p<0.001$ ) and accounted for $9.8 \%$ of the variance. The other variable was MSE with a beta coefficient of $-0.366(p=0.005)$ and a unique contribution of $5.91 \%$ to the overall $33.5 \%$ variance. The other three variables, AoAoE, PSE and ESLM, were not significant predictors of SNR $_{50}$ in this particular model with beta values of $0.020,0.159$ and -0.019 respectively. However, AoAoE and ESLM showed significant correlations with $\mathrm{SNR}_{50}$. Figure 4.4 graphically shows the zero-order correlations and beta coefficients for the four variables that were highly correlated to SNR ${ }_{50}$ as also shown in Table 4.3.


Figure 4.4 Significant correlations and beta values between $\mathrm{SNR}_{50}$ and factors relating to English language skills. Figures a-c were based on answers from Likert scales ranging from 1=poor to $5=$ excellent for figure $a$, and from $1=$ never to $5=$ very often for figures $b \& c$. $S N R_{50}=$ the Signal to Noise Ratio at which the student got $50 \%$ of the sentences correct. ${ }^{* *}$ p $<0.001,{ }^{*}$ p $<0.05$.

One caveat to interpretation of our results is that the five variables pertaining to English proficiency and usage (AoAoE, PEP, MSE, PSE and ESLM) are also highly significantly correlated with each other, with $r$ values $>0.5$ (Table 4.3). This may suggest that these variables share the same set of underlying causal elements that affect vWM for L2 and its usage, i.e. they demonstrate multicollinearity. Therefore, a principal component analysis was performed to establish if there were underlying common constructs involved across these factors. The analysis yielded one factor with an eigenvalue $>1.0$ that accounted for $65 \%$ of the variance. All variables had high loadings with a minimum of 0.725 , and a reliability test yielded a Cronbach's $\alpha$ coefficient of 0.760 (considered an acceptable value of good internal consistency) (Appendix E).

In order to include all variables in this construct, it is necessary for all variables to be of the same scale. One variable, AoAoE, however, could not be changed (reverse coded) to
the same scale as the other four variables in an appropriate way that did not change its correlation values. Therefore, it could not sit in this new construct and as it has been widely documented that language proficiency is influenced by the age at which the language is acquired, hierarchical analysis was conducted.

The new construct of the four remaining variables, i.e. PEP, MSE, PSE and ESLM, was representative of the amount of exposure and usage the students had of English and a self-rating of their English skills. It was thus an approximation of the students' overall English proficiency, renamed 'English Language Skills' (ELS) and the means were calculated for analysis and checked for multicollinearity against SNR $_{50}$. Hierarchical multiple regression analyses were used, controlling for AoAoE in the first step and SNR 50 and the new construct ELS in the second step. Analysis was performed for the End of Year Total scores, as well as for each Assessment (as described in the Methods section) for Year 1 and Year 2 of study. Results are set out in Table 4.4 and discussed in detail below.

Table 4.4 Hierarchical multiple regression to assess academic performance of MBBS students

| $\begin{aligned} & \text { Year } 1 \\ & \mathrm{~N}=103 \end{aligned}$ |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Assessments | Mean (SD) | Predictor Variables | $\mathrm{R}^{2}$ | $\mathrm{R}^{2}$ Change | $\beta$ | ANOVA |
| End of Year 1 Total | 75.87 (6.17) | Step 1: | . 003 | . 001 |  | $F(3,99)=.137, p=.938$ |
|  |  | AoAoE |  |  | -. 057 |  |
|  |  | Step 2: | . 004 |  | . 036 |  |
|  |  | AoAoE |  |  | -. 036 |  |
|  |  | SNR ${ }_{50}$ |  |  | . 022 |  |
|  |  | ELS |  |  | . 041 |  |
| Examinations Year 1 | 72.94 (8.19) | Step 1: | . 011 | . 002 | -. 107 | $F(3,99)=.462, p=.709$ |
|  |  | AoAoE |  |  |  |  |
|  |  | Step 2: | . 014 |  |  |  |
|  |  | AoAoE |  |  | -. 116 |  |
|  |  | SNR ${ }_{50}$ |  |  | . 056 |  |
|  |  | ELS |  |  | . 018 |  |
| Coursework Year 1 | 80.66 (8.17) | Step 1: $\quad 003$AoAoE |  | . 004 |  | $F(3,99)=.254, p=.858$ |
|  |  |  |  | . 059 |  |  |
|  |  | Step 2: | . 008 |  |  |  |
|  |  | AoAoE |  |  | . 023 |  |
|  |  | SNR ${ }_{\text {E }}$ |  |  | . 066 |  |
|  |  |  |  | -. 013 |  |  |
| OSCE Year 1 | 79.13 (7.83) | Step 1: . 001 |  |  | . 033 | . 031 | $F(3,99)=1.157, p=.330$ |
|  |  | AoAoE |  |  |  |  |  |
|  |  | Step 2:AoAoE |  |  |  |  |  |
|  |  |  |  | . 176 |  |  |  |
|  |  |  |  | -. 150 |  |  |  |
|  |  | $\begin{aligned} & \text { SNR }_{50} \\ & \text { ELS } \end{aligned}$ |  | . 119 |  |  |  |
| OSCE Communications Year$1$ | 78.39 (8.81) |  | . 000 | . 050 | . 003 | $F(3,99)=1.753, p=.161$ |  |
|  |  | AoAoE |  |  |  |  |  |
|  |  | Step 2: | . 050 |  |  |  |  |
|  |  | AoAoE SNR ${ }_{50}$ ELS |  |  | $\begin{aligned} & .128 \\ & -.231^{*} \\ & .046 \end{aligned}$ |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| OSCE Technical Year 1 | 81.59 (9.87) | Step 1: | . 005 | . 058 | . 073 | $F(3,99)=2.225, p=.090$ |  |
|  |  | AoAoE |  |  |  |  |  |
|  |  | Step 2: | . 063 |  |  |  |  |
|  |  | AoAoE |  |  | .326* |  |  |
|  |  | SNR ${ }_{50}$ |  |  | -. 038 |  |  |
|  |  | ELS |  |  | .329* |  |  |



[^6]These results establish that not only is $\mathrm{SNR}_{50}$ a good index of verbal working memory for L2, but it could be employed to test if poorer L2 vWM is a strong predictor of academic performance along with language proficiency skills.

### 4.6.2. Academic performance and relationship to English language skills

In the first year of study, the results showed that SNR $_{50}$ and ELS were not significant predictors of overall academic performance, even when AoAoE was controlled for. However, the L 2 vWM index ( $\mathrm{SNR}_{50}$ ) did make a significant unique contribution to the OSCE Communications performance, with a beta coefficient of -0.231 ( $p=0.043$ ). This demonstrated that the smaller the $\mathrm{SNR}_{50}$ ratio (i.e., the better the vWM for discrimination of simple English sentences from noise), then the greater the Communications score.

In contrast to this, results for the OSCE Technical skills showed significant positive correlations with the AoAoE (beta coefficient of $0.326, p=0.023$ ) and with ELS (beta coefficient of $0.329, p=0.030$ ). These correlations showed that students who had learnt English significantly later in life, but who rated their English skills more highly (international students with good English proficiency skills), performed better in the technical aspects of the OSCEs, despite learning the L2 at a later age. The SNR ${ }_{50}$ was not significant, indicating that L2 vWM does not influence academic performance for this particular assessment.

Overall, after controlling for the age English was acquired, there was no clear, major predictor of academic performance in Year 1.

In Year 2, this model of VWM and ELS while controlling for AoAoE was a significant predictor of academic performance of the OSCE Communications skills ( $p=0.008$ ), explaining $21 \%$ of the variance of this assessment. ELS had the highest beta coefficient of 0.315 but this was not statistically significant and accounted for only $3.46 \%$ to the overall $21 \%$ variance. There was also a significant negative correlation with AoAoE on its own in Step 1 (beta coefficient $=-0.384, p=0.004$ ), but AoAoE was no longer uniquely significant in the overall model for predicting OSCE Communication skills, indicating it has only an indirect influence on predicting performance of this academic assessment.

With regard to the OSCE Technical assessment for Year 2, the effects were incongruous with those observed in the results obtained for Year 1, with the SNR $_{50}$ now significantly correlated (beta coefficient $=0.346, p=0.038$ ), but AoAoE and ELS showing no correlation with academic performance. As it was the international medical students who exhibited higher $\mathrm{SNR}_{50}$ ratios, this would indicate that these students could be performing better in this category than their local counterparts. This was confirmed by an independent samples $t$-test, which showed that the international medical students performed better in this assessment in Year 2 than their local peers $(t(43.73)=3.376, p=0.002)$. This would suggest that the international students' L2 vWM is not impaired in this assessment in Year 2 (as in Year 1), perhaps because the recall of technical data is not as challenging on vWM capacity as conceptual and abstract comprehension (Van Merriënboer \& Sweller, 2010). Overall, the model is not a significant predictor for this assessment and explains only $11 \%$ of the variance, with $\mathrm{SNR}_{50}$ uniquely contributing $8.07 \%$.

Although the model was not a significant predictor of the academic performance of the 2nd year total OSCE (i.e. not subdivided into OSCE Communications and OSCE Technical), it is worth noting that it accounts for $13 \%$ of the overall variance for this variable, which in the classroom would be regarded as a considerable proportion. T-test analysis of the Year 2 OSCE scores showed that while there was no significant difference between local and international medical students ( $p=0.113$ ), there was a significant difference for the AoAoE, with students who acquired English before the age of five having better overall marks for the OSCE assessment than those who acquired English later $(t) 52)=2.038$, $p=0.047$ ). This is also evident in the significant negative correlation of AoAoE in Step 1, with a beta coefficient of -0.320 and significant $p$-value of 0.018 . However, in Step 2, AoAoE was no longer significant, demonstrating that there are overlapping effects with the other variables.

To summarise, after controlling for the age at which English was first learnt, verbal working memory for English (as indexed by the SNR $_{50}$ in our speech-in-noise task) and ELS were not strong predictors of the overall End of Year Totals or for the individual Assessments, with the exception of the OSCEs. For the OSCE assessments, the contribution made to the variance by each predictor varied for the OSCE types and was
different for each year of study. The OSCE Communications was the only significant model, which in itself is a significant finding and which is discussed later.

### 4.7. Discussion

The relationship between verbal Working Memory and academic attainment has been well documented in L1, particularly with young learners (Gathercole et al., 2004b). However, the role of vWM in predicting academic achievement in L2 adults, particularly medical students, has been only occasionally examined with inconsistent effects (see Harrington \& Sawyer, 1992; Juffs \& Harrington, 2011).

The aim of the current study was to explore if L2 VWM plays a role in academic attainment in ESL students. We indexed L2 vWM using a SiN task as a WM verbal test, as such tasks have been well documented to be a good indicator of L2 vWM and because such a task reflected, to a consistent degree, the background conditions occurring in some of the venues in which information was imparted to student doctors in their course. Linguistically, English target speech and English speech noise consist of many common properties (e.g. phonemes, syllable structures, prosodic features, etc.), which may make it more difficult for listeners, particularly non-native, to segregate target language from background noise and this may contribute to greater informational masking (e.g. Bronkhorst, 2000; Brouwer et al., 2012; Brungart, 2001; Brungart, Simpson, Ericson, \& Scott, 2001; Lutfi, 1990; Rhebergen et al., 2005; Scott, Rosen, Wickham, \& Wise, 2004; Simpson \& Cooke, 2005; Van Engen, 2010). Background masking noise can be classed as energetic or informational; energetic masking is thought to affect speech processing at the level of the auditory periphery, whereas informational masking, e.g. babble noise, interferes with higher-order processing such as attention and cognitive load. Informational maskers have therefore been often used in working memory tasks to good effect. Hygge, et al. (2003) found that meaningful irrelevant speech noise significantly impaired recall in a text-reading memory task in 92 native high school students in Sweden.

We also examined a number of other factors known or postulated to influence L2 skills, in particular the age at which the participants first learnt English (as their L2) as this factor
has previously been shown to influence English learning and proficiency (Johnson \& Newport, 1989).

In our first analysis, we confirmed that the point of subjective performance (the $\mathrm{SNR}_{50}$ score) in our SiN task was indeed a good index of verbal working memory for L2 in our student population, with our results showing that the EFL students had smaller $\mathrm{SNR}_{50}$ scores than the ESL students. This meant that the EFL medical students were better able to identify simple English words in a noisy background than the ESL medical students. This was an important step as this SiN task is free of L2 proficiency concerns that have been a major criticism of previous studies that have used measures such as the Reading Span Task (Harrington \& Sawyer, 1992; Juffs \& Harrington, 2011) to show differences in L2 vWM and may be one explanation for the mixed findings of past studies. It is also worth noting that Waters \& Caplan (2005) have argued that traditional measures of WM do not relate to on-line processing of sentences, which they postulate to be due to a specialised WM system; we believe that tasks such as the SiN task are likely to be better evaluators of WM in online processing of whole connected speech.

We then used this index of vWM along with English Language Skills (ELS) as our model to predict academic attainment whilst controlling for the age that English was first acquired by the student (AoAoE).

### 4.7.1. Different language-related factors affect different subcategories of the

## Objective Structured Clinical Examination assessment

In Year 1, this overall model was not a strong predictor of academic achievement, but there was a significant unique contribution of SNR $_{50}$ to the OSCE Communications score, indicating that vWM has a role in this assessment, and significant unique contributions of AoAoE and ELS to the OSCE Technical scores indicating that language fluency rather than vWM is involved in academic performance of the latter assessment. It is not surprising that the OSCE subcategories were the only assessments that showed significant correlations. This assessment type, particularly the Communications component, is one that has continually shown major performance differences between L1 and L2 medical students in many different countries and regardless of whether the L1 is English or
another language (Fernandez et al., 2007; Liddell \& Koritsas, 2004; Schoonheim-Klein et al., 2007; Van Zanten et al., 2003; Wass et al., 2003; Woolf et al., 2007).

We have also found similar results in a current study of a larger cohort of 872 medical students (Mann, Canny, Lindley, \& Rajan, unpublished), in which we did not measure L2 vWM or proficiency as in the present study. Our findings in this study showed that in the first year of the course, international medical students performed academically worse than their local peers in the OSCE assessment only, and not the Examinations or Coursework assessments. There were similar findings in the second year of the course; however, some groups did perform worse in all assessments including the OSCEs.

The above findings of the OSCE subcategories suggest that specifically, the memorising and automated recalling of technical information may not be as challenging to vWM as the complex task of trying to express conceptual and abstract themes (i.e. higher-order cognitive processing) by the ESL students as posited by Van Merriënboer \& Sweller, (2010). Similarly, Tyler, (2001) suggests that the knowledge and familiarity of a topic will determine how well a non-native speaker will perform. Therefore, factual information that is rote-learnt, such as the OSCE Technical, will be equally easy to recall for both nonnative experienced and inexperienced student doctors than unfamiliar abstract or conceptual topics, such as needed in the OSCE Communication tasks, which require good verbal working memory for the L2.

Although the impairment of communication skills is more apparent in the 2nd year of study, it is important to note that we collated second year data only for the 2008 \& 2009 cohorts and not for the 2010 cohort. The dynamics for the years may not be the same and each year should be examined on its' own basis. Notwithstanding, this model again predicted academic performance in the OSCE Communication assessment, suggesting both vWM and language deficits in the ESL students affect this assessment subcategory in the second year. Similarly, whilst the OSCE Technical model that was found to apply in 1st year was not overall predictive of academic achievement, there was a significant correlation of vWM for this assessment subtype in 2nd year. Together, both OSCE subcategories point to L2 VWM impairments in these 2nd year students. This may be due to the 2nd year curriculum being more difficult than basic first year outlines, and therefore the greater demands on English language skills consequently resulting in poorer
performance by the ESL. This is quite possible as Collier, (1992) has stated that growth curves on normalized tests tend to flatten as students' progress in age and grade level and as the school load becomes academically more complex.

Overall, our model of L2 vWM and English Language Skills was a strong predictor of academic attainment (controlling for the age English was first learnt) for the OSCE Communications assessment subcategory. The fact that the Communications assessment was the only significant model is in itself significant, as although the international students have proven English proficiency (via IELTS or TOEFL), these medical students still perform academically worse than their local counterparts in this assessment, even whilst achieving higher scores for the other subjects.

Similar to the fact that we found no effects of L2 vWM on other components of assessments, in a study using L1 participants, Kidd, et al. (2007) found only a weak correlation between SAT scores and auditory abilities using SiN tasks. Using a broad WM test battery, Krumm, et al. (2008) also found only small indirect measures of WM as a predictor of academic performance. In contrast, Tolar, et al. (2009) found that WM strongly related to an adult's mathematical performance, but not when other cognitive factors where controlled for.

Verbal WM is not the only factor poorer for an L2 learner. McDonald, (2006) reported that late English language learners had, in addition to poorer WM, poorer English decoding ability and lower speed of processing in English. Takano \& Noda, (1993) posited this slower speed of L2 processing as a temporary decline in thinking ability because the demanding processing load interfered strongly with the L2 subject's thinking, beyond the normal foreign language processing difficulties experienced by non-native speakers. Takano \& Noda, (1995) demonstrated that this "foreign language effect" was greater the more the foreign language was dissimilar to the native language, with greater performance differences between, for instance, Japanese and English than German and English, which share similar language roots.

It is important to note that only $51-75 \%$ of variance in academic attainment is explained by general cognitive abilities (of which processing speed and WM are two cognitive processes) (Rohde \& Thompson, 2007). It is not surprising then that correlations among
working memory (or vWM) measures, e.g. reading span, generally tend to be moderate (Tolar et al., 2009) as seen in the aforementioned studies and the results of this report.

### 4.7.2. Limitations of the study

We have discussed our findings in relation to verbal WM as the $\operatorname{SiN}$ task is a verbal/auditory task and, therefore, a measure of the phonological loop of WM. We did not employ visual memory tasks, e.g. written examinations, and further research into how the mode of presentation could affect outcomes is required.

Further, we had categorised our AoAoE group as having acquired English either before or after the age of 5 years old according to extant literature. In our sample, the age range was 1-12 years, meaning that the majority of subjects in our sample learnt English prepuberty. Most studies find greater discrepancies with L2 learners who have learnt English post-puberty ( $\sim 14$ years old Mayo et al., 1997). Therefore, our results may underestimate the true effect of L2 age of acquisition on advanced learning.

### 4.7.3. Conclusions and implications for future pedagogical design of MBBS courses

In summary, our study contributes to the growing research examining why non-native medical undergraduates generally perform academically worse than their native speaker counterparts despite having good L2 proficiency skills. The implications are that in a prestigious course such as the MBBS degree, where all students have proven high academic abilities, motivation and expectations prior to commencement, small differences at the early stages could have disproportionate impacts on the medical careers of L2 students, for example, in selection for highly competitive specialist training positions or fellowships. The knowledge from this study, therefore, could be used in the training of medical students from diverse backgrounds, for instance, by introducing compulsory language immersion programs prior to commencement of the formal course. An immersion program is typically 3-6 months and forces the student to speak and think in the host country's language in order to understand the language and the culture. Even for students who have apparently high levels of English proficiency (as gauged for our medical students by the stringent IELTS / TOEFL tests and face-to-face interviews) such immersion programs may prove to improve vWM in the language of instruction simply
through more extensive use. This could be either general language immersion, or may be better if targeted to the specific clinical and health sciences language that medical students will encounter on commencement of the course. Further, advanced technology could be installed in areas of high noise conditions, e.g. audio systems in lecture theatres, that filter out 'white noise' to give better signal enhancement and brain processing of information to students. Having this information could also help medical students' in forming appropriate study habits such as understanding what is a 'good' study environment, etc.

We note that our study highlights an area where international medical students continually fall down despite rigorous processes and comparable English proficiency. Under these circumstances, we believe that our study provides a strong basis for carrying out procedures as noted above to improve equity of access by international students to resources to improve their academic outcomes.

### 4.8. ADDENDUM

### 4.8.1. Musical Abilities

### 4.8.1.1. Introduction


n the published paper preceding this section, 'Poorer verbal working memory for a second language selectively impacts academic achievement in university medical students', it was shown that there were strong correlations between Age of Acquisition of Music and a number of variables pertaining to English language skills, such as a preference to speak English, how often in the last month English was spoken, self-perceived English proficiency, self-rate of musical skills and the Age of Acquisition of English (see Table 4.3, p. 109, for beta values). However, Age of Acquisition of Music was not significantly correlated to the students' $\mathrm{SNR}_{50}$ in the SiN test (also shown in Table 4.3), nor did it significantly impact on academic performance as hypothesised in the Introduction on page 31, 1.9.4. Specific Hypotheses. Therefore, data relating to music was not included in the submission to the publishers, Peer J, and, as this was a published paper, it could not be altered for this thesis. Nevertheless, it was important to include musical abilities as a factor that may have an impact on academic performance regardless of the outcome of these findings.

Here, the data analysis relating to musical abilities and academic performance is presented with suggested rationalizations for the negative findings.

### 4.8.1.2. Methods and Materials

A detailed description of the methods and materials is listed in the above-mentioned publication. Briefly, participants were the same students who sat the SiN test except for two students who did not provide their age of acquisition of music, making a total of 101 students. All other details remain unaffected.

All students who attended the Speech-in-Noise test were asked at the end of the test session to complete a short musical questionnaire (Appendix B2) in relation to their age of acquisition and musical abilities.

Data was then entered and statistical analyses were conducted using SPSS v19.0.0 (SPSS Statistics Inc.) for Windows. The relationship between Age of Acquisition of Music and End of Year Totals and Assessment Types was investigated using regression analyses (Pearson correlation coefficient).

### 4.8.1.3. Results

There were no significant correlations between musical abilities and any of the other measures as seen in the following tables for either year of study.

Table 4.5. Musical Abilities and Academic Performance Correlations for Year 1 MBBS students

|  |  | End of Year 1 <br> Total | Exams <br> Year 1 | Coursework <br> Year 1 | OSCE Year <br> 1 | OSCE <br> Comms <br> Year 1 | OSCE <br> Technical <br> Year 1 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Age of <br> acquisition <br> of Music | Pearson <br> Correlation | .085 | .079 | -.009 | .101 | -.162 | -.011 |
|  | .396 | .431 | .926 | .314 | .106 | .911 |  |
|  | N | 101 | 101 | 101 | 101 | 101 | 101 |

Table 4.6. Musical Abilities and Academic Performance Correlations for Year 2 MBBS students

|  |  | End of Year 2 Total | Exams Year 2 | Coursework <br> Year 2 | $\begin{gathered} \text { OSCE Year } \\ 2 \end{gathered}$ | OSCE <br> Comms <br> Year 2 | OSCE Technical Year 2 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Age of acquisition of Music | Pearson <br> Correlation | . 007 | . 135 | -. 173 | -. 122 | -. 179 | . 019 |
|  | Sig. (2- <br> tailed) | . 959 | . 340 | . 219 | . 390 | . 203 | . 895 |
|  | $N$ | 52 | 52 | 52 | 52 | 52 | 52 |

### 4.8.1.4. Discussion

In this brief study there was no significant relationship found between the age at which a student started to learn a musical instrument and academic attainment. This is incongruent to a large library of studies that show positive correlations between musical abilities and enhanced auditory skills, (Crawley et al., 2002; Francois \& Schön, 2011; Parbery-Clark, Skoe, Lam, \& Kraus, 2009b; Rauschecker, 1998; Schön et al., 2004; Song, Skoe, Banai, \& Kraus, 2012; Strait, Kraus, Skoe, \& Ashley, 2009; Strait, O'Connell, ParberyClark, \& Kraus, 2013; Tallal \& Gaab, 2006; Zatorre, Chen, \& Penhune, 2007).

Generally, most of the above studies have measured auditory skills between groups of 'musicians' and 'non-musicians', where there has been a vast distinction between the levels of musical expertise in the two groups (Abrams, Bhatara, Ryali, Balaban, Levitin, \& Menon, 2011; Brand, 2001; Francois \& Schön, 2011; Musacchia, Sams, Skoe, \& Kraus, 2007). Generally, a 'musician' is classed as someone with $10+$ years of sustained musical activity (Francois \& Schön, 2011; Parbery-Clark et al., 2009b) and a 'non-musician' may be someone who has less than 10 years' experience or no experience at all with a musical instrument. In the cohort of the present study, the level of musical training varied between participants from <3 years to >10 years of sustained musical activity, even though the students had learnt music from a young age. Unfortunately, there were insufficient students who could be classified as being at 'musician' level, and the lack of musical expertise could be one reason for the absence of an effect in this study.

Another explanation for null results may be a fundamental flaw in the hypothesis. Whilst the literature has shown that highly trained musical abilities significantly improves auditory processing, there is no a priori reason to believe that better auditory processing necessarily translates into higher academic scores. To date there has been no study that shows that musical training has a direct impact on academic performance, however one study does show very close links between musical training and improved reading skills (Tierney \& Kraus, 2013), though there is no evidence to show that better reading skills translate to higher academic achievement.

Academic achievement involves a range of other processes such as $I Q$, speed of processing, working memory, socio-economic background, etc. and even these are not
necessarily good predictors of academic outcome (Alloway \& Alloway, 2010; Rohde \& Thompson, 2007; Waiter, Deary, Staff, Murray, Fox, Starr, \& Whalley, 2009). In the previous Study 3, it was shown that poorer verbal Working Memory was likely an important factor in affecting academic performance and better auditory processing skills may be just one factor towards improved vWM. Also, enhanced auditory processing skills may arise from more efficient processing of low-level auditory features (e.g., frequency, intensity modulations etc.).

In conclusion, prolonged, sustained musical activity may enhance a person's auditory processing skills; however, further research is needed to determine if this would result in higher academic achievement, and if a person's L2 would impact on these outcomes.

# CHAPTER 5: 

## GENERAL

## DISCUSSION

### 5.1. Overview of Findings

$\tau$
he increasing numbers of international medical students travelling to western institutions for tertiary health studies, such as in the USA, UK and Australia, has led to numerous reports on disparities in academic performance between local students and their international peers as stated throughout this report.

This thesis examined these disparities in a cohort of highly-motivated academically wellprepared medical undergraduates with similar socioeconomic backgrounds, in a program of study that required high proficiency in the medium of instruction. This cohort allowed mitigation of important factors that have been problematic for other such studies, namely proficiency in the language of instruction, the academic preparedness of the different cohorts of students, and the level of motivation for study in the course under examination.

Whilst there are a number of factors understood to influence academic outcomes of international and other L2 learners, this thesis identified that communication skills, particularly in the OSCEs, were a major contributor to poorer academic performance of the international MBBS students compared to the local students in the first two years of study in the course. Furthermore, not all OSCE categories were equally affected, with greater differences seen in the OSCE tasks dependent on communication rather than technical skills. These results are discussed here with particular emphasis on the issues thought to affect L2 learners as outlined at the start of this dissertation, i.e. First Language Influences, Age of Acquisition of English, Sociometric Variables (particularly Acculturative Stress) and Working Memory.

### 5.2. General Discussion

In Study 1, comparison of the overall end of year results established that the international students performed worse academically than the local undergraduates, in both Year 1 and Year 2, in the cohorts enrolled in each year of 2002-2006. One of the factors known to impact on L2 learners, L1 influences, was used to categorize the cohorts according to the Language Family of the students' first language. This was an important distinction as the results showed there were statistically significant differences within the same

Language Families and, thus, language was not a major predictor of academic performance. Acculturative stress was indicated as a likely contributing factor towards the lower performance, one of the sociometric factors that have been found to influence academic outcomes particularly in the early years of university (Cameron \& Kirkman, 2010; Lacina, 2002; Zhang \& Mi, 2009). This was surprising since it was anticipated (from the findings in the current literature) that L1 influences may be more important than sociometric factors. One potential explanation for the possible increase in importance of sociometric variables such as acculturative stress is the major restructure of the MBBS curriculum from a traditional lecture-based format to a PBL-based program in 2002, when the students, academic and student support staff were adapting to the new syllabus. It is possible that with this major change in program format, sociocultural issues may have had a more prominent influence than anticipated.

Study 2 aimed to expand the findings from the first study to explore if the disparities between local and international students were based on the nature of the assessments undertaken in the course and if any assessment format was particularly problematic for the foreign students in line with the expectations from the first study on acculturative stress. Therefore, using the same large database of academic performance for students from the first study, an investigation was carried out to examine these differences across the various types of assessments making up the students' overall yearly score. These assessments looked at different skills sets such as communication skills, language proficiency, recall of technical knowledge and critical thinking skills.

The results from this study were instrumental in highlighting differences between the cohorts and revealed more information than was able to be gained from the first study. Whilst the original data showed an overall total year poorer performance in the international students in both years, the more detailed examination in Study 2 revealed that different effects occurred in the 1st and 2nd years and different assessments showed greater effects than others. Namely, in the 1st year, international MBBS students performed worse than locals only in the OSCE assessments and was dependent on the Language Family. The variation was great enough to influence the total year score as seen in the original analysis in Study 1. This lead to the hypothesis that differences in the first year could not be due to language proficiency per se. This was verified when it was shown
that the foreign students did just as well as the locals in the Examinations and Coursework.

Furthermore, when the OSCE assessment was categorized into communications-based or technical skills, all three Language Families showed significant differences in the communications-based category whereas only the English LF showed significant differences between the local and overseas cohorts for the technical sub-category. Finally, it is worth noting that the effects occurred only for the OSCE communications examinations and not for other assessment types that included some communication skills component (e.g. the Coursework assessment category).

These effects are consistent with the existing literature, which also show that OSCE examinations are particularly difficult for international students (Liddell \& Koritsas, 2004; Schoonheim-Klein et al., 2007; Wass et al., 2003). However, these studies have not differentiated OSCEs distinctly into assessments based on technical skills versus assessments based on communications skills, as has been done in this study. The findings in this research indicates that it is not the OSCE examination per se that is problematic for international students; in fact, in the latter 2008-2010 cohort, the international students performed better in the OSCE technical component than their local peers, but the OSCECommunications format, that is face-to-face oral testing in a time-restricted, highly pressured and stressful environment, that was problematic. The fact that the home and foreign students performed equally significantly worse in the Examinations, which is also undertaken in a time-restricted, highly stressful environment, also shows that it is not the OSCE examination per se that is the problem.

Interestingly, the poorer performance in the communications-based OSCE assessments occurred despite the stringent screening procedures for English proficiency required for this MBBS course and it occurred even for the international students who spoke predominantly English at home suggesting that there may be other language barriers rather than just proficiency. In the previous chapters, it was posited that the overall end of year difference may be partly attributable to acculturative stress. This hypothesis is consistent with a large literature (e.g. Rosenthal et al., 2007; Treloar et al., 2000; Ying \& Han, 2006) that international students often have lower linguistic competency in the classroom of instruction of the host country whilst in their transitional stages.

Salamonson et al. (2008) have argued that a powerful factor in acculturation to a new country is acculturation for the primary language of that country, and this may be regardless of how proficient the students are in that language (Yeh \& Inose, 2003). If international students are not accustomed to formulating their thoughts in a culturally- or grammatically-similar way to that used by local students then expressing them in a nonnative language most likely would be an added burden.

Another reason for these effects is proposed by Tyler (2001), who posited that experienced non-native speakers with a high degree of language competency, rely heavily on topic knowledge. However, experienced non-natives do just as poorly as inexperienced non-natives when the topic is unknown or unfamiliar, and this is demonstrated by the international students in the English Language Family who performed poorly compared to their local counterparts. Adank et al. have also repeatedly demonstrated that accent for an L1 can impair speech discrimination (Adank, 2012; Adank, Davis, \& Hagoort, 2012; Adank, Noordzij, \& Hagoort, 2012), which, coupled with acculturative stress, could also explain the poorer performance of the English LF overseas students. Li (2009) stated that students with strong confidence in their knowledge of the language, such as the foreign students in the English Language Family, may place greater expectations on themselves to do well. However, these students may suffer greatly if the realisation is different, i.e. their knowledge of the language is not as good as they had expected, resulting in a sense of failure and an academic performance on par with, or worse than, other L2 students.

Unexpectedly, in the 2nd year a different pattern of effects emerged. Here international students did worse than local students in all assessment categories and this was statistically significant for both the English and Indo-European Language Families, but not statistically different for the Sino-Tibetan Language Family (however, the same trend occurred).

Collier (1992, p. 187) states that "If a program is new, and staff and students are excited about the innovation...[it] can influence early student gains, but may wear off in succeeding years". This is known as the 'Novelty Effect' (Kaufman, Day, \& Mensink, 1996; Polyzois, Claffey, \& Mattheos, 2010) where there is an initial improvement in academic performance in response to an increased interest in a new curriculum or technology and
not at all due to an actual improvement in learning or scholastic attainment. While it is not known if the novelty effect would impact on both cohorts of students equally, it may be one contributing factor to the dissimilarities noted between the two years of study.

Collier (1992, p. 187) also stated that "Normal growth curves on standardized tests typically flatten out as students move up in age and grade level, as the curriculum becomes academically and cognitively more complex". Therefore the poorer results of the international students in all assessments may be due to the 2nd year curriculum being more complex than Year 1. Again, Collier did not differentiate between local and foreign students, but an academically challenging syllabus may place greater demands on English language skills in the ESL students, consequently resulting in poorer performance. This reasoning is supported by the literature pertaining to poorer working memory capacity and the generally-accepted relationship between speed of information processing and measures of intelligence in L2 learners (Conway et al., 1993; DeDe et al., 2004; Schweizer, 1993; Waters \& Caplan, 2005) as detailed in the General Introduction of this thesis.

Another cause is suggested by Henning, et al. (2012) based on extensive studies examining the quality of life and cultural differences in New Zealand medical university students, both local and international. Henning, et al. (2012b) suggests that the international students may do worse in their second year as they may find it more stressful and therefore may be prone to more health problems. Health problems are thought to be a great source of acculturative stress as many international students do not make use of the social and health support afforded to them such as doctors and other health professionals (Lee et al., 2004; Wei et al., 2007). The New Zealand culture is extremely similar to Australia (Murphy, Herrman, Hawthorne, Pinzone, \& Evert, 2000) and therefore, it is possible that the effects identified by Henning may also apply in Australia.

Finally, it should be emphasised that international students travel from many varying countries, ethnicities and cultures, and it is wrong to regard them as an homogenous group. In Section 1.9.4. Specific Hypotheses, it was theorised that cultural and language distances would also impact on the academic outcomes between the different language families, with the Indo-European LF posited to outperform the Sino-Tibetan LF. However, this was not the case and in Study 1, the Sino-Tibetan foreign students outperformed the Indo-Europeans in both years, with the differences in the second year being significantly
greater. This may be due to the exceptional attitude of the Asian students towards education (Sue \& Okazaki, 1990); the fact that they did not perform as well as their local counterparts in the first year may be due to acculturative stress. However, in the second year, whilst the other international students had begun to trail behind the locals, there were no longer any significant differences between the students in this Language Family. This may possibly be due to language proficiency equal to or on-par with their counterparts or these students may have good coping strategies; therefore the overall lower grades in international students may be due to a combination of language skills and acculturative stress for some NESB groups ${ }^{\text {i }}$.

As noted above, Study 2 established that verbal communications skills in the OSCE assessments appeared to be a major contributor to poorer academic performance by the international students. To test one potential linguistic-related factor that could account for this effect, in Study 3 a model was developed to test working memory, principally of the phonological loop, in a new cohort of students, who had enrolled in each year of 2008-2010. The aim was to examine if this factor could be correlated to factors related to the students' English language background, such as Age of English Acquisition (AoAoE) and self-reported English language skills (ELS). A Speech-in-Noise task was chosen as a measure of WM as it has been shown previously to be a good index of verbal working memory (Ljung et al., 2010). It was also appropriate as it had been shown to differentiate between L1 and L2 speakers (Brouwer et al., 2012; Mayo et al., 1997).

For both years of study, there were significant correlations in the subcategories of the OSCE assessment to vWM for English as assessed by point of subjective equality $\left(\mathrm{SNR}_{50}\right)$ in the individual subject's psychometric functions in the Speech-in-Noise task. Specifically, there was a significant unique contribution of SNR $_{50}$ to the OSCE Communications score for Years 1 and 2, indicating that WM had a continuing effect on this assessment, a view which is supported by the existing literature findings that L2 learners have a lower WM capacity for L2 (Andersson, 2010; Service et al., 2002; Tokowicz et al., 2004). In contrast, for the OSCE Technical scores in the first year, there were no significant correlations with vWM, but there were unique contributions of age and self-reported English language skills. Surprisingly, these correlations showed that the students who had learnt English significantly later in life, but who rated their English skills more highly (i.e. International
students with good English proficiency skills), actually performed better in the technical aspects of the OSCEs than the native speakers. This is an important finding as it shows that proficiency in English is not necessarily dependent on a critical age of acquisition for successful academic attainment.

The findings of the 1st year OSCE assessments suggest that specifically, for the ESL students, the memorising and automated recall of technical information may not be as challenging to vWM as the complex task of trying to express conceptual and abstract themes, as posited by Van Merriënboer \& Sweller (2010). In addition, factual information that is rote-learnt, such as that assessed in the OSCE Technical, will be equally easy to recall for both non-native experienced and inexperienced speakers than unfamiliar abstract or conceptual topics, such as that assessed in the OSCE Communication tasks, which require good working memory for the L2. Moreover, it has been widely noted in the existing literature that many international students prefer the Surface Learning approach (Bagot et al., 2005; Volet et al., 1994), which adopts memorising factual details in isolation from the wider context of information. It is speculated that this effect may be particularly prominent in international students in their first year of university (perhaps as an acculturation by-product).

In the 2nd year of study, a significant correlation was seen between L2 WM $\left(S N R_{50}\right.$ in the Speech-in-Noise task) and both the OSCE Technical and the OSCE Communications assessments. Together, these findings further imply that the 2nd year workload may place increasing demands on L2 vWM resources. However, again, these increasing demands only manifest as impairments in academic performance of the international students in the OSCE Communications and not OSCE Technical subject.

### 5.3. General Conclusion

Whilst it was not always made explicit in this study, either statistically or in commentary, the international students of the latter cohorts, 2008-2010, did not generally underperform compared with their local peers as happened in the cohorts of 2002-2006. Direct comparisons of the two groups were not reasonable, but anecdotal evidence from academic staff of the MBBS course suggest that this may be due to the increase in the different cultural and geographic origins of this latter wave of international students.

Notwithstanding, the fact remains that whether or not these international pupils academically outperformed their local counterparts, the one area that has continually shown to be at a poorer academic level than the local students is that of verbal communication in the international students and this was noted in the two different year cohorts of students enrolled in this MBBS course from 2002-2006 and 2008-2010. To reiterate, the fact remains that the international students must pass stringent English language measures, as well as a complex, structured interview process assessing their self-motivation and academic-preparedness, for entry into the MBBS course examined here. Therefore, evidence from this thesis implies that the most likely cause of the lower academic outcomes of these international ESL medical students is probably due to poorer working memory capacity in L2. The age of acquisition of the L2 and L2 language skills also likely contributes to lower academic achievement seen in this thesis, with acculturative stress also impacting on first year results for some international students.

Given the relationship between WM capacity and academic achievement, this suggests that students learning a course in their L2 may be at a severe disadvantage. This is especially true with new evidence to show that students may hear correctly but not be able to properly recall academic material delivered from lecture theatres that mimics normal speech reverberation and noisy backgrounds of most university learning environments (Ljung et al., 2010). This is of also particular consequence for students who already have a poorer vWM for the language of instruction because it is not their first language.

The findings from this study show some evidence to support the hypothesis that verbal working memory may be poorer in international students and this may be due to neural processing mechanisms. However, this was evident only in assessments where communicating in a second language was necessary and not in other assessments such as memorising technical information so therefore still other factors must come into play.

A major interesting finding throughout these studies was that communication skills were always found to be significantly poorer in the foreign students despite proven English proficiency skills. Therefore, just having the knowledge of grammar, phonetic and syntactic skills is not sufficient in performing well in academic assessments, but being able to express abstract concepts and relay information is equally important in academic
achievement. This is an area that needs to be addressed in Second Language learning, whether through immersion programs or through testing measures such as the International English Language Testing Scheme (IELTS).

### 5.3.1. Future Studies

In researching the topic of academic outcomes of international students, certain areas of further research have become apparent. Firstly, there is still much debate regarding whether neurophysiological pathways are shared to process L1/L2 or if they are processed separately that need to be resolved either through more neuroimaging or electrophysiological measurements such as mismatch negativity. As an adjunct to this, though it has been shown that the brain pathways may differ for processing of speech in noise and in quiet, there have been no studies to date to show that this differs for L1 and L2 listeners (although this may depend on outcomes of the former debate). Also, a major criticism of studies measuring WM for L2 is that these studies do not take into account L2 proficiency and are in effect are still measuring working memory of the listeners' first language. Whilst this study has attempted to control for this, more studies researching participants of varying English proficiency skills would be valuable for our understanding of VWM in bilinguals. Ljung's (2010) research of testing for memory rather than speech intelligibility is a highly beneficial study worth replicating using L2 listeners as well. However, the most prominent gap noted during the writing of this entire thesis was the lack of studies that correlated the research directly back to academic outcomes for older (secondary and tertiary education) students, and thereby somewhat reducing the generalizability and applicability of many of these studies, as many other factors come into play for academic attainment other than isolated skills such as listening comprehension, phonemic discrimination, etc. This dissertation plays a small part towards addressing this issue, in medical undergraduates at least.

### 5.3.2. Final Summary

In summary, this doctorate study uniquely contributes to the growing research examining why international medical students generally underperform academically compared with their local counterparts and has highlighted areas of further research beneficial for future pedagogical policies.

[^7]Many studies pertaining to educational attainment in Asian students have explored a number of social and psychological factors that have been postulated to ascribe Asian students with gifted talents leading to the 'Asian myth' of these students being of higher intelligence than their western counterparts (Kao, 1995; Sue \& Okazaki, 1990). Whilst there has been no absolute evidence to prove this theory, a number of sociometric values, such as those listed in this thesis, has shown that Asian students have a propensity that is conducive to good study behaviours and therefore high academic attainment. These behaviours include; emphasis on importance of education and authority; studying for long hours; studying in focused study groups; forgoing social activities; knowing the amount of study to allocate to different subjects; and so on (Niles, 1995; Rosenthal et al., 2007; Sue \& Okazaki, 1990) Further, these tendencies have been enmeshed in the Asian culture for some time and therefore family expectations for students to do well in their studies are high, which is passed on to their children and their grandchildren (Kao \& Thompson, 2003). These parental expectations, in many cases, surpass the students' own aspirations, with most students enrolling in courses chosen by their parents who inevitably choose high-prestige/high-academic courses such as medicine or law (Xie \& Goyette, 2003). However, that is not to say that these students are not still highly motivated and, because there is less pressure on the student, grateful for having the decision made for them (Kao, 1995). In a recent study by Malau-Aduli (2011) the author explored the coping strategies of international medical students in a Tasmanian university in their $3^{\text {rd }}$ or $4^{\text {th }}$ year of studies. Of the seven international countries, six were Asian countries and the last country was Canada. Although the international students did not perform as well as their local counterparts, the author concluded that despite the substantial challenges of culture shock, language barriers, curriculum overload and financial constraints, the students had adopted coping strategies to overcome these burdens, which was largely due to their high sense of responsibility to their families abroad.

Therefore, it is not altogether surprising to see the students of the Sino-Tibetan LF do well, be they local or international as their known work ethics may be a factor that overcomes acculturation, WM or other known influences.

Anecdotally, the most difficult students to recruit for the SiN study of this thesis were the Asian international students who often gave the excuse of 'having to study' for not attending the test sessions!

## APPENDIX A:

# MONASH MEDICAL <br> CURRICULUM AND 

## ENTRY

REQUIREMENTS
he Monash MBBS course employs a number of stringent measures in selecting students for acceptance into the course. First and foremost, these include a high level of English language proficiency (as measured via internationally validated assessments such as IELTS or TOEFL). Applicants must obtain an IELTS score of 7.0 with no individual band score less than 6.5 and a TOEFL minimum test score of either; in the written TOEFL, 587 with a Test of Written English (TWE) score of at least 4.5; or in the internet-based TOEFL, an overall score of at least 94 with at least 24 in the written section, 19 reading section, and no less than 20 in any other section.

Applicants must undertake either the Undergraduate Medicine and Health Sciences Admission Test (UMAT) for national students, or the International Student Admissions Test (ISAT) for international students. UMAT is a 3 hour aptitude test consisting of 134 multiple choice questions consisting of: Logical Reasoning and Problem Solving; Understanding People; and Non-verbal Reasoning. The test is not curriculum-based and presupposes no particular subjects at secondary level so that there is no bias. Similarly, ISAT is a 3 hour computer-based multiple choice test that is not subject specific, but rather assesses an applicant's critical and quantitative reasoning skills. The test is presented in units, with stimulus material followed by questions. There are 100 questions, which typically require applicants to read and think about a passage of writing, to interpret graphical displays of information, to use mathematical relationships and to reason about tables of data. All the information required to answer questions is contained in the stimulus material.

Finally, applicants undergo a semi-structured rigorous interview with trained interviewers conducting timed dialogue incorporating pre-scripted components. Each interview panel consists of three members, and gender was balanced across all panels; a faculty or university member, a medical graduate, and a community representative. Interviews explore motivation, interpersonal skills and include three tasks (unique to each session) to assess communication skills. These attributes are deemed crucial for this course and, therefore, the interview seeks an assessment of the quality of motivation, rather than simply its quantity and applicants are required to establish the reasons they are interested in studying medicine, and to demonstrate that they have realistically examined the implications and demands of a career in medicine. The manner of interpersonal skills
sought includes evidence of past teamwork, leadership, empathy, sympathy, and the ability to deal with ambiguity and uncertainty. On completion of the interview, each panel member independently assesses every component of the candidate's performance subsequent to a discussion of the candidate's performance, to arrive at a consensus decision.

In 2002, the course was extensively re-designed from the conventional structure of lectures-cum-tutorials for the first three years of study followed by clinical placements for the latter half of their studies. The new five year curriculum emphasized learning in an integrated manner that incorporated four themes covering clinical and didactic learning from the very first year of study. Campus-based instruction is now undertaken in the first two years, after which students are placed in various clinical settings for the last three years of the course. Learning occurs in an ethos underpinned by problem-based outcomes, with more diverse teaching modes and themes used from the outset of the degree and, correspondingly, an increase in the diversity of assessment tools used in the course.

Learning is achieved through the four-theme-based lectures, tutorials and practicals, with an expected attendance rate of $100 \%$ and a minimum of 25 contact hours per week for Years 1 and 2 students and an $80 \%$ attendance hurdle requirement.

The four themes are termed:
I) Personal and professional development:
> This theme is further subdivided into Professional Issues, Personal Development and Key Learning Experiences. This theme focuses on the doctor as an individual, focussing on the personal attributes needed by students and providing opportunities to pick up generic skills throughout the course.
II) Society, population, health and illness:
> This theme is also further subdivided into Health and Society, Health and Information and Health and Population. This theme is aimed at developing the student's ability to deal with the broader society and population issues, rather than issues concerning the individual. Students are taught about the history and
philosophy of the scientific approach to medicine, extending to an understanding of evidence-based medicine.
III) Scientific basis of clinical practice:
> Much of the basic sciences of anatomy, biochemistry, microbiology, pathology, pharmacology and physiology are delivered within this theme, in an integrated manner and from a relevant clinical perspective.
IV) Clinical skills:
$>$ In the early years of the course, this theme includes an introduction to clinics and hospitals, giving the students educational interactions with nurses, paramedics, radiographers and other healthcare professionals. The later years involves advanced experience in diverse medical work places within a clinical setting.

Table 1 Appendix A. Weightings of assessments by year for the years examined in this thesis. Note the total weightings do not add up to 1 as figures for group assessments are not included, but only the weightings of assessments for the students' individual work

| WEIGHTINGS |  |  |  |
| :---: | :---: | :---: | :---: |
| YEAR | EXAMINATIONS | COURSEWORK | OSCE |
| 2002 |  |  |  |
| Year 1 | 0.6 | 0.25 | 0.1 |
| Year 2 | 0.45 | 0.2 | 0.15 |
| 2003 |  |  |  |
| Year 1 | 0.5 | 0.2 | 0.2 |
| Year 2 | 0.45 | 0.2 | 0.15 |
| 2005 |  |  |  |
| Year 1 | 0.5 | 0.2 | 0.25 |
| Year 2 | 0.35 | 0.3 | 0.15 |
| 2006 |  |  |  |
| Year 1 | 0.25 | 0.5 | 0.2 |
| Year 2 | 0.45 | 0.2 | 0.15 |
| 2008 |  |  |  |
| Year 1 | 0.55 | 0.2 | 0.2 |
| Year 2 | 0.45 | 0.3 | 0.15 |
| 2009 |  |  |  |
| Year 1 | 0.55 | 0.2 | 0.2 |
| Year 2 | 0.45 | 0.3 | 0.15 |
| 2010 |  |  |  |
| Year 1 | 0.55 | 0.2 | 0.2 |

# APPENDIX B: QUESTIONNAIRES 

## B1 English Acquisition Status and Academic Performance in MBBS Students - Questionnaire

## Section A

## Personal and Family Details

This section asks for information about you and your parents.

Family Name $\qquad$ First Name $\qquad$

Student ID Number $\qquad$ Date of Birth $\qquad$

Monash Email Address $\qquad$

Contact Telephone $\qquad$ Gender $\square$ F

Country of Birth $\qquad$

Residential Status (Please Tick Relevant Box)

Australian Citizen

Australian Permanent ResidentYear of Arrival $\qquad$

Temporary Entry Permit (International Student)

Other $\square$ (Please Specify) $\qquad$

What are your living arrangements for this year?Living with parents/other family membersLiving aloneUniversity or shared accommodation

With what ethnic group do you identify?

Where were your parents born?


Other $\square$ (Please Specify) $\qquad$

Father
Australia $\square$

Other $\square$ (Please Specify) $\qquad$

What is the current residential status of your parents?
Father Mother

| Australian Citizen | $\square$ | $\square$ |
| :--- | ---: | :--- |
| Permanent Resident | $\square$ | $\square$ |
| Temporary Resident | $\square$ | $\square$ |
| Other (E.g. Unknown, Deceased, | $\square$ | $\square$ |

Not Resident in Australia)
$\alpha 80038$

What is the main occupation of each of your parents?


[^8]
## Section B

## Language Acquisition \& Usage

These next few questions ask about how you learnt English and any other languages you may speak.

At what age did you learn to speak English?
$\qquad$ Years Old (Specify Age In Years As Best As You Can Remember)

Where did you learn to speak English? (Please Tick Relevant Box/es)

Do you speak a language/s other than English? (Please Specify)

Language1) $\qquad$

Language2) $\qquad$

Language3) $\qquad$

At what age did you learn to speak this/these languages?

Language1) $\qquad$ Years Old

Language2) $\qquad$ Years Old

Language3) $\qquad$ Years Old

## $\cdots 80088$

Where did you learn to speak this/these languages? (Please Tick Relevant Box/es)

Language1) At Home $\square$ At School $\square$ Other $\square$ (Please Specify)
$\qquad$

Language2) At Home $\square$ At School $\square$ Other $\square$ (Please Specify)
$\qquad$

Language3) At Home $\square$ At School $\square$ Other $\square$ (Please Specify)
$\qquad$

In what order did you learn English and the other language/s? (Please Tick One Box Only)
$\square$ English only
$\square$ English and my other language/s were learnt at the same time i.e. concurrently
$\square$ English was learnt first and the other language/s laterMy other language/s were learnt first and English later

## $\cos \cos 8$

The next few questions ask about your language usage. In each case, you will be asked to indicate by circling how often you spoke these languages.
0 = never 1 = almost never 2 = sometimes 3 = fairly often 4 = very often




 When I was growing up my father spoke English at home..... $\begin{aligned} & 0 \\ & \\ & 1\end{aligned} \quad 2 \quad 2 \quad 3 \quad 4$ When I was growing up my mother spoke English at home... $0 \begin{array}{llllll} & 1 & 2 & 3 & 4\end{array}$

The next few questions ask about your language proficiency. In each case, you will be asked to indicate by circling how well you speak these languages.
$0=$ poor $\quad 1$ = basic $\quad 2$ = good $\quad 3$ = very good $\quad 4$ = excellent

My proficiency in English is
01234

My proficiency in Language 1 is $\qquad$ 01234

My proficiency in Language 2 is $\qquad$ 01234

My proficiency in Language 3 is $\qquad$ 01234

## $\cos 9380$

## Section C

## Musical Abilities

In the next few questions, we would like you to provide some information about your musical abilities.

Do you play a musical instrument? (Including Singing)

## $\square$ Yes <br> $\square$ No <br> Sing

If applicable, what is the highest level/grade you have achieved playing this instrument? (E.g. AMEB grade 5 in piano)

Do you read sheet music?No

How would you rate your musical skills overall?

## $\square$ Basic $\square$ Good $\square$ Very Good $\square$ Excellent

Using the following scale, indicate how often you play this instrument
0 = never 1 = almost never 2 = sometimes 3 =fairly often 4 = very often In the last 3 months I played this instrument. $\qquad$ 01234

## $\alpha 80088$

## Section D

## Perceived Stress Scale

The questions in this scale ask you about your feelings and thoughts during the last month. In each case, you will be asked to indicate by circling how often you felt or thought a certain way

0 = Never 1 =Almost Never 2 = Sometimes 3 =Fairly Often 4 = Very Often

1. In the last month, how often have you been upset because of something that happened $\begin{array}{lllllll} & 0 & 1 & 2 & 3 & 4 \\ \text { unexpectedly? }\end{array}$
2. In the last month, how often have you felt that you were unable to control the important $\begin{array}{lllllll}0 & 1 & 2 & 3 & 4\end{array}$ things in your life?
3. In the last month, how often have you felt nervous and "stressed"
4. In the last month, how often have you felt confident about your ability to handle your $\begin{array}{lllllll}0 & 1 & 2 & 3 & 4\end{array}$ personal problems?
5. In the last month, how often have you felt that things were going your way?
6. In the last month, how often have you found $\begin{array}{llllllll}\text { that you could not cope with all the things that } & 0 & 1 & 2 & 3 & 4\end{array}$ you had to do?
7. In the last month, how often have you been able to control irritations in your life?
8. In the last month, how often have you felt you were on top of things?
9. In the last month, how often have you been angered because of things outside your $0 \begin{array}{llllll} & 1 & 2 & 3 & 4\end{array}$ control?
10. In the last month, how often have you felt $\begin{array}{llllllll}\text { difficulties were piling up so high that you could } & 0 & 1 & 2 & 3 & 4\end{array}$ not overcome them?

## $\cdots 80088$

## Section E

## Index of Learning Styles*

These next questions ask you about your preferred learning style. For each of the 44 questions below, please select one answer by circling either " A " or " B " to indicate your choice. Please choose only one answer for each question. If both " $A$ " and " $B$ " seem to apply to you, choose the one that applies more frequently.

1. I Understand Something Better After I
(A) Try It Out.
(B) Think It Through.
2. I Would Rather Be Considered
(A) Realistic.
(B) Innovative.
3. When I Think About What I Did Yesterday, I Am Most Likely To Get
(A) A Picture.
(B) Words.
4. I Tend To
(A) Understand Details Of A Subject But May Be Fuzzy About Its Overall Structure.
(B) Understand The Overall Structure But May Be Fuzzy About Details.
5. When I Am Learning Something New, It Helps Me To
(A) Talk About It.
(B) Think About It.
6. If I Were A Teacher, I Would Rather Teach A Course
(A) That Deals With Facts And Real Life Situations.
(B) That Deals With Ideas And Theories.
7. I Prefer To Get New Information In
(A) Pictures, Diagrams, Graphs, Or Maps.
(B) Written Directions Or Verbal Information.
8. Once I Understand
(A) All The Parts, I Understand The Whole Thing.
(B) The Whole Thing, I See How The Parts Fit.
9. In A Study Group Working On Difficult Material, I Am More Likely To
(A) Jump In And Contribute Ideas.
(B) Sit Back And Listen.
10. I Find It Easier
(A) To Learn Facts.
(B) To Learn Concepts.
11. In A Book With Lots Of Pictures And Charts, I Am Likely To
(A) Look Over The Pictures And Charts Carefully.
(B) Focus On The Written Text.
12. When I Solve Math Problems
(A) I Usually Work My Way To The Solutions One Step At A Time.
(B) I Often Just See The Solutions But Then Have To Struggle To Figure Out The Steps To Get To Them.
13. In Classes I Have Taken
(A) I Have Usually Gotten To Know Many Of The Students.
(B) I Have Rarely Gotten To Know Many Of The Students.
14. In Reading Nonfiction, I Prefer
(A) Something That Teaches Me New Facts Or Tells Me How To Do Something.
(B) Something That Gives Me New Ideas To Think About.
15. I Like Teachers
(A) Who Put A Lot Of Diagrams On The Board.
(B) Who Spend A Lot Of Time Explaining.
16. When I'm Analyzing A Story Or A Novel
(A) I Think Of The Incidents And Try To Put Them Together To Figure Out The Themes.
(B) I Just Know What The Themes Are When I Finish Reading And Then I Have To Go Back And Find The Incidents That Demonstrate Them.
17. When I Start A Homework Problem, I Am More Likely To
(A) Start Working On The Solution Immediately.
(B) Try To Fully Understand The Problem First.
18. I Prefer The Idea Of
(A) Certainty.
(B) Theory.
19. I Remember Best
(A) What I See.
(B) What I Hear.
20. It Is More Important To Me That An Instructor
(A) Lay Out The Material In Clear Sequential Steps.
(B) Give Me An Overall Picture And Relate The Material To Other Subjects.
21. I Prefer To Study
(A) In A Study Group.
(B) Alone.
22. I Am More Likely To Be Considered
(A) Careful About The Details Of My Work.
(B) Creative About How To Do My Work.
23. When I Get Directions To A New Place, I Prefer
(A) A Map.
(B) Written Instructions.
24. I Learn
(A) At A Fairly Regular Pace. If I Study Hard, I'll "Get It."
(B) In Fits And Starts. I'll Be Totally Confused And Then Suddenly It All "Clicks."
25. I Would Rather First
(A) Try Things Out.
(B) Think About How I'm Going To Do It.
26. When I Am Reading For Enjoyment, I Like Writers To
(A) Clearly Say What They Mean.
(B) Say Things In Creative, Interesting Ways.
27. When I See A Diagram Or Sketch In Class, I Am Most Likely To Remember
(A) The Picture.
(B) What The Instructor Said About It.
28. When Considering A Body Of Information, I Am More Likely To
(A) Focus On Details And Miss The Big Picture.
(B) Try To Understand The Big Picture Before Getting Into The Details.
29. I More Easily Remember
(A) Something I Have Done.
(B) Something I Have Thought A Lot About.
30. When I Have To Perform A Task, I Prefer To
(A) Master One Way Of Doing It.
(B) Come Up With New Ways Of Doing It.
31. When Someone Is Showing Me Data, I Prefer
(A) Charts Or Graphs.
(B) Text Summarizing The Results.
32. When Writing A Paper, I Am More Likely To
(A) Work On (Think About Or Write) The Beginning Of The Paper And Progress Forward.
(B) Work On (Think About Or Write) Different Parts Of The Paper And Then Order Them.
33. When I Have To Work On A Group Project, I First Want To
(A) Have "Group Brainstorming" Where Everyone Contributes Ideas.
(B) Brainstorm Individually And Then Come Together As A Group To Compare Ideas.
34. I Consider It Higher Praise To Call Someone
(A) Sensible.
(B) Imaginative.
35. When I Meet People At A Party, I Am More Likely To Remember
(A) What They Looked Like.
(B) What They Said About Themselves.
36. When I Am Learning A New Subject, I Prefer To
(A) Stay Focused On That Subject, Learning As Much About It As I Can.
(B) Try To Make Connections Between That Subject And Related Subjects.
37. I Am More Likely To Be Considered
(A) Outgoing.
(B) Reserved
38. I Prefer Courses That Emphasize
(A) Concrete Material (Facts, Data).
(B) Abstract Material (Concepts, Theories).
39. For Entertainment, I Would Rather
(A) Watch Television.
(B) Read A Book.
40. Some Teachers Start Their Lectures With An Outline Of What They Will Cover.

Such Outlines Are
(A) Somewhat Helpful To Me.
(B) Very Helpful To Me.
41. The Idea Of Doing Homework In Groups, With One Grade For The Entire Group,
(A) Appeals To Me.
(B) Does Not Appeal To Me.
42. When I Am Doing Long Calculations,
(A) I Tend To Repeat All My Steps And Check My Work Carefully.
(B) I Find Checking My Work Tiresome And Have To Force Myself To Do It.
43. I Tend To Picture Places I Have Been
(A) Easily And Fairly Accurately.
(B) With Difficulty And Without Much Detail.
44. When Solving Problems In A Group, I Would Be More Likely To
(A) Think Of The Steps In The Solution Process.
(B) Think Of Possible Consequences Or Applications Of The Solution In A Wide Range Of Areas

## B2 MBBS Musical Questionnaire ${ }^{8}$

## STUDENT ID

1. How old are you today?
$\qquad$ age in years
2. At what age did you begin sustained musical activity? "Sustained musical activity" might include regular music lessons or daily musical practice that lasted for at least three consecutive years. If you have never been musically active for a sustained time period, answer with zero.
$\qquad$ age at start of sustained musical activity
3. How many years of private music lessons have you received? If you have received lessons on more than one instrument, including voice, give the number of years for the one instrument/voice you've studied longest. If you have never received private lessons, answer with zero.
$\qquad$ years of private lessons
4. For how many years have you engaged in regular, daily practice of a musical instrument or singing? "Daily" can be defined as 5 to 7 days per week. A "year" can be defined as 10 to 12 months. If you have never practiced regularly, or have practiced regularly for fewer than 10 months, answer with zero.
$\qquad$ years of regular practice
5. Which category comes nearest to the amount of time you currently spend practicing an instrument (or voice)? Count individual practice time only; not group rehearsals.
$\square$ I rarely or never practice singing or playing an instrument
$\square$ About 1 hour per monthAbout 1 hour per week

[^9]About 15 minutes per dayAbout 1 hour per dayMore than 2 hours per day
6. Have you ever played/sung in a band, choir or orchestra?

No (Skip to \#8)
Yes
7. Which option best describes your experience at playing/singing in a band, choir or orchestra?I am currently in a band/choir and I play/sing regularly (at least 3 times a week including practicing and performing in a group for the last 3 months)I am currently in a band/choir, but do not play/sing regularly (less than 3 times a week including practicing and performing in a group for the last 3 months)I used to be in a band/choir and played/sang regularly but stopped over 3 months agoI used to be in a band/choir, but did not play/sing regularly
8. Have you ever enrolled in any music courses offered at college (or university)?

No ` (Skip to \#10)
Yes
9. (If Yes) How much college-level coursework in music have you completed? If more than one category applies, select your most recently completed level.None
$\square 1$ or 2 NON-major courses (e.g., music appreciation, playing or singing in an ensemble)3 or more courses for NON-majors
$\square$ An introductory or preparatory music program for Bachelor's level work1 year of full-time coursework in a Bachelor of Music degree program (or equivalent)2 years of full-time coursework in a Bachelor of Music degree program (or equivalent)3 or more years of full-time coursework in a Bachelor of Music degree program (or equivalent)
$\square$ Completion of a Bachelor of Music degree program (or equivalent)One or more graduate-level music courses or degrees
10. Which option best describes your experience at composing music?Have never composed any musicHave composed bits and pieces, but have never completed a piece of musicHave composed one or more complete pieces, but none have been performedHave composed pieces as assignments or projects for one or more music classes; one or more of my pieces have been performed and/or recorded within the context of my educational environmentHave composed pieces that have been performed for a local audienceHave composed pieces that have been performed for a regional or national audience (e.g., nationally known performer or ensemble, major concert venue, broadly distributed recording)
11. To the best of your memory, how many live concerts (of any style, with free or paid admission) have you attended as an audience member in the past 12 months? Please do not include regular religious services in your count, but you may include special musical productions or events.None1-45-89-12
12. Which title best describes you?NonmusicianMusic-loving nonmusicianAmateur musicianSerious amateur musicianSemiprofessional musicianProfessional musician

THANK YOU FOR COMPLETING THIS QUESTIONNAIRE

## B3 2008000857 On-Line Questionnaire (Via Surveymonkey®)

1) At what age did you learn to speak English?
$\qquad$ Years Old (Specify Age In Years As Best As You Can Remember)
2) Do you speak a language/s other than English? (Please Specify)

Language1) $\qquad$

Language2) $\qquad$

Language3) $\qquad$
3) At what age did you learn to speak this/these languages?

Language1) $\qquad$ Years Old

Language2) $\qquad$ Years Old

Language3) $\qquad$ Years Old
4) In what order did you learn English and the other language/s? (Please Tick One Box Only)English is my only languageEnglish and my other language/s were learnt at the same time i.e. concurrentlyEnglish was learnt first and the other language/s laterMy other language/s were learnt first and English later

# APPENDIX C: ETHICS APPLICATIONS 

## MONASH University

## C1 Ethics To Analyse Previously Collected Data For 2002-6 Cohort

Application for
Ethical Approval of a Research Project Involving Humans (SCERH is the primary HREC)

| DATE RECEIVED | APPLICATION NUMBER 2008000857 |
| :--- | :--- | :--- |
| Office use only | Office use only |
|  |  |


| Section 1 - Project details |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| 1.1 |  | Title of project |  |  |
| Max 10 words <br> ESL and academic performance in MBBS students. |  |  |  |  |
| 1.2 | Resea | hers invol | ved in the conduct | of the project |
| Chief Investigator / Primary Supervisor (must be a Monash University staff member) |  |  |  |  |
| Title: <br> A/Prof | Name <br> Rajan | Ramesh | Staff ID: <br> 00200155  | Current qualifications (please include all): PhD, 1985 University of Western Australia |
| Department: Physiology |  |  |  | Campus: Clayton |
| Phone 1: 52525 |  | Phone 2: | Fax: |  |
| Email : Ramesh.Rajan@med.monash.edu.au |  |  |  |  |
| 1.2 | Researchers involved in the conduct of the project |  |  |  |
| Chief Investigator / Primary Supervisor (must be a Monash University staff member) |  |  |  |  |
| Title: <br> Prof | Name: Ben <br> Canny  |  | Staff ID: <br> 00352055  | Current qualifications (please include all): BMedSC (Hons) MBBS PhD |
| Department: Physiology |  |  |  | Campus: Clayton |
| Phone 1: 52567 |  | Phone 2: | Fax: |  |


cohort, perform significantly worse than local students. This overall poorer performance has been, generally, attributed to poorer English proficiency. However, some international students perform as well as their local cohorts and some local students perform as badly as the poorer-performing international students. We would like to investigate further by additional data analysis of individual assessment instruments for the first two years of enrolment, i.e. Year 1 \& Year 2, for each student of the MBBS (Bachelor of Medicine, Bachelor of Surgery) course from 2002-2007.
Assessment instruments vary for each year and include case studies, written exams (multiple choice questions and short answer essays), group projects and essays. Students are also marked on performance of OSCEs (Objective Structured Clinical Examinations). Here the student is assessed for their communication and performance skills in a real-life clinical setting. Each student is given 6-8 minutes at a number of stations to assess and diagnose a patient's problem. The student's evaluation is based on how well they interviewed the patient, communicated and resolved the main issues presented to them. Overall, the assessment instruments gauge the student's progress via written, oral and performance-based communications and each instrument is weighted to attain an overall final mark. Thus, it is important to investigate any factors, which may impact negatively, or positively, on the weighting scale. Preliminary analysis from the original study already indicates the OSCEs as being a negative predictor for academic performance in international students compared to their local counterparts, due to poorer communication skills.
We also anticipate using results from this study (subject to ethics submission and approval) as a basis for refining our test design for impending research (an ethics application will be submitted in due course), based on neurophysiological findings by CI1. These recent neurophysiological studies by C1 investigating a core brain competency, namely the ability to extract important signals in the presence of distractors (noise), suggest that even slightly later acquisition of English as a 2nd language, significantly retards the ability to acquire normal speech information in a noisy environment and may also block the brain's ability to learn and improve in this skill. This skill is required for information acquisition in some settings at university and not others and so it may well be that this skill can be linked to performance in some types of assessment tasks in the MBBS course, specifically those where information is imparted in a noisy environment. The impending research, mentioned earlier, will look at how or if educational performance and learning is affected by speech-in-noise processing in MBBS students and if there is a correlation with English acquisition of varying ages. By using the same cohort of students (MBBS) we can maintain validity and eliminate some confounding variables for this project. Therefore, this preliminary phase is a vital foundation block.
CF07/4841 - 2007002083. This project, designed independently of the present application as part of Cl 1 's research, examines how gender and training affect the ability of people to learn to discriminate speech from noise. This study is and will be carried out in the general Monash staff and student population and looks at how various other factors influence the ability to understand speech in the presence of background noise
and how to improve in this skill, but does not intend to examine how any of this relates to educational outcomes, as we propose to do in our impending study for which we will be seeking ethics approval in due course.
These projects both relate to potential avenues for addressing some differences between local and international students, generally, in academic performance and learning styles. This is of significant consideration to the University given the increasing number of international students enrolling in all courses at the University, as well as the number of students from different linguistic backgrounds, with English acquisition at different stages of life, at all of our campuses both in Australia and overseas. For example, this issue has already attracted attention from our colleagues in the Faculty of Medicine, Nursing and Health Sciences at Monash Malaysia as they feel it may also have direct implications for their own experiences in teaching in Malaysia.
In the present application we propose a study of much more limited scope to help us design a more efficient format for our subsequent detailed study of neurophysiology, sociometric factors and educational outcomes in current Monash MBBS students. We propose to take advantage of the existing data from the longitudinal study on educational outcomes of MBBS students and their status as local and international students, and some limited sociometric data, to carry out analyses to identify the specific educational assessments that may be linked to whether a student is of local or international origin and some of the limited sociometry available in these existing data sets.

| 1.4 | Plain language descriptions |
| :--- | :--- |
| 1.4 a | In plain language, give a succinct description of the background and potential <br> significance of the research project |

250 words max
The brain's ability to extract important sensory inputs from noise underlies our remarkable ability to identify things in our noisy world. The most obvious example is our ability to understand speech in lecture theatres, tutorials or other crowded environments. Impairment in this ability may cause difficulties in learning when information is imparted in such environments. In this context, anecdotal and incidental evidence indicate that international students show a range of learning outcomes, but, as a cohort, tend to perform significantly worse than local students. Poorer English proficiency alone cannot satisfactorily account for all effects. Therefore, further scientific analysis is needed to support the empirical data.
Our preliminary data suggests that even slightly later acquisition of English as a 2nd language (after age of 5 , but well before the brain's language circuits become 'hardwired') impedes, on a neurophysiological level, the ability to understand English speech in noisy conditions and the ability to further improve brain functions underlying this skill.
This has direct implications for Monash generally, given the large number of students from non-English-speaking backgrounds (NESB) who have acquired English as a second language. This study could provide an approach linking performance-assessment and
neurophysiological-testing from which we can derive designs for improvements in educational outcomes for international students. Education is the 3rd largest export commodity for Australia, and universities are increasingly dependent upon this source of income. Further, Monash, as an International University, needs to have a thorough understanding of the learning challenges faced by its students.

| 1.5 | Clearly state the aims and/or hypotheses of the research project |
| :--- | :--- |

250 words max
The general aim of this study is to explore the congruity between academic performance and residential status as a foundation for the next phase study.

More specifically this study aims to:
Analyse collected baseline information on a range of academic and demographic characteristics of medical students upon entry to university and to link this information with student records of academic achievement.
Identify the associations between individual instruments of assessment to ascertain if modality is a significant predictor of academic achievement for local and overseas students.
Examine changes in students' academic characteristics over the duration of the 1st and 2nd years of their degree.

| 1.6 a | Type of research -1 |
| :--- | :--- |


| $\boxed{\boxtimes}$ | Staff research |  |
| :--- | :--- | :--- |
| $\boxtimes$ | Student research | If YES, check the relevant box and give full title of degree <br> $\bigotimes \mathrm{PhD}$ (in Physiology) |

1.6b $\quad$ Type of research - 2

| $\boxed{Z}$ | Quantitative | Research examining academic performance |
| :--- | :--- | :--- |
| $\boxed{Z}$ | Social science | Correlating learning modalities with local vs. international <br> students |
| 1.7 a | Funding of your research project |  |
| $\boxed{Z}$ | Funding will be sought in the future: please advise SCERH as soon as practicable. <br> Please proceed to Qu 1.7b |  |


| 1.7 b | Do any of the researchers have any financial or other involvement in the research <br> (apart from their research role) or will they receive any reward, pecuniary or <br> otherwise? |
| :--- | :--- |
| $\boxed{\triangle}$ | If NO, please go to Qu 1.8 |
| 1.8 | Submission of this project to other Human Research Ethics Committees (HRECs) |


| 1.8 a | Has or will this project be submitted to other Human Research Ethics Committees <br> (HRECs)? |
| :--- | :--- |
| $\boxtimes$ | If NO, please go to Section 2 |

Section 2 - Details about the participants of the proposed research project

2.1 | Does your research project involve the direct involvement or participation of human |
| :--- | :--- | participants?

If NO:
I am only using data that has been collected for another purpose
with previous ethics approval - provide approval number if available
Go to Section 3b
$\square$ data was collected without ethics approval - Go to Q 2.1b I am using human tissues/fluids/stem cells - please complete Form HT - Application for Ethical Approval for the use of Human Tissue or Human Stem Cells

| Section 3b - Data materials and procedures <br> To be completed if project involves the use of existing data |  |
| :--- | :--- |
| 3 b .1 | Please describe the form of the data set <br> For example database, spreadsheet: |
| Currently the existing data is kept as spreadsheets on password-protected databases. <br> However, occasionally some data may need to be retained, or referred to, from original <br> hardback surveys /questionnaires. |  |
| 3b.2 | How was the data originally collected? |
| Demographic and sociometric data was collected by consent via questionnaires |  |
| completed by the participants. Academic data was gained from faculty records. |  |
| 3b.3 | Did you obtain Ethics approval at the time of data collection? Please provide <br> approval number |
| Yes, 2001/598 |  |
| 3b.4 | What was the primary purpose for original collection of data? |
| Medical schools in Australia attract large numbers of highly competent applicants. <br> However, the methods used to select a relatively small proportion of applicants are not <br> well validated in terms of academic success, ability to cope with stress or <br> personal/emotional suitability for medical practice. High levels of stress, combined with |  |

ineffective coping skills and intrinsic personality characteristics (e.g. perfectionism) are linked with the high rate of mental health problems among doctors. Such problems include depression, drug abuse and suicide.

The medical profession has a responsibility to promote the health and well-being of their members while ensuring that the public receive optimal treatment from competent doctors. Investigating the psychological characteristics of medical students and their association with academic performance not only informs selection procedures and evaluations of the new curriculum but can assist in developing programs which encourage students to adopt more effective coping strategies which they can take into their adult lives and medical career.

Thus, the general purpose of this study was to explore the congruity between selection procedures for entry to medical school, pedagogical strategies and desired outcomes.

3b. 5 Please explain what information the participants were given at the time the data was collected from them and how that information was given to them (eg Explanatory Statement, verbal explanation). Your explanation will be determined by how the data was originally collected.

All students who entered the medical degree at Monash University from 2002-2006 were eligible to participate in the study. At the Transitional Weekend which was attended by all students, the Head of the School of Primary Health Care addressed the students for approximately 15 minutes to explain the purpose and outline of the study. He also clarified that participation was voluntary. The Transitional Weekend occurred just under two weeks before the administration of the study, which gave the students ample time to think about whether or not they would participate.

The one and a half hours it took to complete the study was scheduled into the timetable in the first few weeks of the academic year. A lecture theatre was booked for this purpose. The lecture theatre was different to the one scheduled for the students preceding lecture. Therefore, students who chose to participate had to actively make that decision by physically moving from one location to the other.

The session began with a 20 minute briefing. In the 20 minute briefing session project staff explained the aims of the project and requested the student's participation. The project staff recruiting students and administering instruments were not lecturers or examiners in the course and the explanation clearly informed students that their participation or non-participation would have no impact on their progress or treatment in the course. Information was provided both verbally and in written form. Students were encouraged to seek clarification and ask questions.

Students who decided to participate in the study used the remainder of the timetabled session to complete the questionnaires.

| $\boxed{ }$ | If an Explanatory Statement was used, please attach a copy (if it is available). |
| :--- | :--- |
| 3b.6 | Will the organisation who owns the dataset be fully informed about the true <br> nature of the research? |
| $\boxed{Z}$ | YES |
|  | Procedures for gaining informed consent |
| 3b.7 | Please explain the method used for obtaining consent from the original <br> participants for the original collection and use of the data. |
| $\boxed{Z}$ | Consent form (please attach the consent form to this application if available) |
| 3b.8 | Have all the participants consented to the use of the information for the <br> purposes of this research project? |
| $\triangle$ YES | Please explain how: |


|  | Implied consent - for example the return of an anonymous survey implied <br> consent |
| :--- | :--- | :--- |
| 3b.9a | Does your project involve access to the National Coronial Information System <br> (NCIS)? |
| $\boxtimes$ | NO, please proceed to 2.9 |


| Section 4 - Compliance with privacy legislation - Research involving collection, use and <br> disclosure of information |  |
| :--- | :--- |
| 4.1 | Are you collecting, using or disclosing PERSONAL INFORMATION, HEALTH <br> INFORMATION or SENSITIVE INFORMATION: |
|  | If YES, you will need to complete the Form P (Privacy Issues) which is available on <br> the Human Ethics website. Please also complete the rest of Section 4. |
| 4.2 | University regulations require the following procedures concerning storage of <br> data. You should indicate your compliance with these regulations by ticking the <br> following three boxes. Do you agree to comply with each of the following: |
| YES | Only the researchers will have access to the original data. |
| YES | Data will be retained in the Department for at least five years, longer for clinical <br> trials. If the data are to be retained other than within a department or academic <br> unit, a record of their location must be filed with the Head of the unit and a copy <br> with the secretary |
| YES <br> YES | Victorian privacy laws require the University to "take reasonable steps to destroy <br> or permanently de-identify personal information if it is no longer needed for any <br> purpose" (IPP 4.2, Information Privacy Act 2000 (Vic.); |
| 4.4 | Describe the procedures you will use to protect participants from any distress, <br> embarrassment or other harm that might be caused when the data is reported. |
| Data will only be reported in totally de-identified summary form in which no individual <br> can be identified. |  |


| Section 5 －Collection of data materials and procedures |  |
| :---: | :---: |
| 5.1 | How，where and by whom are the data to be collected？Researchers should briefly outline all research procedures to be used with each category of participants． |
| How will the data be collected？ <br> Tick as many boxes as relevant to your project |  |
| 】 | Other Specify：Data is existing data already collected and now in de－identified form from questionnaires／surveys completed by the students from 2002 onwards and their academic records．These are stored in spreadsheets on password－protected databases in faculty offices． |
|  | Where will the data be collected？If not known，please provide suggested locations． |
| The existing data will be collected from faculty offices，subject to faculty／MBBS Exec approval，where it is currently stored on password－protected databases． |  |
| 5.3 | By whom will the data be collected？ |
| Student academic records will be given a unique de－identifying code by faculty staff． These results，along with the already de－identified questionnaire data，will be collected by Collette Mann，Research Student for data analysis． |  |
| 5．4a | Will the data be collected in a location other than Australia？ |
| 区 | If NO，please go to Qu 5．4b |
| 5．4b | Does the research involve participants in Australia who have specific cultural needs，i．e．specific consent arrangements or sensitivities？ $\square$ |
| 区 | If NO，please go to Qu 5．4c |
| 5．4c | Will you require the use of a translator or will you use documentation translated into a language other than English？ |
| 区 | If NO，please go to Qu 5.5 |
| 5.5 | Does your research project involve any of the following？NO If YES，please complete table below If NO，please proceed to Qu 5.6 |


| 5.6 | Does this research involve interactions with children or other vulnerable individuals who are not supervised by a parent／guardian／teacher／carer？ |
| :---: | :---: |
| 区 | If NO，please proceed to Qu 5.7 |
| 5.7 | Is there a dependent or unequal relationship between any person collecting the data and the participant？ |
| 区 | If NO，please go to Qu 5.8 |
| 5.8 | Does the research involve the administration of any tests or other procedures that can only be used by people with particular qualifications？ |
| 区 | If NO，please go to Qu 5.9 |
| 5．9a | Are any of the measures or procedures you propose using diagnostic or indicative of any medical or clinical condition，or other situation of concern（e．g．anaemia， bulimia，anorexia，depression，anxiety，suicidal tendencies，aggressive behaviour， etc？） |
| 区 | If NO，please go to Qu 6.1 |

## Section 6 －Collection of data：risks and procedures

6．1 $\quad$ Define the risk of physical／psychological stress，inconvenience or discomfort beyond the normal experience of everyday life，in either the short or long term，from participation in the project．

There will be no such stress，inconvenience or discomfort to the participants．
6．5 $\quad$ Are there any risks for the researchers？Please outline the strategies you have in place to reduce this risk．

There are no risks to the researchers．
6．6 $\quad$ Some researchers are mandated by law to report certain findings－Is any person involved with the research project required by law to report？Please explain． This information must be included in the Explanatory Statement．

No．

| Section 7 －Feedback and debriefing procedures |  |
| :--- | :--- |
| 7.1 a | In what form will you publish this research？ |
| $\boxed{\text { 7．1b }}$ | Thesis |
| In what form will information about results of the project be communicated to |  |


|  | participants and／or parents and guardians？ |
| :---: | :---: |
| 区 | Copy of journal article／book／chapter |
| 【 | Other，please specify <br> The faculty will provide a general overview of the results to the Student representative groups |
| 7．1c | How will participants be provided with the results？ |
| 区 | Other，please specify <br> Individual participants will not be provided with the results，though there will be clear communication with MUMUS（Monash University Medical Undergraduates Society）about the findings． |
| 7．1d | Will any other persons or organisation be provided with the results？ |
| 】 | YES Examiners marking the thesis or other persons within the department will read the results． |
| 7．1e | How will others be provided with the results？ |
| 区 | In totally deidentified summary form in which no individual can be identified |
| 7.2 | Is a form of debriefing required because deception has been employed or because the research has aroused emotional feelings？How will this be arranged？ <br> All research involving deception requires that participants be advised of the true nature of the research after completing the procedures． |
| No． |  |

## Section 8 －Other ethical issues

8．Are there any other ethical issues raised by the proposed project？What is your response to them？

Answers to this section are of great importance to the Committee in considering projects where complex ethical issues are possible．

This project raises a number of critical ethical issues．These include：
Involvement of senior faculty staff in the project．The issue we identify here is that the involvement of senior MBBS academics in the project．This raises a potential issue of a lack of appropriate review and approval by Faculty structures．To circumvent this potential problem，Prof Canny will not be involved in decisions taken by the Monash

MBBS Executive as to whether this research should be endorsed. Sometimes, the involvement of a senior staff member might raise issues of coercion, but this seems unlikely, given the data are already collected, will only be used where consent has been previously provided, and there is no direct approach to participants. The research group considered seriously whether Prof Canny should be involved in this application, given his senior position. It eventually resolved that he should, as he is involved in the research, and any other approach was potentially disingenuous.

Data Linkage and Potential for Loss of Privacy: For the successful completion of this project, the following technical steps must be followed. Generation of the previously collected data from the survey instruments; generation of assessment data and data linkage. Data linkage will be undertaken using the Student ID number provided by the students willing to be involved in the research. This will enable us to find the assessment results. The linkage of the two files will be undertaken by administrative staff of the Faculty of Medicine, Nursing and Health Sciences and they will provide unique identifiers for the data back to the researchers. The file linking student ID and the unique identifiers will be held by the Faculty staff, who will only reveal it if required for data verification purposes. In this way, the data will be "potentially identifiable" in a very protected manner.

Potential of Marginalisation of a Group of Students: This research has the potential to reflect negatively on a specific group of students (i.e. International Students) if it is revealed that they do worse in assessments. A serious effect is unlikely, as this is a topic of discussion that is already openly canvassed in the Faculty, and International Students are already aware of the relative performance of the cohort. In fact, this research will contribute to an ongoing effort of the Faculty to identify the cause of these differences, and redress a current, potential injustice.

## DECLARATIONS AND SIGNATURES

I/We, the undersigned, declare the following

I / we accept responsibility for the conduct of the research detailed above in accordance with the principles outlined in the National Statement and the Australian Code for the Responsible Conduct of Research.

I/we undertake to conduct this research project in accordance with the protocols and procedures as approved by SCERH.

I/we undertake to conduct this research in accordance with relevant legislation and regulations.

If any changes to the protocol are proposed after the approval of the Committee has been obtained then SCERH will be informed using a Request for Amendment form.

I / we have used the Guidelines to complete this form.

I/ we have read the National Statement.

I/ we will provide Annual and Final reports to SCERH.

In addition to the above

In the case of student research I will be the primary investigator responsible for the research project

I understand and agree that study files and documents and research records and data may be subject to inspection by SCERH, research governance officer, the sponsor or an independent body for audit and monitoring purposes

I understand that information relating to this research, and about me as a researcher, will be held by the HREC, research governance officer, and on the Research Ethics Database (RED). This information will be used for reporting purposes and managed according to the principles established in the Privacy Act 1988 (Cth) and relevant laws in the States and Territories of Australia.

| Signature of Chief Investigator/or Supervisor |  |
| :--- | :--- |
| Name Ramesh Rajan | Date |
|  |  |
| Signature |  |


| Signature of Chief Investigator/or Supervisor |  |
| :--- | :--- |
| Name Ben Canny | Date |
|  |  |
| Signature |  |


| Signature of Chief Investigator/or Supervisor |  |
| :--- | :--- |
| Name Tony Luff | Date |
|  |  |
| Signature |  |


| Signature of Chief Investigator/or Supervisor |  |
| :--- | :--- |
| Name Sheila Vance | Date |
|  |  |
| Signature |  |

In addition to the above

I also take responsibility for the ethical conduct of the research project

| Signatures of Signature/s of Co-Investigator(s)/Student Researcher |  |
| :--- | :--- |
| Name Jennifer Lindley | Date |
| Signature |  |
| Signatures of Signature/s of Co-Investigator(s)/Student Researcher |  |
| Name Collette Mann | Date |
| Signature |  |

In addition to the above

I certify that my department takes responsibility for this research.

I certify that I have read the research project application named above.

I certify that I have discussed this research project and the resource implications for this Department, with the Principal Investigator.

I certify that all researchers/students from my department involved in the research project have the skills, training and experience necessary to undertake their role.

My signature indicates that I support this research project being carried out using this Department/School's resources.

| Signature of Head (Acting) of Department/School/ /Director of Centre |  |
| :--- | :--- |
| IMPORTANT: The Head of Department/School cannot sign to take responsibility for <br> research where they are listed as a chief investigator or a co-investigator. <br> In these circumstances, please delegate signatory to the Faculty/School Manager, <br> Associate Dean of Research (ADR) or suitably appropriate person. <br> Name lain Clarke <br> Signature <br> Official position: Head of Department, Physiology, Faculty of Medicine, Nursing \& Health <br> Sciences$.$Date |  |

FORM P (Privacy Issues)

Section 4 - Compliance with privacy legislation - Research involving collection, use and disclosure of information

This section is reproduced with amendments to Section E of the Common Application Form with the permission of the Department of Human Services, Victoria.

Protection of privacy in research involving human participants is an important consideration for researchers in developing a research project. There are several pieces of legislation (State and Commonwealth) that could apply to your project. For a more detailed description of the relevant privacy laws, refer to the Question 13 Guidelines at:
http://www.monash.edu.au/research/ethics/human/researchers/privacy.html

The following questions assist SCERH in assessing the project proposal with respect to privacy legislation and provide information that fulfils SCERH's mandatory reporting requirements.

NOTE: To 'cross' the box electronically, double click the box, and a Form Field Option Box will appear. Under "Default Value" mark "checked", and it will place the cross in the box for you.

### 4.2 Collection of Information Directly from Individuals

4.2 (a) Does the project involve collection of information directly from individuals about themselves?

No - go to Question 4.3

### 4.3 Do Other Questions in this Section have to be Completed?

4.3 (a) Does the project involve the collection, use or disclosure of identified or potentially identifiable information from sources other than the individual whose information it is? (see Module One Guidelines for definitions)

## Yes - answer the following question

4.3 (b) Does the project involve the collection, use or disclosure of information without the consent of the individual whose information it is (or their legal guardian)?

No - Go to Question 4.8 and do not answer questions 4.4, 4.5, 4.6 or 4.7

### 4.8 GENERAL ISSUES

4.8 (a) How many records will be collected, used or disclosed? Specify the information that will be collected, used or disclosed (e.g. date of birth, medical history, number of convictions, etc) Complete this question only if you are seeking privacy exemption from this HREC

Number of records: ~2000 student records

Type of information: i) demographic information, e.g. date of birth, residential status, etc.
ii) academic performance, e.g. exam results.
4.8 (b) Does the project involve the adoption of unique identifiers assigned to individuals by other agencies or organisations?
$\square$ Yes $\boxtimes$ No
4.8 (c) Does the project involve trans-border (i.e. interstate or overseas) data flow?
$\square$ Yes $\boxtimes$ No
4.8 (d) For what period of time will the information be retained? How will the information be disposed of at the end of this period?

5 years. At the end of this term, the data will be either archived or destroyed in an appropriate manner, e.g. security shredded, password-protected databases, in accordance with University guidelines.
4.8 (e) Describe the security arrangements for storage of the information. Where will the information be stored? Who will have access to the information?

De-identified data will be stored on password-protected computer software in the offices of Cl 1 , who, along with CM , will be the only persons with access to the information for the 5 year period.
4.8 (f) How will the privacy of individuals be respected in any publication arising from this project?

All results and data will be published in only de-identified summary form in which no individual can be identified.
4.8 (g) Are procedures in place to manage, monitor and report adverse and/or unforeseen events relating to the collection, use or disclosure of information?

All staff members involved in handling/collection of sensitive data are aware of university policies on privacy and confidentiality of participants. Further, staff are instructed to maintain best practice when dealing with such data to ensure that adverse events do not occur.

However, we have identified two areas where a possible breach may occur:
a unique identifier may mistakenly not be assigned and the student's identity/name is made known to Collette Mann, research student or;
a unique identifier is assigned, but the unmasking of the student's identity is still possible to Ms Mann via student ID number.

In the unlikely event of one of these breaches occurring, then a number of steps be taken:

Ms Mann would immediately alert her supervisor, Prof Rajan.

Prof Rajan would then contact the SCERH and the faculty.

All analysis would stop, the source of the breach would be identified, records for that student would be deleted and the entire process of confidentiality would be re-examined.

The project team would discuss how/who would be the best person to discuss the breach
with the student, if deemed necessary by the faculty.

### 4.9 Other Ethical Issues

Discuss any other ethical issues relevant to the collection, use or disclosure of information proposed in this project. Explain how these issues have been addressed.
here are no other ethical issues than those already addressed.

## MONASH University

## C2 Amendment to include 2006 online data

## Monash University Human Research Ethics Committee (MUHREC)

Request for Amendment Form

Amendment (v1.2009)





| 1.5 | Do the changes involve consideration of privacy legislation? YES <br> Will you be obtaining personal information from a source other than the <br> participant? NO |
| :--- | :--- |
| 1.6 | Will you be using Undergraduate Psychology Student Participant Pool? This <br> recruitment method is designed for Low Risk non-contentious research where the <br> foreseeable risk to participants is no more than discomfort. If your research is <br> higher risk or deals with contentious issues, you must justify the use of the pool in <br> this research. Failure to provide a justification may delay the consideration of the <br> project. (Note: this Pool is only available to Investigators/Staff in the SPPPM). |
| $\square$ | NO |

## ATTACHMENTS

Attached is an Explanatory Statement that will be submitted to the participants on-line via email. This is new due to the data being existing data, thus an Explanatory Statement was not issued earlier.

Attached also is a word document of the four questions that we would like to submit in an on-line questionnaire via software supplied by SurveyMonkey©. The on-line format may vary slightly, but the content will remain the same.

There is no change to the Consent Form.

## DECLARATIONS AND SIGNATURES

| Signature of Chief Investigator/or Primary Supervisor |  |
| :--- | :--- |
| Name: Ramesh Rajan | Date 26th February, 2010 |
|  |  |
| Signature |  |


| Signature of Chief Investigator |  |
| :--- | :--- |
| Name: Ben Canny | Date 26th February, 2010 |

Signature

| Signature of Chief Investigator |  |
| :--- | :--- |
| Name: Tony Luff | Date 26th February, 2010 |
| Signature |  |
|  |  |


| Signature of Chief Investigator |  |
| :--- | :--- |
| Name: Sheila Vance | Date 26th February, 2010 |

Signature

| Signature of Co-Investigator |  |
| :--- | :--- |
| Name: Jennifer Lindley | Date 26th February, 2010 |
| Signature |  |


| Signature of Student Researcher |  |
| :--- | :--- |
| Name: Collette Mann | Date 26th February, 2010 |
| Signature |  |


| Form P－Compliance with privacy legislation－Research involving collection，use and disclosure of information |  |
| :---: | :---: |
| 6.1 | Are you collecting，using or disclosing PERSONAL INFORMATION，HEALTH INFORMATION or SENSITIVE INFORMATION： |
| 】 | If YES，please also complete the rest of Section 6. |
| 6.2 | University regulations require the following procedures concerning storage of data．You should indicate your compliance with these regulations by ticking the following three boxes．Do you agree to comply with each of the following： |
| \ YES | Only the researchers will have access to the original data． |
| \ YES | Data will be retained in the Department for at least five years，longer for clinical trials．If the data are to be retained other than within a department or academic unit，a record of their location must be filed with the Head of the unit and a copy with the secretary |
| 区 YES | Victorian privacy laws require the University to＂take reasonable steps to destroy or permanently de－identify personal information if it is no longer needed for any purpose＂（IPP 4．2，Information Privacy Act 2000 （Vic．）； |
| 6.3 | If the above regulations（in $Q$ 6．2）are not being adhered to，how will information be handled to safeguard confidentiality？ |
| N／A |  |
| 6.4 | Describe the procedures you will use to protect participants from any distress， embarrassment or other harm that might be caused when the data is reported． |
| Data will only be reported in totally de－identified summary form in which no individual can be identified |  |
| 6.5 | Collection of Data |
| 6．5a | Does the project involve collection of information directly from individuals about themselves？ |
| \ YES | Answer Q 6．5b－Q6．5c |
| 6．5b | What type of information will be collected？（Tick as many as apply） |
| 【 | personal information |
| 区 | sensitive information |
| 6．5c | Does the Participant Information and Consent Form explain the following |


| $\begin{aligned} & \triangle \text { Yes } \\ & \text { No } \end{aligned}$ |  | The identity of the organisation collecting the information and how to contact it? |
| :---: | :---: | :---: |
| $\begin{aligned} & \boxtimes \text { Yes } \\ & \text { No } \end{aligned}$ |  | The purposes for which the information is being collected? |
|  |  | The period |
| Yes No |  | The steps taken to ensure confidentiality and secure storage of data? |
| $\begin{aligned} & \boxtimes \text { Yes } \\ & \text { No } \end{aligned}$ |  | The types of individuals or organisations to which your organisation usually discloses information of this kind? |
| Yes <br> No |  | How privacy will be protected in any publication of the information? |
| Yes <br> No |  | The fact that the individual may access that information? |
| $\begin{aligned} & \square \text { Yes } \\ & \text { N/A } \end{aligned}$ |  | Any law that requires the particular information to be collected? |
| $\begin{aligned} & \boxed{X} \text { Yes } \\ & \mathrm{N} / \mathrm{A} \end{aligned}$ | $\square$ | The consequences (if any) for the individual if all or part of the information is not provided |
| 6.6a | Doe <br> pot <br> who | the project involve the collection, use or disclosure of identified or ntially identifiable information from sources other than the individual e information it is? |
| 【 NO |  | Q 6.11b (Do not answer remainder of Q 6.6, 6.7, 6.8, 6.9, 6.10) |
| 6.11b | Doe <br> indi | the project involve the adoption of unique identifiers assigned to duals by other agencies or organisations? $\square$ No $\square$ Yes |
| 6.11c |  | e project involve trans-border (i.e. interstate or overseas) data flow? $\square$ Yes |
| 6.11d |  | what period of time will the information be retained? How will the mation be disposed of at the end of this period? |
| 5 years. At the end of this term, the data will be either archived or destroyed in an appropriate manner, e.g. security shredded, password-protected databases, in accordance with University guidelines. |  |  |
| 6.11e | Des | ribe the security arrangements for storage of the information. Where will |

the information be stored? Who will have access to the information?
De-identified data will be stored on password-protected computer software in the offices of CI1, who, along with CM, will be the only persons with access to the information for the 5 year period.
6.11f How will the privacy of individuals be respected in any publication arising from this project?

All results and data will be published in only de-identified summary form in which no individual can be identified.
6.11g Are procedures in place to manage, monitor and report adverse and/or unforeseen events relating to the collection, use or disclosure of information?

All staff members involved in handling/collection of sensitive data are aware of University policies on privacy and confidentiality of participants. Further, staff are instructed to maintain best practice when dealing with such data to ensure that adverse events do not occur.

However, in the unlikely event of a breach occurring, then a number of steps will be taken:

Ms Mann will immediately alert her supervisor, Prof Rajan.
Prof Rajan will then contact the SCERH and the faculty.
All analysis will stop, the source of the breach will be identified, records for that student will be deleted and the entire process of confidentiality will be re-examined.

The project team will discuss how/who would be the best person to discuss the breach with the student, if deemed necessary by the faculty.
6.11h $\quad$ Discuss any other ethical issues relevant to the collection, use or disclosure of information proposed in this project. Explain how these issues have been addressed.

There are no other ethical issues than those already addressed.

## MONASH University

## C3 Ethics to recruit cohort 2008-2009

## Application for

Ethical Approval of a Research Project Involving Humans (SCERH is the primary HREC)

|  | DATE RECEIVED |  | APPLICATION NUMBER |
| :--- | :--- | :--- | :--- |
| Office use only | Office use only |  |  |


| Section 1 - Project details |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| 1.1 | Title of project |  |  |  |
| Max 10 words <br> English acquisition status and academic performance in MBBS students. |  |  |  |  |
| 1.2a | Researchers involved in the conduct of the project |  |  |  |
| Chief Investigator / Primary Supervisor (must be a Monash University staff member) |  |  |  |  |
| Title: <br> A/Prof | Name: Ramesh Rajan |  | Staff ID: <br> 00200155  | Current qualifications: <br> PhD, 1985 University of Western Australia |
| Department: Physiology |  |  |  | Campus: Clayton |
| Full postal address (if external address including international campuses): |  |  |  |  |
| Phone 1: 52525 |  | Phone 2: |  | Fax: |
| Email: Ramesh.Rajan@med.monash.edu.au |  |  |  |  |
| 1.2b | Researchers involved in the conduct of the project |  |  |  |
| Chief Investigator / Primary Supervisor (must be a Monash University staff member) |  |  |  |  |
| Title: <br> Prof | Name: Ben Canny |  | Staff ID: <br> 00352055  | Current qualifications: <br> PhD, 1990 Monash <br> University  |
| Department: Physiology |  |  |  | Campus: Clayton |
| Full postal address (if external address including international campuses): |  |  |  |  |
| Phone 1: 52567 |  | Phone 2: |  | Fax: |
| Email: Ben.Canny@med.monash.edu.au |  |  |  |  |
| 1.2c | Researchers involved in the conduct of the project |  |  |  |
| Chief Investigator / Primary Supervisor (must be a Monash University staff member) |  |  |  |  |
| Title: Dr | Name: Sheila Vance |  | Staff ID: <br> 00192031  | Current qualifications: <br> PhD, 1993 Monash University |
| Department: Student Academic Support Unit |  |  |  | Campus: Clayton |


| Full postal address (if external address including international campuses): |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| Phone 1: 54027 |  | Phone 2: | Fax: |  |
| Email: Sheila.Vance@med.monash.edu.au |  |  |  |  |
| 1.2d | Researchers involved in the conduct of the project |  |  |  |
| Chief Investigator / Primary Supervisor (must be a Monash University staff member) |  |  |  |  |
| Title: <br> Prof | Name: |  | Staff ID: <br> 00069612  | Current qualifications: PhD 1968 University of Hull |
| Department: Physiology |  |  |  | Campus: Clayton |
| Full postal address (if external address including international campuses): |  |  |  |  |
| Phone 1: 58169 |  | Phone 2: |  | Fax: |
| Email: Tony.Luff@med.monash.edu.au |  |  |  |  |
| 1.2e | Researchers involved in the conduct of the project |  |  |  |
| 区 | Student researcher |  |  |  |
| Title: <br> Ms | Name: Collette Mann |  | Staff ID: N/A |  |
| Department: Physiology |  |  |  | Campus: Clayton |
| Full postal address (if external address including international campuses): |  |  |  |  |
| Phone 1: 58003 |  | Phone 2: |  | Fax: |
| Email: Collette.Mann@med.monash.edu.au |  |  |  |  |
| If student researcher - Student ID number: 18226574 |  |  |  |  |

1.3 If applicable, please provide previous Monash University SCERH application number(s) related to this project and how the project(s) is related to the current application
2001/598 Data collected from this previous longitudinal study over many years by Cl 3 , and more lately Cl 2 , suggest that international students show a wide range of learning outcomes, but, as a cohort, perform significantly worse than local students. This overall poorer performance has been, generally, attributed to poorer English proficiency. However, some international students perform as well as their local cohorts and some local students perform as badly as the poorer-performing international students. Recent neurophysiological studies by Cl 1 of a core brain competency: the ability to extract important signals in the presence of distractors (noise), suggest that even slightly later acquisition of English as a 2nd language significantly retards the ability to acquire normal speech information in a noisy environment and may also block the brain's ability to learn and improve in this skill.
2008000857 Ethics for this study was obtained for research that formed the first part of our project; this application is for ethics for the second part of the project. In this study, we performed data analysis of individual assessment instruments for the first two years of enrolment, i.e. Year 1 \& Year 2, for each student of the MBBS (Bachelor of Medicine, Bachelor of Surgery) course from 2002-2007 from


#### Abstract

existing data collected from the study above (2001/598). Assessment instruments vary for each year and include case studies, written exams (multiple choice questions and short answer essays), group projects and essays. Students are also marked on performance of OSCEs (Objective Structured Clinical Examinations). Here the student is assessed for their communication and performance skills in a real-life clinical setting. Overall, the assessment instruments gauge the student's progress via written, oral and performancebased communications and each instrument is weighted to attain an overall final mark. Thus, it was important to investigate any factors which impact negatively, or positively, on the weighting scale. Preliminary analysis from the original study already indicated the OSCEs as being a negative predictor for academic performance in international students compared to their local counterparts, due to poorer communication skills.


Data from this preliminary research have acted as a vital foundation block, enabling us to gain a better understanding of which key variables need investigation and have helped in refining our test design in the second part of this project. In this sequel we will continue to look at how educational performance and learning is affected by English as a 2nd language. However, we will also correlate our findings with neurophysiological testing by speech-in-noise processing and explore the correlation with age of language acquisition and sociometric data. By using the same cohort of students, (albeit 2008 \& 2009 cohorts for this phase of the project), we can maintain validity, as all students, past and present, have similarities which can eliminate some confounding variables.
CF07/4841 - 2007002083 This project, designed independently of the present application as part of the $\mathrm{Cl1}$ 's research, examines how gender and training affect the ability of people to learn to discriminate speech from noise. The present application will use the same audiological/auditory test battery to examine the ability of MBBS students to (a) discriminate complex everyday sounds (i.e., speech) from background noise that mimics real-life situations where there are crowds or other sources of speech in the background, and (b) learn and improve in this skill in repetitive audiological tests carried out over a short time period.
These projects both relate to potential avenues for addressing some differences between local and international students, generally, in academic performance and learning styles. This is of significant consideration to the University given the increasing number of international students enrolling in all courses at the University, as well as the number of students from different linguistic backgrounds, with English acquisition at different stages of life, at all of our campuses both in Australia and overseas. For example, this issue has already attracted attention from our colleagues in the Faculty of Medicine, Nursing and Health Sciences at Monash Malaysia as they feel it may also have direct implications for their own experiences in teaching in Malaysia.

| 1.4 | Plain language descriptions |
| :--- | :--- |
| 1.4 a | In plain language, give a succinct description of the background and potential <br> significance of the research project |

## 250 words max

The brain's ability to extract important sensory inputs from competing signals underlies our remarkable ability to identify things in our noisy world. The most obvious example is our ability to understand speech in lecture theatres, tutorials or other crowded environments. Impairment in this ability may cause difficulties in learning when information is imparted in such environments. In this context, anecdotal and incidental evidence indicate that international students show a range of learning outcomes, but, as a cohort, tend to perform significantly worse than local students. Poorer English proficiency alone cannot satisfactorily account for all effects.
Our preliminary data suggests that even slightly later acquisition of English as a 2nd language (after age of 5 , but well before the brain's language circuits become 'hardwired') impedes, on a neurophysiological level, the ability to understand English speech in noisy conditions and the ability to further improve brain functions underlying this skill.

This has direct implications for Monash generally, given the large number of students from non-English-speaking backgrounds (NESB) who have acquired English as a second language. This study could provide a performance-assessment and neurophysiologicaltesting approach to base designs for improvements in educational outcomes for international students. Education is the 3rd largest export commodity for Australia, and universities are increasingly dependent upon this source of income, estimated at $\sim \$ 12$ billion. Further, Monash, as an International University, needs to have a thorough understanding of the learning challenges faced by its students.

### 1.5 $\quad$ Clearly state the aims and/or hypotheses of the research project

250 words max
We propose two parallel studies to link a core brain competency to learning outcomes. The former will be tested in a neurophysiological study examining how bilingualism at different broad life stages affects the ability to process natural English speech in noisy backgrounds and the ability to improve in this skill, focusing on NESB students. This will be correlated with detailed sociometric data on their learning outcomes, to directly examine how brain processing differences insidiously affects behavioural outcomes.
The specific aims of this research project are to:
Carry out a prospective study of national and international students from the 2008 \& 2009 MBBS cohorts, examining neurophysiological indices of the ability to extract English speech from other competing sounds, with testing being carried out over academic years 2009 \& 2010 for the respective cohorts.
Collect census data on learning outcomes in the 1st and 2nd years of study of the above cohorts (i.e. Year 1 \& Year 2 for students commencing their studies in 2008, and Year 1 \& Year 2 for students commencing their studies in 2009) in parallel with sociometric data, including family history (e.g., age of English language acquisition, Language family of the 1st language, language spoken at home etc.), Preferred learning styles, and Musical abilities. The sociometric data is collected only once in the form of a questionnaire (see attached).

| 3．Correlate neurophysiological measures of brain extraction of signals in noise with their sociometric data and academic performance in a range of tasks． |  |  |
| :---: | :---: | :---: |
| 1．6a | Type of research－ 1 |  |
| 区 | Staff research |  |
| 】 | Student research | If YES，check the relevant box and give full title of degree PhD（In Physiology） |
| 1．6b | Type of research－ 2 |  |
| 区 | Medical research | Research on learning in sensory perception |
| 区 | Quantitative | Research examining academic performance |
| 区 | Social science | Correlating brain function to life outcomes |
| 1．7a | Funding of your research project |  |
| 】 | Funding will be sought in the future：Funding will be sought for this research project from eligible grants，awards and／or scholarships，as they become open for application．Should we be successful in securing funding，we will notify SCERH immediately． |  |
| 1．7b | Do any of the researchers have any financial or other involvement in the research （apart from their research role）or will they receive any reward，pecuniary or otherwise？ |  |
| 区 | If NO，please go to Qu 1.8 |  |
| 1.8 | Submission of this project to other Human Research Ethics Committees（HRECs） |  |
| 1．8a | Has or will this project be submitted to other Human Research Ethics Committees （HRECs）？ |  |
| 区 | If NO，please go to Section 2 |  |


| Section 2 －Details about the participants of the proposed research project |  |  |
| :--- | :--- | :--- |
| 2.1 | Does your research project involve the direct involvement or participation of <br> human participants？ |  |
| $\boxed{ }$ | If YES，have you considered whether your research is Low Risk research and you <br> could complete Form LR instead？ |  |
| 2.1 b | Please identify if you are using potentially vulnerable participants as listed <br> below． <br> If you are not using potentially vulnerable participants，please go to Qu 2．2 |  |
| YES | Please identify which group |  |
| $\boxed{Z}$ | Children or young people aged 16 or 17 <br> whose circumstances indicate that they are <br> capable of giving informed consent，e．g． | Participants are undergraduate <br> UBBS students at Monash |


|  | University students aged 17. |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| 区 | Persons in dependant or unequal relationships relevant to the research |  | Participants may be students of one or more Cls for some lectures; also, Cls 2 and 4 are part of the management structure of the MBBS course. |  |
| 2.2 | Please describe the participants (in groups) involved in your research project |  |  |  |
|  | How many people | Group of people involved |  | Age range |
| Group <br> 1 | 50+ students | Students for whom English is their 1st language |  | 17-25 |
| Group <br> 2 | 25-30 students | Bilingual students who acquired English before the age of 5 years (before schooling), with an IndoEuropean other language (e.g., Hindi, Russian, Spanish, etc) |  | 17-25 |
| Group <br> 3 | 25-30 students | Bilingual students; English before the age of 5 years, with a SinoTibetan other language (e.g., Mandarin, Cantonese, Burmese etc) |  | 17-25 |
| Group <br> 4 | 25-30 students | Bilingual students; English before the age of 5 years, with an Austronesian other language (e.g., Malay, Indonesian, Maori, etc) |  | 17-25 |
| Group 5 | 25-30 students | Bilingual students; English as 2nd language acquired between 5-10 years of age (i.e. pre-puberty) with an Indo-European 1st language |  | 17-25 |


|  |  | (e.g., Hindi, Russian, Spanish, etc) |  |
| :---: | :---: | :---: | :---: |
| Group <br> 6 | 25-30 students | Bilingual students; English as 2nd language acquired between 5-10 years of age with a Sino-Tibetan 1st language (e.g., Mandarin, Cantonese, Burmese, etc) | 17-25 |
| Group 7 | 25-30 students | Bilingual students; English as 2nd language acquired between 5-10 years of age with an Austronesian 1st language (e.g., Malay, Indonesian, Maori, etc) | 17-25 |
| Group <br> 8 | 30-40 students (this is likely to be the smallest group and we will have to test as many as available. It will be stressed that we will only test willing participants and, therefore, students should not feel obliged to participate because they are in a minority group.) | Bilingual students for whom English is their 2nd language and acquired after the age of 14 (i.e. postpuberty) | 17-25 |
| 2.3 | In your research design, do you have any criteria for exclusion from your participant groups? <br> If YES, please provide full details to explain each exclusion criterion for each group <br> If NO, please specify none and proceed to Qu 2.4 |  |  |
| All groups | Subjects are required to have normal hearing. |  |  |


| 2.4 | Describe how much time you are asking of participants in each group and when the time will be required. |
| :---: | :---: |
| All groups | All groups will be required to attend a single session of a standard audiometric hearing test and 6 short speech-in-noise tests lasting approximately 30 minutes in total. Attendance will be at a mutually convenient time and can be at any time during the 1st or 2 nd year of their course, during normal university hours. |
| 2.5 | Will you be offering reimbursement or any other incentives to participants? |
| 区 | If NO, please proceed to Qu 2.6 |
| 2.6 | Recruitment <br> If relevant, include a flow diagram or flow chart, text of poster / advertisement / email <br> Please note the use of Callista for recruitment of student participants will not be approved. Please refer to the CALLISTA POLICY on our website for further information. <br> If you plan to contact participants by phone, please refer to the Do Not Call Register Act 2006 notes on our website for further information. |
| 2.6a | Will you be using Undergraduate Psychology Student Participant Pool? This recruitment method is designed for Low Risk non-contentious research where the foreseeable risk to participants is no more than discomfort. If your research is higher risk or deals with contentious issues, you must justify the use of the pool in this research. Failure to provide a justification may delay the consideration of the project. (Note: this Pool is only available to Investigators/Staff in the School of Psychology, Psychiatry and Psychological Medicine (SPPPM)). |
| 区 | If NO, please proceed to Qu 2.6b |
| 2.6b | Please explain how you will select participants in each group. |
| Groups 1-8 | Selection for each group will be based on answers given on questionnaires completed by the participants on their English language acquisition status and other language status, e.g. if participant states English is their only language then they will be selected for Group 1; if they acquired English as a 2nd language between the ages of 5-10, then they will be selected for one of Groups <br> 5-7 depending on what other language they speak; etc. |


| 2.6c | Please explain in full step-by-step detail how you will recruit your participants <br> and invite them to participate? |
| :--- | :--- |
| groups | All students entering the medical degree at Monash University from 2008 will <br> be eligible to participate in the study. However, as the 2008 academic year is <br> nearing completion, the 2008 cohort will need to be recruited along with the <br> 2009 cohort early in 2009 (as the timetable for next year has not been finalised, <br> an exact date is yet to be confirmed). It is envisaged that this will be early in the <br> first semester of 2009, probably at the Transitional Weekend, which is attended <br> by all students. At this meeting, CI2, who is the Deputy Dean for the MBBS <br> Curriculum, will address the students for approximately 15 minutes to outline <br> the study and explain its purpose, and to invite the students' participation. <br> Students will explicitly be informed that participation is voluntary and that non- <br> participation in the study will have no impact whatsoever on the student's <br> assessment. Students will then be told that if they wish to participate, the first <br> step will be to complete a questionnaire on their English and other language(s) <br> acquisition status, as well as a number of sociometric variables, which will be <br> handed out at a second and special session later in the semester at a time <br> scheduled into the timetable <br> The second special session will begin with a 20 minute briefing in which project <br> staff (Collette Mann, Ramesh Rajan and Jennifer Lindley), will explain the aims <br> of the project, including the processes in the neurophysiological testing and a <br> thorough explanation of the sociometric variables asked of them in the <br> questionnaire. The project staff recruiting students and administering <br> instruments will not be lecturers or examiners in the course and the explanation |
| will clearly inform students that their participation or non-participation will |  |
| have no impact on their progress or treatment in the course. Information will |  |
| be provided both verbally and in written form. Students will be encouraged to |  |
| seek clarification and ask questions. |  |
| Students who decide to participate in the study will use the remainder of the |  |
| timetabled session to complete and return the questionnaires in sealed |  |
| envelopes. Students will also be informed that they will be contacted by project |  |
| staff to arrange a mutually convenient time to carry out the neurophysiological |  |
| testing sessions. |  |


| 2.8 | Will any dependent or unequal relationship exist between anyone involved in <br> the recruitment and the participants? |
| :--- | :--- |
| $\boxtimes$ | If YES, describe the nature of the relationship, and explain what special <br> precautions will preserve the rights of such people to decline to participate or to <br> withdraw from participation once the research has begun. <br> See below: |
| Participants will be MBBS students at Monash University and may therefore be <br> students of one or more Cls for some lectures; also, Cls 2 and 4 are part of the <br> management structure of the MBBS course. <br> To ensure that the students will not feel coerced to participate in the <br> experiments, the first information session will be given to the entire MBBS <br> cohort (of $\sim 500$ students) in a large lecture theatre. There it will be emphasized <br> that participation in the project is completely voluntary and in no way will impact <br> on any relationship they have with any of the Cls as teachers, mentors or <br> Monash academics, or impact in any way on their academic performance - in <br> fact, the purpose of the project is to get an unbiased data set of their academic <br> performance. They will also be told the project will employ a double code <br> system as a double barrier to disguise student identity, and therefore a double <br> barrier protecting student privacy, from those experimenters who will be doing <br> the data analysis and interpretation. This double code system will be explained in <br> greater detail in the second session, which will be attended only by students <br> who, by actively turning up, have indicated a desire to participate in the <br> research. <br> If students wish to participate in the experiments, they will have to actively turn <br> up at the second information and questionnaire session (as explained above in <br> 2.6c). The session will begin with a 20 minute briefing in which project staff will <br> explain the aims of the project, including the processes in the neurophysiological <br> testing and a detailed explanation of the contents of the questionnaire. The <br> project staff recruiting students and administering instruments will not be <br> lecturers or examiners in the course and the explanation will clearly inform <br> students that their participation or non-participation will have no impact on their <br> progress or treatment in the course. At this session, the double code system to <br> be used will be explained, as follows: <br> that all questionnaires will be collected by an independent person (Ms Jennifer <br> Lindley, of the Centre for Medical and Health Sciences Education). Ms Lindley will <br> then allocate each student a unique identifier code (UI) and, along with Cl1, <br> segregate each student into his/her relevant group number. Ms Lindley has |  |


|  | experience in administering such codes and maintaining privacy (she was <br> involved in Project 2001/598 which involved similar academic data collection). <br> academic performance data will be collated using the students' Monash ID <br> number only, by a member of the MBBS administration staff as per usual <br> Monash practice. Data will then be returned to Ms Lindley, who will remove the <br> students' Monash ID number and complete data entry. <br> that Ms Lindley will simultaneously distribute, to the experimenters, via an excel <br> spreadsheet, the name and contact details of all participants to arrange a <br> mutually convenient time to perform the neurophysiological tests. The results <br> will be returned to Ms Lindley, who will remove the students' name and contact <br> details and complete data entry again <br> Ms Lindley will then collate the academic performance data, the <br> neurophysiological testing data and the group number with the Ul and return all <br> the now coded information to the experimenters (CM \& RR) to carry out data <br> analysis. In this form, the project staff doing the analysis and interpretation will <br> not have access to the identity of the student, but only to the Ul. <br> Students will also be given an Informed Consent form to fill in and return to <br> indicate their agreement to participate in the study but, as noted on the <br> Informed Consent form, they will be advised that they can drop out of the <br> project at any stage. Information will be provided both verbally and in written <br> form. Students will be encouraged to seek clarification and ask questions. <br> The sociometric information from the questionnaire will be used to assign <br> students to the different groups on the basis of their language acquisition status <br> (see 2.2). |
| :--- | :--- |


| 2.9 | If YES, please explain what your role at that/ those organisation(s) is/are and <br> what measures you have implemented to reduce the possibility of coercion. <br> All Cls are members of staff at Monash University, either as lecturers or as <br> course management senior staff or as administration staff and some have <br> dealings with the MBBS students who will be participants in this project. |
| :--- | :--- |
| $\square$ |  |
| 2.10 | Does your research involve collectivities and / or communities? |
| $\square$ | If NO, please proceed to Qu3.1 |

Section 3a - Procedures for explanation and gaining informed consent
To be completed if project involves direct human participation

|  | Procedures for providing explanation to participants |
| :--- | :--- |
| 3a.1 | Will you use a written Explanatory Statement to inform each participant about the <br> research project? |
| $\boxed{ }$ | If YES, please attach the Explanatory Statement and complete the checklist at the <br> end of the document |
| $3 a .2$ | Will all participants, including organisations, be fully informed about the true <br> nature of the research? |
| $\boxed{Z a .3}$ | YES <br> Yoase explain how you will obtain informed consent from your participants. If <br> inappropriate. |
| $\boxed{ }$ | Consent form (please attach the consent form to this application) |
|  | Please explain the process by which the participants will give consent and how the <br> consent form will be returned to the researcher <br> Participants will be handed a consent form at the information session (see Q2.6c) <br> and given time to complete and return the form on the day. |


| 3 Ba 4 | If the participants in your study are unable to consent for themselves, explain how <br> you intend to obtain informed consent. How will adequate information be <br> provided to those who will give consent on their behalf? |
| :--- | :--- |
| Only participants who are able to give consent for themselves will be eligible for this <br> study. |  |
| 3a.5 | Is an independent witness to the participant's consent necessary? |
| $区$ | If NO, please proceed to Section 4. |


| Section 4 - Compliance with privacy legislation - Research involving collection, use and <br> disclosure of information |  |
| :--- | :--- |
| 4.1 | Are you collecting, using or disclosing PERSONAL INFORMATION, HEALTH <br> INFORMATION or SENSITIVE INFORMATION: |
| $\boxed{Z}$ | If YES, you will need to complete the Form P (Privacy Issues) which is available on <br> the Human Ethics website. Please also complete the rest of Section 4. |
| 4.2 | University regulations require the following procedures concerning storage of <br> data. You should indicate your compliance with these regulations by ticking the <br> following three boxes. Do you agree to comply with each of the following: |
| $\boxed{\text { YES }}$ | Only the researchers will have access to the original data. |
| $\boxed{\text { YES }}$Data will be retained in the Department for at least five years, longer for clinical <br> trials. If the data are to be retained other than within a department or <br> academic unit, a record of their location must be filed with the Head of the unit <br> and a copy with the secretary |  |
| $\boxed{Z Y E S}$ | Victorian privacy laws require the University to "take reasonable steps to <br> destroy or permanently de-identify personal information if it is no longer <br> needed for any purpose" (IPP 4.2, Information Privacy Act 2000 (Vic.); |
| 4.3 | If the above regulations (in 4.2) are not being adhered to, how will information <br> be handled to safeguard confidentiality? |
| N/A | Describe the procedures you will use to protect participants from any distress, <br> embarrassment or other harm that might be caused when the data is reported. |
| 4.4 | Data will only be reported in totally deidentified summary form in which no individual can <br> be identified |

## Section 5 - Collection of data materials and procedures

5.1 How, where and by whom are the data to be collected? Researchers should briefly outline all research procedures to be used with each category of participants.

|  | will the data be | ted? |
| :---: | :---: | :---: |
|  |  | Please complete as specified: |
| 区 | Questionnaire(s) or survey(s) | $\boxtimes \quad$ Fully identifiable Attach questionnaire(s)/survey(s) <br> (name on it) <br> Please specify how the survey will <br> be returned to you <br> Students will be able to return the <br> questionnaires on the day of the  <br> information session to Ms Jennifer  <br> Lindley who will then assign each a  <br> unique identifier code.  |
| 区 | Responses to tasks or stimuli or simulations | Provide copies or description of tasks <br> Audiometry: All subjects will first undertake audiometry in which their hearing sensitivity will be measured in each ear at frequencies from 500 Hertz to 8000 Hertz. Only subjects with thresholds within the normal range will then proceed to the rest of the study involving the speech-in-noise learning task. <br> Speech-in-noise task: In our speech-in-noise learning task, subjects will wear a pair of headphones through which they will hear digital recordings of a woman's voice saying sentences while a background interfering sound is played simultaneously. This background sound, called multi-talker babble, will consist of a digital recording of many people talking at once (thus mimicking parties, lecture theatres, cafes, pubs etc.). This is the basic speech-in-noise task and all subjects will undertake 6 brief sessions of this task (each time with different test sentences). All these stimuli are played out through a computer program. Each sentence contains 3 keywords and what is scored on the computer is which of the 3 keywords were correctly detected. The average noise level tolerated by the subjects to correctly detect $66 \%$ of the sentences is recorded for each session and we examine whether, across the 6 sessions, subjects could tolerate more of the background noise, i.e., whether there was any learning of how to discriminate speech from background interfering sounds. |


| 【 | Psychology inventories | The Felder \＆Soloman （1991）＇Index of Learning Styles＇will be used to determine preferred learning styles of the participants． | Attach inventories <br> Please specify how the tests will be returned to you <br> As this inventory is part of the above questionnaire，students will be able to return it as one document on the day of the information session to Ms Jennifer Lindley in a sealed envelope． |
| :---: | :---: | :---: | :---: |
| Open text for further details you would like to provide（for example flow diagram of data collection，description of experimental protocol，description of complicated data collection method，description of new data collection method）．Attach any additional documents you think would assist the committee． |  |  |  |
| 5.2 | Where w locations． | data be collected？If not | known，please provide suggested |
| Monash，Clayton campus |  |  |  |
| 5.3 | By whom will the data be collected？ |  |  |
| The sociometric and academic data will be collected by Jennifer Lindley，Administrator \＆ Project Officer for the 2001／598 study．Neurophysiological data will be collected by Collette Mann and Ramesh Rajan． |  |  |  |
| 5．4a | Will the data be collected in a location other than Australia？ |  |  |
| 区 | If NO，please go to Qu 5．4b |  |  |
| 5．4b | Does the research involve participants in Australia who have specific cultural needs，i．e．specific consent arrangements or sensitivities？ |  |  |
| 区 | If NO，please go to Qu 5．4c |  |  |
| 5．4c | Will you require the use of a translator or will you use documentation translated into a language other than English？ |  |  |
| 区 | If NO，please go to Qu 5.5 |  |  |
| 5.5 | Does your research project involve any of the following？ If YES，please complete table below If NO，please proceed to Qu 5.6 |  |  |
| 5.6 | Does this research involve interactions with children or other vulnerable individuals who are not supervised by a parent／guardian／teacher／carer？ |  |  |
| 区 | If NO，please proceed to Qu 5.7 |  |  |
| 5.7 | Is there a dependent or unequal relationship between any person collecting the data and the participant？ |  |  |
| Q | If NO，please go to Qu 5.8 |  |  |


| 5.8 | Does the research involve the administration of any tests or other procedures that can only be used by people with particular qualifications？ |
| :---: | :---: |
| 区 | If NO，please go to Qu 5.9 |
| 5．9a | Are any of the measures or procedures you propose using diagnostic or indicative of any medical or clinical condition，or other situation of concern（e．g．anaemia， bulimia，anorexia，depression，anxiety，suicidal tendencies，aggressive behaviour， etc？） |
| 区 | If YES，please describe whether diagnostic or indicative and for what conditions or situations and please answer Qu 5．9b－5．9e below． <br> Audiometry may indicate a hearing loss． |
| 5．9b | Please describe the criteria you will use to assess when participants in your research have results indicating that they or others are＇at risk＇． |
| Audiometry involves the comparison of a subject＇s hearing thresholds against hearing sensitivity population norms and can reveal a hearing loss，though it is not diagnostic of the sources of or reasons for the heraing loss． |  |
| 5．9c | How will you deal with your duty of care to the participants in your research identified as＇at risk＇？ |
| If any subject is found to have a hearing loss as defined by standard audiological criteria， they will be advised to see a doctor and get a referral to an audiologist． |  |
| 5．9d | Have you acquired the necessary competence to administer，score and interpret the proposed measures and procedures，with the type of participants being used in this research？ |
| 区 | YES |
| 5．9e | Will you indicate the procedure proposed above to potential participants in your explanatory statement？ |
| 区 | YES |

## Section 6 －Collection of data：risks and procedures

6．1 Define the risk of physical／psychological stress，inconvenience or discomfort beyond the normal experience of everyday life，in either the short or long term， from participation in the project．
None－the speech－in－noise tasks mimic everyday experience of trying to understand speech when there is noise in the background and the audiometry is a simple hearing test procedure done very routinely

| 6.2 | Are all of these risks outlined on the explanatory statement and，where relevant， <br> on the consent form？If NO，why not？ |  |
| :--- | :--- | :---: |
| N／A | Outline the arrangements planned to minimise the risks involved in these <br> procedures． |  |
| 6.3 | $\mid$ |  |
| 6.4 | Should serious events or emergencies occur during the conduct of the research |  |


|  | what will you do？What facilities are available to deal with such incidents？Is an <br> appropriate list of counselling services available with the Explanatory Statement？ <br> e．g．an adverse drug reaction，revelation of child abuse，illegal activities， <br> participant becomes distressed during data collection or at some time afterwards |
| :--- | :--- |
| The project uses simple tasks that mimic everyday experience and our experience over 5 |  |
| years of using the same procedures is that subjects are never distressed by them but find |  |
| them interesting and intruiging |  |$|$| 6.5 | Are there any risks for the researchers？Please outline the strategies you have in <br> place to reduce this risk． |
| :--- | :--- |
| There are no risks for the researchers． |  |
| 6.6 | Some researchers are mandated by law to report certain findings－Is any person <br> involved with the research project required by law to report？Please explain． |
| No． | This information must be included in the Explanatory Statement． |


| Section 7 －Feedback and debriefing procedures |  |
| :---: | :---: |
| 7．1a | In what form will you publish this research？ |
| 区 | Thesis |
| 7．1b | In what form will information about results of the project be communicated to participants and／or parents and guardians？ |
| 区 | Copy of journal article／book／chapter |
| 区 | Other，please specify <br> The faculty will provide a general overview of the results to the Student representative groups |
| 7．1c | How will participants be provided with the results？ |
| 【 | Participants will be provided with the researchers＇contact details in the Explanatory Statement to request the results |
| 】 | Other，please specify Individual participants will not be provided with the results，though there will be clear communication with MUMUS（Monash University Medical Undergraduates Society）about the findings． |
| 7．1d | Will any other persons or organisation be provided with the results？ |
| 区 | NO |
| 7．1e | How will others be provided with the results？ |
| 区 | In totally deidentified summary form in which no individual can be identified |
| 7.2 | Is a form of debriefing required because deception has been employed or because the research has aroused emotional feelings？How will this be arranged？ <br> All research involving deception requires that participants be advised of the true |


|  | nature of the research after completing the procedures. |
| :--- | :--- |
| No. | How will information about results of any tests be communicated to participants <br> and / or parents and guardians? What arrangements will be in place to deal with <br> participants' distress in the case of adverse test results? |
| 7.3 | Participants will be given the contact details of the Project Officers whom they may <br> contact to obtain information of their own results of any tests. In the unlikely event that a <br> participant feels distressed at any adverse test results, such as hearing impairment, then <br> they will be directed to consult their GP to obtain a referral to an experienced audiologist. |
| 7.4 | If your research involves a collectivity and / or community, will you and if so, how <br> will you provide the information to the community? |
| N/A. |  |

Section 8 - Other ethical issues
8. $\quad$ Are there any other ethical issues raised by the proposed project? What is your response to them?
Answers to this section are of great importance to the Committee in considering projects where complex ethical issues are possible.

This project raises a number of critical ethical issues. These include:
Involvement of senior faculty staff in the project: The issue we identify here is the involvement of senior MBBS academics in the project. This raises a potential issue of a lack of appropriate review and approval by Faculty structures. To circumvent this potential problem, Prof Canny will not be involved in decisions taken by the Monash MBBS Executive as to whether this research should be endorsed.
Data Linkage and Potential for Loss of Privacy: For the successful completion of this project, the following technical steps must be followed. Generation of data from the survey instruments; generation of assessment data and data linkage. Data linkage will be undertaken using the Student ID number provided by the students willing to be involved in the research. This will enable us to find the assessment results. The linkage of the two files will be undertaken by administrative staff of the Faculty of Medicine, Nursing and Health Sciences and they will provide unique identifiers for the data back to the researchers. The file linking student ID and the unique identifiers will be held by the Faculty staff, who will only reveal it if required for data verification purposes. In this way, the data will be "potentially identifiable" in a very protected manner.

Potential of Marginalisation of a Group of Students: This research has the potential to reflect negatively on a specific group of students (i.e. International Students) if it is revealed that they do worse in assessments. A serious effect is unlikely, as this is a topic of discussion that is already openly canvassed in the Faculty, and International Students are already aware of the relative performance of the cohort. In fact, this research will contribute to an ongoing effort of the Faculty to identify the cause of these differences, and redress a current, potential injustice.

## DECLARATIONS AND SIGNATURES

I/We, the undersigned, declare the following

I / we accept responsibility for the conduct of the research detailed above in accordance with the principles outlined in the National Statement and the Australian Code for the Responsible Conduct of Research.

I/we undertake to conduct this research project in accordance with the protocols and procedures as approved by SCERH.

I/we undertake to conduct this research in accordance with relevant legislation and regulations.

If any changes to the protocol are proposed after the approval of the Committee has been obtained then SCERH will be informed using a Request for Amendment form.

I / we have used the Guidelines to complete this form.

I / we have read the National Statement.

I/ we will provide Annual and Final reports to SCERH.

In addition to the above

In the case of student research I will be the primary investigator responsible for the research project

I understand and agree that study files and documents and research records and data may be subject to inspection by SCERH, research governance officer, the sponsor or an independent body for audit and monitoring purposes

I understand that information relating to this research, and about me as a researcher, will be held by the HREC, research governance officer, and on the Research Ethics Database (RED). This information will be used for reporting purposes and managed according to the principles established in the Privacy Act 1988 (Cth) and relevant laws in the States and Territories of Australia.

| Signature of Chief Investigator/or Supervisor |  |
| :--- | :--- |
| Name Ramesh Rajan | Date |
| Signature |  |
| Signature of Chief Investigator/or Supervisor |  |
| Name Ben Canny |  |
| Signature |  |
| Signature of Chief Investigator/or Supervisor |  |
| Name Sheila Vance | Date |
| Signature |  |
| Signature of Chief Investigator/or Supervisor |  |
| Name Tony Luff |  |
| Signature |  |

In addition to the above

I also take responsibility for the ethical conduct of the research project

| Signatures of Signature/s of Co-Investigator(s)/Student Researcher |  |
| :--- | :--- |
| Name Collette Mann | Date |
|  |  |

## Signature

In addition to the above

I certify that my department takes responsibility for this research.

I certify that I have read the research project application named above.

I certify that I have discussed this research project and the resource implications for this Department, with the Principal Investigator.

I certify that all researchers/students from my department involved in the research project have the skills, training and experience necessary to undertake their role.

My signature indicates that I support this research project being carried out using this Department/School's resources.

Signature of Head (Acting) of Department/School/ /Director of Centre

IMPORTANT: The Head of Department/School cannot sign to take responsibility for research where they are listed as a chief investigator or a co-investigator.

In these circumstances, please delegate signatory to the Faculty/School Manager, Associate Dean of Research (ADR) or suitably appropriate person.

| Name lain Clarke | Date |
| :--- | :--- |

Signature

Official position: Head of Department, Physiology, Faculty of Medicine, Nursing \& Health Sciences

Form P - Privacy issues (please delete if it is not required)

Section 4 - Compliance with privacy legislation - Research involving collection, use and disclosure of information

This section is reproduced with amendments to Section E of the Common Application Form with the permission of the Department of Human Services, Victoria.

Protection of privacy in research involving human participants is an important consideration for researchers in developing a research project. There are several pieces of legislation (State and Commonwealth) that could apply to your project. For a more detailed description of the relevant privacy laws, refer to the Question 13 Guidelines at:
http://www.monash.edu.au/research/ethics/human/researchers/privacy.html

The following questions assist SCERH in assessing the project proposal with respect to privacy legislation and provide information that fulfils SCERH's mandatory reporting requirements.

NOTE: To 'cross' the box electronically, double click the box, and a Form Field Option Box will appear. Under "Default Value" mark "checked", and it will place the cross in the box for you.

### 4.2 Collection of Information Directly from Individuals

4.2 (a) Does the project involve collection of information directly from individuals about themselves?
$\square$ No - go to Question 4.3
$\boxtimes$ Yes - answer the following questions:
4.2 (b) What type of information will be collected? (Tick as many as apply)
$\boxtimes$ personal information
$\boxtimes$ sensitive informationhealth information
4.2 (c) Does the Participant Information and Consent Form explain the following:

The identity of the organisation collecting the information and how Yes $\boxtimes$ No $\square$ to contact it?

The purposes for which the information is being collected?
Yes $\boxtimes \mathrm{No} \square$
The period for which the records relating to the participant will be Yes $\boxtimes$ No $\square$ kept?

The steps taken to ensure confidentiality and secure storage of Yes $\boxtimes \mathrm{No} \square$ data?

The types of individuals or organisations to which your organisation usually discloses information of this kind?

How privacy will be protected in any publication of the information?

The fact that the individual may access that information?
Yes $\boxtimes$ No $\square$

Any law that requires the particular information to be collected?
YesNo $\boxtimes$

The consequences (if any) for the individual if all or part of the information is not provided

$$
\mathrm{Yes} \boxtimes \mathrm{No} \square
$$

$\square$

```
Yes\boxtimesNo\square
```

If you answered "No" to any of these questions, give the reasons why this information has not been included in the Participant Information and Consent Form.

There is no law that requires this information to be collected
4.3 Do Other Questions in this Section have to be Completed?
4.3 (a) Does the project involve the collection, use or disclosure of identified or potentially identifiable information from sources other than the individual whose information it is? (see Module One Guidelines for definitions)

No - Go to Question 4.8 and do not answer the remainder of question 4.3, 4.4, 4.5, 4.6 or 4.7Yes - answer the following question
4.3 (b) Does the project involve the collection, use or disclosure of information without the consent of the individual whose information it is (or their legal guardian)?
$\boxtimes$ No - Go to Question 4.8 and do not answer questions 4.4, 4.5, 4.6 or 4.7
$\square$ Yes - answer the following questions

### 4.8 GENERAL ISSUES

4.8 (a) How many records will be collected, used or disclosed? Specify the information that will be collected, used or disclosed (e.g. date of birth, medical history, number of convictions, etc) Complete this question only if you are seeking privacy exemption from this HREC

Number of records: up to 500 records, depending on how many students volunteer for the project.

Type of information: Three categories of data will be collected from the students:
academic data e.g. exam results, assessments etc.
sociometric data e.g. date of birth, country of birth, English acquisition status etc.
neurophysiological data e.g. audiometry testing
4.8 (b) Does the project involve the adoption of unique identifiers assigned to individuals by other agencies or organisations?
$\square$ Yes $\boxtimes$ No
4.8 (c) Does the project involve trans-border (i.e. interstate or overseas) data flow?
$\square$ Yes $\boxtimes$ No
4.8 (d) For what period of time will the information be retained? How will the information be disposed of at the end of this period?

5 years. At the end of this term, the data will be either archived or destroyed in an appropriate manner, e.g. security shredded, password-protected databases, in accordance with University guidelines.
4.8 (e) Describe the security arrangements for storage of the information. Where will the information be stored? Who will have access to the information?

De-identified data will be stored on password-protected computer software in the offices of Cl 1 , who, along with CM , will be the only persons with access to the information for the 5 year period.
4.8 (f) How will the privacy of individuals be respected in any publication arising from this project?

All results and data will be published in only de-identified summary form in which no individual can be identified.
4.8 (g) Are procedures in place to manage, monitor and report adverse and/or unforeseen events relating to the collection, use or disclosure of information?

All staff members involved in handling/collection of sensitive data are aware of University policies on privacy and confidentiality of participants. Further, staff are
instructed to maintain best practice when dealing with such data to ensure that adverse events do not occur.

However, we have identified two areas where a possible breach may occur:
a unique identifier may mistakenly not be assigned and the student's identity/name is made known to Collette Mann, research student or;
a unique identifier is assigned, but the unmasking of the student's identity is still possible to Ms Mann via student ID number.

In the unlikely event of one of these breaches occurring, then a number of steps will be taken:

Ms Mann will immediately alert her supervisor, Prof Rajan.

Prof Rajan will then contact the SCERH and the faculty.

All analysis will stop, the source of the breach will be identified, records for that student will be deleted and the entire process of confidentiality will be reexamined.

The project team will discuss how/who would be the best person to discuss the breach with the student, if deemed necessary by the faculty.

### 4.9 Other Ethical Issues

Discuss any other ethical issues relevant to the collection, use or disclosure of information proposed in this project. Explain how these issues have been addressed.

There are no other ethical issues than those already addressed.

## CHECKLIST FOR THE APPLICATION

Must be completed and included in the application

Failure to complete these checklists and attach appropriate documents will hinder the approval procedure．

## APPLICATION

| YES |  |
| :--- | :--- |
| $\triangle$ | I have read relevant sections of the National Statement on Ethical Conduct in <br> Research Involving Humans |
| $\boxed{Z}$ | I used the Form 1 guidelines to complete this form |
| $\boxed{Z}$ | The application form is completed electronically，NOT handwritten |
| $\boxed{\text { The application is a current version accepted by SCERH }}$ |  |
| $\boxed{Z}$ | I have included signatures of the Chief Investigator，all Co－Investigators and Head of <br> Department |

## ATTACHMENTS

| YES | N／A |  |  |
| :---: | :---: | :---: | :---: |
| $\square$ | 区 | Summary of proposal to funding agency／ies | Qu 1.7 |
| $\square$ | 区 | Letters of approval from funding agencies | Qu 1.7 |
| $\square$ | 区 | Letters of approval from other Human Research Ethics Committees | Qu 1.8 |
| $\square$ | 区 | Copy of poster or advertisements to recruit participants | Qu 2.6 |
| $\square$ | 区 | Permission letters from organisations | Qu 2.7 |


| 区 | $\square$ | Explanatory Statement（see checklist below） | Qu 3.1 |
| :---: | :---: | :---: | :---: |
| 区 | $\square$ | Consent form（see checklist below） | Qu 3.2 |
| 区 | $\square$ | Form P | Qu 4.1 |
| 】 | $\square$ | Copies of questionnaires，interview topics／questions or specifications of instruments | Qu 5.1 |
| $\square$ | 区 | Letters／certificates of other clearances | Qu 5.5 |

CONSENT FORM－attach consent form

| YES | N／A | Mandatory items on the consent form |
| :---: | :---: | :---: |
| 区 | $\square$ | That it is a Consent Form for a specific group of participants |
| 区 | $\square$ | The project title of the project exactly as it appears on your SCERH application form and on the Explanatory Statement |
| 【 | $\square$ | A statement that it is for the purposes of research |
| 【 | $\square$ | That they have had the project explained to them and／or that they have read the Explanatory Statement |
| 】 | $\square$ | That the project is voluntary and at what stages participants can and cannot withdraw |
| 区 | $\square$ | A list of the things that they agree to take part in |
| 区 | $\square$ | Space for participant＇s signature |
| 区 | $\square$ | Space for the date |
|  |  | Items to include if relevant to your research project |
| 【 | $\square$ | A choice as to whether the information will be used in future research |


|  |  | projects |
| :--- | :--- | :--- |
| $\square$ | $\boxed{X}$ | If you are conducting an interview（adjust as appropriate for your research <br> project） <br> A choice of viewing the interview transcript <br> A choice of being audio／video taped or not |
| A choice of how identifiable the information will be |  |  |

EXPLANATORY STATEMENT－attach explanatory statement

| YES | N／A | Mandatory items on the Explanatory Statement if they relate to your project |
| :---: | :---: | :---: |
| 【 | $\square$ | That it is an Explanatory Statement for the specific participant group |
| 】 | $\square$ | Identification of Monash University as the responsible institution and Department involved（preferably use letterhead） |
| 】 | $\square$ | The project title of the project exactly as it appears on your SCERH application form |
| 区 | $\square$ | The name of the Chief Investigator（s）and the department they are affiliated with and any other person who will have direct involvement with research participants，ie student researcher or research assistant |
| 】 | $\square$ | If it is a student research project，include the degree they are attaining |
| 【 | $\square$ | A statement of the purpose of the study／research project |
| 】 | $\square$ | A detailed explanation of how the researcher will contact／has been able to contact the participant（s），where you have obtained their contact details and what groups of people will be／are invited to participate |
| 【 | $\square$ | An indication of the expectations of the potential participant：what is required，activities involved，time involved，level of inconvenience and／or |


|  |  | discomfort and any reimbursement offered |
| :---: | :---: | :---: |
| 区 | $\square$ | An outline of all methods or procedures involving the potential participant |
| 区 | $\square$ | Description of the presence or absence of possible benefits for participants and／or society in general |
| 【 | $\square$ | A list of all possible or reasonably foreseeable risks of harm or possible side effects to the potential participant（outlining likely incidence and severity） |
| 区 | $\square$ | Description of the inclusion／exclusion criteria |
| 区 | $\square$ | An indication of whether participants will be informed of overall results，or any which might affect them personally，and what debriefing procedures are available for those who withdraw（where appropriate） |
| 区 | $\square$ | Description of feedback procedures about the results of the study |
| 区 | $\square$ | A clear statement that participation is voluntary，at what stages participants can and cannot withdraw，or avoid answering questions which are felt too personal or intrusive |
| 区 | $\square$ | Details of what sort of publications other than the current thesis／report might arise from the research and whether anonymity will be maintained |
| 区 | $\square$ | Monash University SCERH complaints clause |
| 区 | $\square$ | Contact details of someone who will answer any inquiries about the research and the name and phone number of someone who can be contacted in an emergency or if the participant has any concerns（i．e．your name and Monash contact number or Monash email address（Personal home addresses，home phone numbers and non－Monash email addresses are not allowed） |
| $\square$ | 【 | A description of any reward，financial or otherwise，to the researchers |
| $\square$ | 区 | Alternative treatments available |


| $\boxed{Z}$ | $\square$ | A statement of where and for how long the records will be stored and details <br> of access and destruction |
| :--- | :--- | :--- |
| $\boxed{\square}$ | $\square$ | If you want to have the option to use the data for other purposes, or for the <br> data to be available to other researchers, you must obtain explicit permission <br> by describing what you want the participants to agree to and asking for <br> permission on the consent form |
| $\square$ | A statement about how you will discharge your responsibility to protect the <br> participants' right to privacy. As it is not possible to make an absolute <br> guarantee of confidentiality/anonymity, explanatory statements should <br> simply describe what steps are being taken to protect this. |  |
| $\square$ | Where the participants may not speak English, a certified translation of the <br> explanatory statement and consent form by an independent and qualified <br> translator must be provided. Arrangements for lodging written complaints <br> with the Committee must be made and described in the explanatory <br> statement. For off-shore projects, a local person who is also fluent in English <br> must be nominated to receive complaints and pass them onto SCERH. |  |
| $\square$ | A statement about funding related to the project, if applicable. |  |

## MONASH University

## C4 Amendment to include recruitment of 2010 cohort

Monash University Human Research Ethics Committee (MUHREC)

Request for Amendment Form

Amendment (v1.2009)



| Full postal address (if external address including international campuses): |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| Phone 1: 52525 |  | Phone 2: |  | Fax: |
| Email: Ramesh.Rajan@med.monash.edu.au |  |  |  |  |
| 1.2b | Researchers involved in the conduct of the project |  |  |  |
| Chief Investigator / Primary Supervisor (must be a Monash University staff member) |  |  |  |  |
| Title: <br> Prof | Name: Ben Canny |  | Staff ID: <br> 00352055  | $\begin{array}{lrr} \hline \text { Current } & \text { qualifications: } \\ \text { PhD, } 1990 & \text { Monash } \\ \text { University } & \\ \hline \end{array}$ |
| Department: Physiology |  |  |  | Campus: Clayton |
| Full postal address (if external address including international campuses): |  |  |  |  |
| Phone 1: 52567 |  | Phone 2: |  | Fax: |
| Email: Ben.Canny@med.monash.edu.au |  |  |  |  |
| 1.2c | Researchers involved in the conduct of the project |  |  |  |
| Chief Investigator / Primary Supervisor (must be a Monash University staff member) |  |  |  |  |
| Title: Prof | Name: Tony Luff |  | Staff ID: <br> 00069612  | Current qualifications: <br> PhD 1968 University of Hull |
| Department: Physiology |  |  |  | Campus: Clayton |
| Full postal address (if external address including international campuses): |  |  |  |  |
| Phone 1: 58169 |  | Phone 2: |  | Fax: |
| Email: Tony.Luff@med.monash.edu.au |  |  |  |  |
| 1.2d | Researchers involved in the conduct of the project |  |  |  |
| 区 | Student researcher |  |  |  |
| Title: <br> Ms |  |  | Staff ID: N/A | Current qualifications: BSC (Hons) |
| Department: Physiology |  |  |  | Campus: Clayton |
| Full postal address (if external address including international campuses): |  |  |  |  |
| Phone 1:58003 P |  | Phone 2: |  | Fax: |
| Email: Collette.Mann@med.monash.edu.au |  |  |  |  |
| If student researcher - Student ID number: 18226574 |  |  |  |  |
| 1.3 | Description of proposed amendment |  |  |  |

We would like to remove Chief Investigator Sheila Vance as she is no longer a Supervisor on this project.

The current ethics approval allows us to recruit the 2008 and 2009 cohorts of MBBS students to our project. We would like to request permission to also recruit the 2010 cohort of MBBS students for our research as the lower-than-anticipated response rate from the former cohorts means that we will need more participants to be able to divide the subjects into four different groups of Language Family and then further subdivide into three different age groups as set out in the original ethics application. The conditions of testing, recruiting, confidentiality, questionnaire used and all other conditions outlined in the original ethics application remains the same.

\section*{| 1.4 | Purpose / justification of proposed amendment |
| :--- | :--- |}

Unfortunately, the response rate from the recruited cohorts, particularly the 2008 cohort, was lower than anticipated and, therefore, we do not have enough participants to be able to categorise subjects into national vs international students, then further divide into four different Language Families and then even further subdivide into three different age groups, dependent on their age of acquisition of English as would be necessary. This is important as the premise of this project is that students from a non-English speaking background who acquired English at a later age (i.e. after 5yo) will perform academically poorer than students from an English speaking background who acquired English before 5yo with particular emphasis on difference between national and international students.
1.5 Do the changes involve consideration of privacy legislation?

Will you be obtaining personal information from a source other than the participant?

X YES If YES, you will need to complete the (Privacy Issues) which is available on the Human Ethics website.

| 1.6 Will you be using Undergraduate Psychology Student Participant Pool? This <br> recruitment method is designed for Low Risk non-contentious research where the  <br> foreseeable risk to participants is no more than discomfort. If your research is  <br> higher risk or deals with contentious issues, you must justify the use of the pool in  <br> this research. Failure to provide a justification may delay the consideration of the  <br> project. (Note: this Pool is only available to Investigators/Staff in the SPPPM).  |  |
| :--- | :--- |
| X | NO |

## ATTACHMENTS

Where relevant, amended Explanatory Statements, Consent Forms, Questionnaires etc. should be attached.

The Explanatory Statements, Consent Forms, and Questionnaires have not been amended.

DECLARATIONS AND SIGNATURES

| Signature of Chief Investigator/or Primary Supervisor |  |
| :--- | :--- |
| Name Ramesh Rajan | Date 12 February 2010 |
| Signature |  |
| Signature of Chief Investigator/or Primary Supervisor |  |
| Name Ben Canny | Date 12 February 2010 |
| Signature |  |
| Signature of Chief Investigator/or Primary Supervisor |  |
| Name Sheila Vance | Date 12 February 2010 |
| Signature |  |
| Signature of Chief Investigator/or Primary Supervisor |  |
| Name Tony Luff | Date 12 February 2010 |
|  |  |
| Signature |  |
| Signature of Student Researcher |  |
| Name Collette Mann |  |
| Signature |  |


| Form P－Compliance with privacy legislation－Research involving collection，use and disclosure of information |  |
| :---: | :---: |
| 6.1 | Are you collecting，using or disclosing PERSONAL INFORMATION，HEALTH INFORMATION or SENSITIVE INFORMATION： |
| 区 | If YES，please also complete the rest of Section 6. |
| 6.2 | University regulations require the following procedures concerning storage of data．You should indicate your compliance with these regulations by ticking the following three boxes．Do you agree to comply with each of the following： |
| $\triangle \mathrm{YES}$ | Only the researchers will have access to the original data． |
| $\triangle \mathrm{YES}$ | Data will be retained in the Department for at least five years，longer for clinical trials．If the data are to be retained other than within a department or academic unit，a record of their location must be filed with the Head of the unit and a copy with the secretary |
| 区 YES | Victorian privacy laws require the University to＂take reasonable steps to destroy or permanently de－identify personal information if it is no longer needed for any purpose＂（IPP 4．2，Information Privacy Act 2000 （Vic．）； |
| 6.3 | If the above regulations（in $Q$ 6．2）are not being adhered to，how will information be handled to safeguard confidentiality？ |
| N／A |  |
| 6.4 | Describe the procedures you will use to protect participants from any distress， embarrassment or other harm that might be caused when the data is reported． |
| Data will only be reported in totally deidentified summary form in which no individual can be identified |  |
| 6.5 | Collection of Data |
| 6．5a | Does the project involve collection of information directly from individuals about themselves？ |
| 区 YES | Answer Q 6．5b－Q6．5c |
| 6．5b | What type of information will be collected？（Tick as many as apply） |
| 区 | personal information |
| 区 | sensitive information |
| 6．5c | Does the Participant Information and Consent Form explain the following |


| $\begin{aligned} & \triangle \text { Yes } \\ & \text { No } \end{aligned}$ |  | The identity of the organisation collecting the information and how to contact it? |
| :---: | :---: | :---: |
| $\begin{aligned} & \boxed{X} \text { Yes } \\ & \text { No } \end{aligned}$ |  | The purposes for which the information is being collected? |
|  |  | The period for which the records relating to the participant will be kept? |
| $\begin{aligned} & \boxtimes \text { Yes } \\ & \text { No } \end{aligned}$ |  | The steps taken to ensure confidentiality and secure storage of data? |
| Yes <br> No |  | The types of individuals or organisations to which your organisation usually discloses information of this kind? |
| $\triangle \text { Yes }$ <br> No |  | How privacy will be protected in any publication of the information? |
| $\begin{aligned} & \boxtimes \text { Yes } \\ & \text { No } \end{aligned}$ |  | The fact that the individual may access that information? |
| $\begin{aligned} & \square \text { Yes } \\ & \text { N/A } \end{aligned}$ |  | Any law that requires the particular information to be collected? |
| $\begin{aligned} & \boxed{X} \mathrm{Yes} \\ & \mathrm{~N} / \mathrm{A} \end{aligned}$ |  | The consequences (if any) for the individual if all or part of the information is not provided |
| 6.6a | Doe pot who | the project involve the collection, use or disclosure of identified or tially identifiable information from sources other than the individual information it is? |
| 区 YES | Ans | er Q 6.6b |
| 6.6b |  | the project involve the collection, use or disclosure of information without onsent of the individual whose information it is (or their legal guardian)? |
| 区 NO |  | Q 6.11b (Do not answer 6.7, 6.8, 6.9, 6.10) |
| 6.11 | GENER | AL ISSUES |
| 6.11a | How <br> that <br> numb <br> privac | many records will be collected, used or disclosed? Specify the information will be collected, used or disclosed (e.g. date of birth, medical history, er of convictions, etc) Complete this question only if you are seeking exemption from this HREC |
| Number of records: up to 310 records from the 2010 cohort of MBBS students, depending on how many volunteer for the project. |  |  |


| Type of records: Three categories of data will be collected from the students: academic data e.g. exam results, assessments etc. sociometric data e.g. date of birth, country of birth, English acquisition status etc. neurophysiological data e.g. audiometry testing |  |
| :---: | :---: |
|  |  |
|  |  |
|  |  |
| 5 years. At the end of this term, the data will be either archived or destroyed in an appropriate manner, e.g. security shredded, password-protected databases, in accordance with University guidelines. |  |
|  |  |
| De-identified data will be stored on password-protected computer software in the offices of CI1, who, along with CM , will be the only persons with access to the information for the 5 year period. |  |
| 6.1 |  |
| All results and data will be published in only de-identified summary form in which no individual can be identified. |  |
|  |  |
| All staff members involved in handling/collection of sensitive data are aware of University policies on privacy and confidentiality of participants. Further, staff are instructed to maintain best practice when dealing with such data to ensure that adverse events do not occur. <br> However, we have identified two areas where a possible breach may occur: <br> a unique identifier may mistakenly not be assigned and the student's identity/name is made known to Collette Mann, research student or; <br> a unique identifier is assigned, but the unmasking of the student's identity is still possible |  |

to Ms Mann via student ID number.
In the unlikely event of one of these breaches occurring, then a number of steps will be taken:

Ms Mann will immediately alert her supervisor, Prof Rajan. Prof Rajan will then contact the SCERH and the faculty. All analysis will stop, the source of the breach will be identified, records for that student will be deleted and the entire process of confidentiality will be re-examined.

The project team will discuss how/who would be the best person to discuss the breach with the student, if deemed necessary by the faculty.
6.11h $\quad$ Discuss any other ethical issues relevant to the collection, use or disclosure of information proposed in this project. Explain how these issues have been addressed.

There are no other ethical issues than those already addressed.

## APPENDIX D: LIST OF BKB(A) SENTENCES USED IN SPEECH-IN-NOISE TEST

1. A boy fell from the window
2. The boy hurried to school
3. A girl kicked the table
4. A letter fell on the mat
5. A man told the police
6. He broke his leg
7. He dropped his money
8. He found his brother
9. He played with his train
10. He's washing his face
11. Lemons grow on trees
12. Potatoes grow in the ground
13. She argued with her sister
14. She cut with her knife
15. She found her purse
16. She stood near her window
17. She's taking her coat
18. The bath towel was wet
19. The boy forgot his book
20. The boy has black hair
21. The buckets hold water
22. The bus left early
23. The children are all eating
24. The children are walking home
25. The children dropped the bag
26. The cook's making a cake
27. The dog came back
28. The family bought a house
29. The fruit came in a box
30. The girl has a picture book
31. The girl's washing her hair
32. The ground was very hard
33. The house had a nice garden
34. The husband brought some flowers
35. The ice cream was pink
36. The jam jar was full
37. The kitchen clock was wrong
38. The lady packed her bag
39. The lady washed the shirt
40. The mailman brought a letter
41. The man cleaned his shoes
42. The matches lie on the shelf
43. The mother heard the baby
44. The mud stuck on his shoe
45. The picture came from a book
46. The school finished early
47. The small boy was asleep
48. The taps are above the sink
49. The towel dropped on the floor
50. The train is moving fast
51. The truck climbed the hill
52. The wife helped her husband
53. The woman cleaned her house
54. The young boy left home
55. The young people are dancing
56. They are climbing the tree
57. They are playing in the park
58. They followed the path
59. They took some food
60. They wanted some potatoes


Figure 1 Appendix D. Snapshot of BKB sentence as seen by the Tester on the computer screen. Top line is the correct sentence. The next seven lines are the possible responses by the participant. The Tester chooses the corresponding response from these seven options as chosen by the participant, including the last line which denotes none of the three keywords were identified.

## APPENDIX E: FACTOR ANALYSIS

Correlation Matrix

|  |  | When I was growing up my Mother spoke English at home... | I Prefer to speak English... | In the last month, how often did you speak English at home | Perceived English Proficiency | Actual Age when first learnt English |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Correlation | When I was growing up my Mother spoke English at home... | 1.000 | . 485 | . 677 | . 366 | -. 676 |
|  | I Prefer to speak English... | . 485 | 1.000 | . 611 | . 575 | -. 528 |
|  | In the last month, how often did you speak English at home | . 677 | . 611 | 1.000 | . 554 | -. 654 |
|  | Perceived English Proficiency | . 366 | . 575 | . 554 | 1.000 | -. 483 |
|  | Actual Age when first learnt English | -. 676 | -. 528 | -. 654 | -. 483 | 1.000 |

Total Variance Explained

| Component | Initial Eigenvalues |  |  | Extraction Sums of Squared Loadings |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Total | \% of Variance | Cumulative \% | Total | \% of Variance | Cumulative \% |
| 1 | 3.254 | 65.088 | 65.088 | 3.254 | 65.088 | 65.088 |
| 2 | . 722 | 14.430 | 79.518 |  |  |  |
| 3 | . 418 | 8.360 | 87.878 |  |  |  |
| 4 | . 336 | 6.716 | 94.594 |  |  |  |
| 5 | . 270 | 5.406 | 100.000 |  |  |  |

Extraction Method: Principal Component Analysis.

Component Matrix ${ }^{\text {a }}$

|  | Component |
| :--- | ---: |
|  | 1 |
| In the last month, how often did you speak English at home | .875 |
| Actual Age when first learnt English | -.835 |
| When I was growing up my Mother spoke English at home... | .801 |
| I Prefer to speak English... | .790 |
| Perceived English Proficiency | .725 |

Extraction Method: Principal Component Analysis.
a. 1 component extracted.

## APPENDIX F: OSCE SCENARIO ASSESSMENT SHEET



| Scenario <br> Number | Abridged Scenario Stem | Communication <br> (History Taking) <br> Score/100\% | Procedural <br> (Demonstration) <br> Score/100\% | Combination <br> $50 / 50 \%$ | Additional <br> Comments |
| :--- | :--- | :--- | :--- | :--- | :--- |
| 6 | Mr. Blass is a 60 year old man who has <br> come to visit the GP because of pain in <br> his legs. | Jane is a 28 year old woman who has come to see you <br> to ask some questions about the oral contraceptive <br> pill. |  |  |  |
| 7 | Celeste/Cameron is a 33 year old factory worker come <br> to the ED to see the doctor for bad pain in the right <br> side of her/his back. |  |  |  |  |
| 8 | Douglas has just been brought in to the emergency <br> department by his wife. |  |  |  |  |
| 9 | Janet is a middle aged woman who lives in a rural <br> area. She came to see the doctor last week because <br> she has been feeling tired and run-down for about 6 <br> months, since the birth of her third child, who is being <br> breast-fed. |  |  |  |  |
| 10 | The 34 year old patient you are about to examine <br> presents to you with a history of headache and visual <br> disturbance for several days. |  |  |  |  |
| 11 |  |  |  |  |  |


| Scenario <br> Number | Abridged Scenario Stem | Communication <br> (History Taking) <br> Score/100\% | Procedural <br> (Demonstration) <br> Score/100\% | Combination <br> $50 / 50 \%$ | Additional <br> Comments |
| :--- | :--- | :--- | :--- | :--- | :--- |
| 12 | Sharon/Steve has made an appointment to see you <br> about 10 days after you saw him/her for breathing <br> problems, diagnosed asthma and commenced <br> treatment. |  |  |  |  |
| 13 | Miss Jean Brown aged 24 donates blood for the first <br> time at the Melbourne blood bank. She is notified to <br> see her own doctor for review of the blood test results. |  |  |  |  |
| 14 | Trang is a 32-year-old lady with renal failure about to <br> start dialysis. |  |  |  |  |
| 15 | Terry is a 36 y/o senior university administrator who <br> presents to you in your general practice for a health <br> review and advice on his/her lifestyle. |  |  |  |  |
| 16 | Don is 22 years old and had a dislocated right shoulder <br> reduced, apparently successfully, one week ago. He is <br> complaining of general weakness in that arm. |  |  |  |  |
| 17 | Danny is a 35-year-old Aboriginal man. He has <br> presented with a singed beard and a burnt right hand <br> and forearm. |  |  |  |  |

Appendix F: OSCE Scenario Assessment Sheet

| Scenario <br> Number | Abridged Scenario Stem | Communication <br> (History Taking) <br> Score/100\% | Procedural <br> (Demonstration) <br> Score/100\% | Combination <br> $50 / 50 \%$ | Additional <br> Comments |
| :--- | :--- | :--- | :--- | :--- | :--- |
| 18 | Mark is a 24-year-old man who fell on to his right hand <br> and now complains of pain in his right elbow. |  |  |  |  |
| 19 | You are Dr Aleysha, a GP obstetrician, and you have just <br> received the results of the Heel Prick test done soon <br> after birth on baby Sheridan. The Heel Prick test shows <br> that Sheridan has a high level of IRT (Immunoreactive <br> trypsinogen) and has a high risk of having Cystic <br> Fibrosis. |  |  |  |  |
| 20 | You are on a clinical placement in a nursing home. As <br> you enter the room of Mrs Lateri, a 72 yo woman <br> previously well, you find her collapsed and unconscious <br> on the floor. |  |  |  |  |
| 21 | Jack/Jane has come to the doctor today because he / <br> she is concerned about his/her hearing. |  |  |  |  |
| J2 |  |  |  |  |  |


| Scenario <br> Number | Abridged Scenario Stem | Communication <br> (History Taking) <br> Score $/ 100 \%$ | Procedural <br> (Demonstration) <br> Score $/ 100 \%$ | Combination <br> $50 / 50 \%$ | Additional <br> Comments |
| :--- | :--- | :--- | :--- | :--- | :--- |
| 23 | The 24 year old patient you are to examine presents <br> complaining of abdominal pain, lethargy, fever, sweats, <br> malaise, nausea and vomiting for 3 days. Your clinical <br> suspicion is that this patient has a gastrointestinal <br> problem. |  |  |  |  |
| N | Jane, a 16 yo girl presents with a six-week history of <br> weight loss, nausea, tiredness and lethargy. Based on <br> her history and your observation of sweet breath, you <br> make a presumptive diagnosis of diabetes mellitus. |  |  |  |  |
| 25 | You, as a junior health promotion student, have an <br> appointment with your health promotion project <br> supervisor. You have previously forwarded your <br> project summary and you now have 'an eight minute <br> interview' with your supervisor. |  |  |  |  |
| 2 | You have just taken a history from Sharon/Steve. Now <br> please conduct a complete physical examination of the <br> respiratory system. |  |  |  |  |


| Scenario <br> Number | Abridged Scenario Stem | Communication <br> (History Taking) <br> Score/100\% | Procedural <br> (Demonstration) Score/100\% | Combination 50/50\% | Additional Comments |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 27 | You have been working all day in a general practice situated a few blocks from the local hospital. The nurse/receptionist has just left and you are finishing up in the office, when a young man appears in the waiting room nursing his left arm which is wrapped in a bloodstained tea-towel. |  |  |  |  |
| 28 | Sharon/Steve is a 23 year old factory worker who has presented to his/her GP today. |  |  |  |  |
| 29 | Rowena is 15 and she presented to casualty complaining of pain in the right lower leg, swelling of the leg and inability to bear weight. |  |  |  |  |
| 30 | Dhama is a 22 year old man. He was brought into hospital early on Sunday morning by the night patrol from the local Aboriginal Co-operative. He was found unconscious in a local park and appeared to be suffering from severe alcohol poisoning. |  |  |  |  |


| Scenario Number | Abridged Scenario Stem | Communication (History Taking) Score/100\% | Procedural <br> (Demonstration) Score/100\% | Combination 50/50\% | Additional Comments |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 31 | Alex comes to see the doctor because he/she is worried about his/her left knee. He/she has noticed that sometimes when walking down stairs the knee is painful. |  |  |  |  |
| 32 | Jack has presented to you to ask advice about his stress. |  |  |  |  |
| 33 | You have resuscitated (patient) who is now stable and will be transferred to a coronary care unit bed when one is identified. A nurse approaches you: "Doctor, the patients' (relative) who brought him in is worried by all the activity. Can you speak to him/her please." |  |  |  |  |
| 34 | The patient is Bronwyn/Bill and is a 53 year old factory worker. He/she has told the receptionist that they need a check up. |  |  |  |  |
| 35 | You have taken a history from the 53 year old factory worker and you now want to examine this patient for evidence of gastrointestinal disease particularly in regard to the presenting complaint. |  |  |  |  |


| Scenario Number | Abridged Scenario Stem | Communication (History Taking) Score/100\% | Procedural <br> (Demonstration) Score/100\% | Combination 50/50\% | Additional Comments |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 36 | Please conduct a complete physical examination of the cardiovascular system. |  |  |  |  |
| 37 | You are asked to obtain written consent for your health promotion study from a potential participant ( 51 yr old Mr John) although you do not presently have a copy of the written information sheet with you. |  |  |  |  |
| 38 | Karen/Ken has presented to you to ask a number of questions because his/her brother had a heart attack a few weeks ago. You have the following history and tests in her/his file. |  |  |  |  |
| 39 | $\mathrm{Mr} / \mathrm{Mrs}$ Myer is a 40-50 year old man/woman who has come to visit the GP with pins and needles in his/her left hand occurring at night. He/she has no arm pain but is repeatedly woken at night with the pain in the hand. |  |  |  |  |
| 40 | An appointment has been made for you to see Mrs Jones and her daughter Sally, who is not moving her left arm. |  |  |  |  |



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[^0]:    ${ }^{1}$ Language Family is the term used to encompass groups of languages that descend from a common phonological ancestor, e.g. Romantic languages such as Spanish and Italian.

[^1]:    ${ }^{2}$ Marin, G., Sabogal, F., Vanoss Marin, B., Otero-Sabogal, F., \& Perez-Stable, E.J. (1987). Development of a short acculturation scale for Hispanics. Hispanic Journal of Behavioral Sciences, 9, 183-205.
    ${ }^{3}$ Sandhu, D.S. \& Asrabadi, B.R. (1994) Development of an acculturative stress scale for international students: Primary findings. Psychological Reports, 75, 435-448.

[^2]:    ${ }^{4}$ For the purposes of this study, English was classed as a Language Family even though it is a member of the IndoEuropean Language Family.

[^3]:    ${ }^{5}$ It should be noted that it is more accurate to use the term 'acculturative stress', which is one aspect of acculturation, as discussed in the General Introduction. However, as this is a published article, it could not be changed for this thesis.

[^4]:    ${ }^{6}$ English is a member of the Indo-European Language Family, but was classed as a separate Language Family for the purposes of this study.

[^5]:    7 'Bilingual' in this study is defined as a participant having acquired English and another language concurrently before the age of five and the student stating in their questionnaire that they are unable to distinguish which language was learnt first. These students were excluded from any analysis where groups were categorized as EFL or ESL, i.e. English as a first or second language, since these students cannot be correctly classed as being in either category exclusively. Further, the current literature indicates that language processing in early bilinguals may be differentially impacted by the age of exposure to the language. There is evidence that early bilinguals may utilise different processing pathways for the language in consideration to the pathways used by late bilinguals. (Chee, et al., 1999; Grosjean, 1989; Kim et al., 1997; Mechelli et al., 2004; Näätänen, 2001; Weber-Fox \& Neville, 1996). Therefore, inclusion of these participants may confound the intent of an analysis to examine how working memory constraints from learning a specific language at different ages affected later academic performance. 'Bilingualism' itself is a topic of much dispute within the current literature, with a number of factors for consideration, and is beyond the scope of this thesis; however for a contemporary review see Zhang \& Wang (2007).

[^6]:    AoAoE: Age of Acquisition of English; SNR 50 $^{\prime}$ : Signal-to-noise Ratio; ELS: English Language Skills. ${ }^{*} P<0.05$

[^7]:    ${ }^{i}$ Whilst a detailed discussion is beyond the scope of this thesis, it is worth noting the unique culture of the Sino-Tibetan (Asian) students of this study, noting that, in Australia, 'Asian' is used to denote East and South-East Asians and not South Asians like Indians, Sri Lankans, and Pakistanis. The bulk of international students studying at this university are from Asia (of the top 10 source countries for total enrolments in the university for 2012, the first five countries were, in decreasing order, Malaysia, China, Indonesia, Singapore and Hong Kong, according to Monash University Pocket Statistics 2012).

[^8]:    c8 80380

[^9]:    ${ }^{8}$ Revised version from "Ollen's Musical Sophistication Index Questionnaire"

