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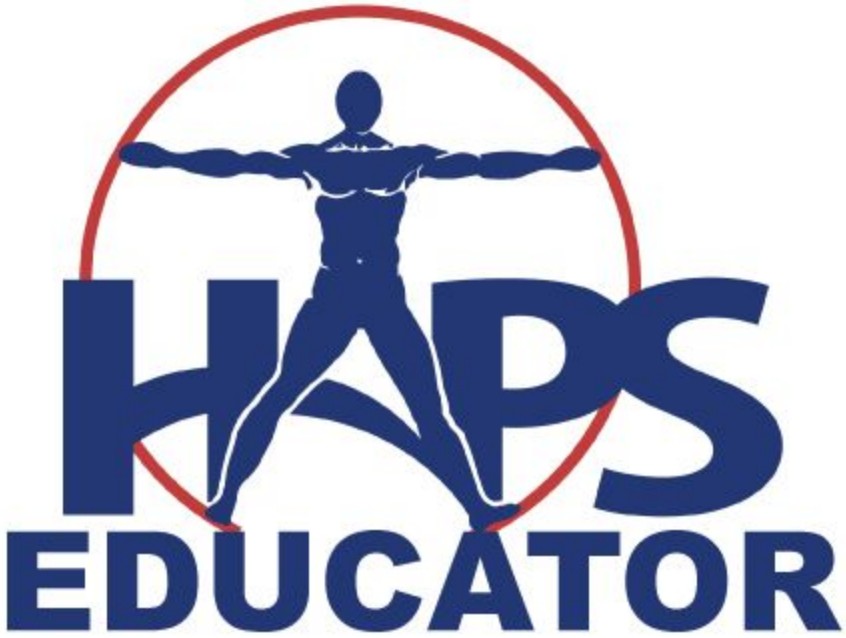

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Why Do Science Students Study Physiology? Career Priorities of 21st Century Physiology Undergraduates

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Abstract
There have been significant increases in the number of students studying physiology in the Bachelor of Science degree-program at our university. We thought that physiology prerequisites for graduate programs in medicine and allied-health areas were facilitating these increased numbers. Undergraduate physiology students were surveyed about their career priorities: 25% were undecided/uncertain; 22% intended to study graduate medicine; 15% wanted to get a job straight after their degree; 10% planned to study in an allied-health area. Their careers uncertainty remained high, even in their final semester, suggesting a critical need for in-curriculum careers education. With 32% of students selecting graduate programs in medicine or allied-health, this supports the idea that elevated student enrolments are driven by their future study plans. With only 5% of students putting research as their career priority, this raises concerns about how we educate our physiology students. Should we be educating them to be researchers and also developing their skills in preparation for graduate health-related programs? https://doi10.21692/haps.2019.010

Introduction
Annual increases in Bachelor of Science students undertaking a physiology major
At our large, research-intensive university in Australia, we have seen substantial increases in the number of students selecting to study physiology as part of their Bachelor of Science (BSc) degree-program. Enrolments in the foundational physiology subject/course have increased from 150 in 2011 to 663 in 2018, without similar increases in student enrolments in the BSc degree-program (data extracted from the Monash University Callista Student Management System). Increased physiology undergraduate enrolments have been experienced at other Australian universities (personal communications from participants of the 2018 meeting of the Australian Physiological Society Education Interest Group), as well as in the US higher education system (personal communications from participants of the 2018 meeting of the American Physiological Society Physiology Majors Interest Group).

It is likely that the entry requirements for Australian graduate medical programs have contributed to enhanced physiology enrolments in the undergraduate science degree program at our university. Of the 19 medical schools that existed in Australia in 2019, nine are undergraduate and eleven are graduate programs. Monash University is counted twice since this university has both graduate and undergraduate medical programs (Australian Medical Association, AMA). In 2000, there were only 11 Australian medical schools, all with undergraduate medical programs that predominantly selected students directly from secondary school (AMA). Most of the current graduate medical programs have physiology as a prerequisite subject in undergraduate degree programs. Similarly, since 2000 many of the Australian university undergraduate degrees have become graduate programs e.g. physiotherapy, paramedicine, nursing, teaching, dietetics, radiography, dentistry, optometry, veterinary science) that often have a physiology prerequisite. Thus, we would expect many of the BSc students majoring in physiology to be aiming for a graduate program in medicine or allied health. This introduction of graduate programs at Australian universities aligns with the US graduate model of higher education (Mercer et al. 2015; Mowery 2015).

Are the increased science student enrolments in physiology facilitated by the students' career destinations?
It is likely that increased student enrolments in physiology are being facilitated by students' aspirations for further study and employment/career outcomes. However, it is difficult to find evidence-based data about graduate and career outcomes for 21st century physiology graduates. The UK's biggest graduate careers website (UK Higher Education Careers Services Unit), quotes 2017 physiology graduate destination data from the UK Higher Education Statistics Agency, with 55% of physiology graduates going into employment (28% into the health area, 13% into childcare/education and 12% as science professionals) and 29% into further study.

University College Cork (Ireland) have been tracking their BSc physiology graduate outcomes. In 2011, 52% of their graduates were in employment and 41% were in further study e.g. graduate medicine, physiotherapy, education,

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masters in biomedical sciences, PhD in science research, Masters in Cardiac Rehabilitation and Prevention (University College Cork). Similarly, King's College London (UK) analysed their physiology graduate destinations from 2012-2014, with 12% in employment and 88% in further study e.g. Dentistry, Medicine, Masters or PhD Science Research, Human and Physiological Sciences Research, and Masters in Global Health and Social Justice (King's College). An article in *The Guardian* (UK 2011) quoted a survey of 2009 physiology and anatomy graduates, for which over half went into physiotherapy-related occupations. Other popular career destinations included exercise physiology, pharmaceutical or biotechnology industries (particularly as clinical research associates), laboratory-based research scientists, secondary teaching, scientific writing/journalism, and medical sales. Seventeen percent of the students surveyed went onto further university study, mainly in medicine, dentistry, or a PhD program to become research scientists (*The Guardian* 2011).

Information about potential career pathways for physiology graduates is provided by the American Physiological Society (APS). They list: researcher (with/without PhD), teacher, public service/government worker, entrepreneur, industry, management and science writer (APS). The University of Cambridge (UK) lists careers for physiology graduates as research (with a PhD), research in the private sector or working for a company, using transferable skills (University of Cambridge).

Information from the University of Manchester (UK), BSc Medical Physiology website indicates that physiology graduates end up with careers in research (at universities, pharmaceutical and bioscience companies or institutes) or in "laboratory-based careers in clinical or technical roles that do not involve research" (University of Manchester). The University of Iowa (US) highlights that careers in health and human physiology include athletic training, exercise science, health promotion, physicians/surgeons, physical therapists, physician assistants, dentists, optometrists, podiatrists, or similar professionals, recreation and sports management and graduate degrees (Masters and/or PhD) in the biomedical or physiological sciences to prepare for careers in research and/or college teaching (University of Iowa).

At our university, we publicise careers for physiology graduates based on the graduate outcomes we have observed. These include: agricultural researcher, audiologist, biotechnology industry worker, Chinese medicine, dietician/nutritionist, echocardiographer, epidemiology, food industry specialist, food technologist, forensic scientist, health economics specialist, health informatics, health promotion researcher, health services worker, information technologist, human resources officer for government or industry, insurance industry researcher, laboratory technologist (health, research or industry), medicine via graduate entry, medical researcher, medical supplies/equipment sales representative, nursing, occupational health and safety, occupational therapy, paramedic, pathology technician, pharmaceutical sales representative, public health worker, policy adviser (to government or industry), reproduction technologist, research scientist, sleep scientist, teacher (secondary/college), toxicologist, veterinary science (Monash University 2000). In summary, it is likely that science/physiology graduates move into a diverse range of careers post-graduation. This is not surprising, as the undergraduate science degree is considered non-vocational, with many students completing the degree because they are interested in science, but do not know what career they would like to follow (Harris 2007; Skatova and Ferguson 2014).

Our hypothesis was that physiology enrolments in our BSc degree program were rising due to physiology requirements for further graduate study programs. We thus surveyed undergraduate science (physiology major) students about their career priorities, their career development and their rationale for their career priorities. The results could have implications for the core concepts and skills development covered in a BSc physiology major. For example, should we be educating and training our physiology students as graduates for a research and/or a health-related career?

Methods

Participants and context

Participants in this research study were undergraduate students at a large, research intensive Australian university. They were BSc students enrolled in the foundation core second year (BSc) physiology subject (PHY2011: Neuroscience of communication, sensory and control systems) in 2016 and 2017 and a final/third year physiology subject (PHY3072: Muscle and exercise). The numbers of students enrolled in these subjects are provided in Table 1. The PHY2011 course is taught in semester one of year two, and the PHY3072 course is taught in semester two of year three, the final semester of the three-year BSc degree program. It should be noted that at our university, physiology is not taught in the first year of the BSc program. In first year of the BSc program, students take general science subjects such as chemistry, math and physics.

Table 1. *Participants in the research study (PHY2011 = Neuroscience of communication, sensory and control systems subject and PHY3072 = Muscle and Exercise subject)*

Year	Subject *(number of students)*	Subject *(number of students)*
2016	PHY2011 *(558)*	not applicable
2017	PHY2011 *(633)*	PHY3072 *(282)*
2018	not applicable	PHY3072 *(244)*

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Research design

At the end of a tutorial, which is an active teaching session led by a faculty member/academic that is held in a flat-floor classroom, with between 60 and 150 students, students were given an overview of the research project and handed a hard copy of an anonymous and voluntary survey. This survey was administered by a person independent of the research study. None of the tutorial classes were compulsory. The survey asked students to:

(1) Select their top career priority upon completion of their current degree.
(2) Rate their career development and career confidence using four career statements with a seven-point Likert scale from strongly disagree to strongly agree.
(3) Provide a written explanation of the rationale for their career intention.

The four careers statements were:

(1) I am certain of what career path I want to pursue when I graduate.
(2) I know how to develop experience and skills in preparation for my career.
(3) I am confident of my ability to communicate my current skills, knowledge and abilities to potential employers.
(4) I am confident of my ability to independently manage my career development.

Students were provided with the following options for their top career priorities:

(1) To get a full-time job after they finish their degree *(specify the area.)*
(2) Attaining a place in a science honours year.
(3) Attaining a place in a science honours year, followed by a PhD.
(4) Attaining a place in a graduate medicine course.
(5) Attaining a place in a graduate allied health course *(specify which area)*.
(6) Attaining a place in a graduate course in teaching *(circle primary or secondary.)*
(7) Attaining a place in another graduate course *(specify the course.)*
(8) Attaining a place in another undergraduate course *(specify the course.)*
(9) I am uncertain or undecided about this; other *(please specify)*.

The survey was administered in the middle of semester one for PHY2011 and at the end of semester two for PHY3072. For most of the PHY3072 students this was the final semester of their degree program.

Statistical tests and thematic analysis

Data were collated on an excel spreadsheet and statistically analysed using *GraphPadPrism* version 7.01. A non-parametric one-way ANOVA (Kruskal-Wallis) was performed across the different student cohorts for each of the career development questions, with a post-hoc Mann-Whitney U test. The written student comments were collated for: (1) the specific graduate allied health program and (2) the rationale for their top career priority. An inductive thematic analysis was used, with coding to identify the main themes in the written comments (Terry et al. 2017). Two researchers independently coding the main themes and their frequency. This research was approved by the Monash University Human Research Ethics Committee and informed consent was obtained from all participants according to ethics protocol number 7195.

Results

All of the surveys had high response rates, with an average response rate of 58% across all four surveys (Table 2). The PHY3072 (2018) survey response rate was lower than the other surveys because the tutorial was a revision tutorial and therefore fewer students attended the tutorial.

Table 2*. Student response rates for the surveys (PHY2011 = Neuroscience of communication, sensory and control systems subject and PHY3072 = Muscle and Exercise subject)*

Year	Subject *(survey response rate)*	Subject *(survey response rate)*
2016	PHY2011 *(65%)*	not applicable
2017	PHY2011 *(55%)*	PHY3072 *(71%)*
2018	not applicable	PHY3072 *(41%)*

Students main career priorities were graduate medicine, or they were uncertain about their future career

Students were asked what their top career priority was after they graduated from their current BSc degree. Figure 1 shows that an average of 25% of students across all four subjects were undecided or uncertain about their careers, even in their final subject; PHY3072, with 22% indicating that they intended to study graduate medicine,15% selecting that they would get a full-time job, 10% indicating that they would continue into further graduate study in allied health, 10% selecting honours and only 5% selecting a PhD in science research and 3% selecting teaching. In the Australian and UK university systems BSc students can take a fourth honours year on top of the three-year degree program. This is a research-based year that culminates in the submission of an honours thesis. Students need this honours year to be eligible to undertake a PhD.

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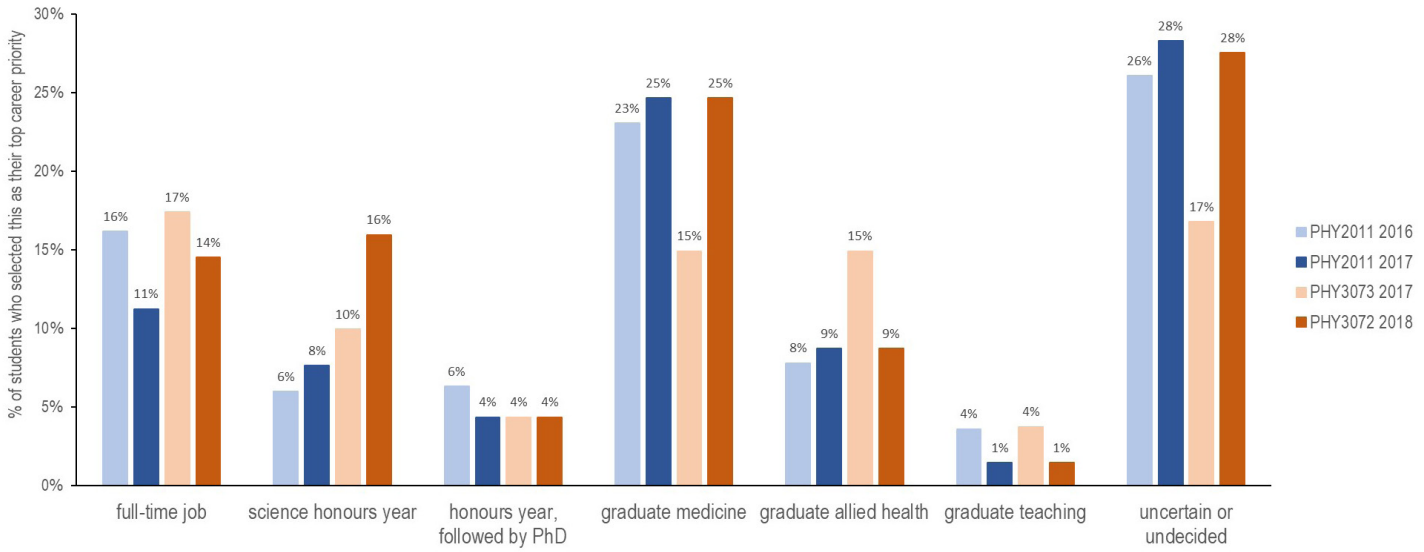

Figure 1. *Top career priorities of physiology students (PHY2011 = Neuroscience of communication, sensory and control systems subject and PHY3072 = Muscle and Exercise subject)*

Many students were uncertain or undecided about their top career priority

A quarter of the students selected indicated that they were uncertain or undecided about their top career priority. The final year PHY3072 (2017) cohort was less uncertain/undecided about their career priorities (17%) compared with the PHY2011 (2016) cohort, which was 26% (Figure 1). This could signify that as the students progressed through their degree from their foundational second year physiology/PHY2011 course to their final semester PHY3072 course, they were more certain about their future career. However, this trend was not observed for the PHY3072 (2018) students compared with the PHY2011 (2017) students.

Of the students who were uncertain or undecided about their top career priority, most stated that they were interested in a few career options but could not, at the time of the survey, pinpoint which option they will take (Table 3). This was followed by a number of students who were uncertain/undecided which career they wanted to do in the future due to the large number of options presented to them. There were a few who wanted to pursue further studies but were unsure which area of study or field to choose. Some were uncertain of the direction of their course or were not sure of their current career options. There were also concerns about their current qualifications to land a job with their degree and whether further studies would alleviate this concern. Students also did not want to worry about their choices until more opportunities presented themselves. Here are some selected PHY2011 student comments that support their main reasons for uncertainty or indecision:

I'm tossing up between a few options. At the moment, I am interested in completing science and potentially doing honours in DEV [anatomy/developmental biology] or PHYSIO [physiology]. I am also considering doing a Master in Teaching. I would also like to get a full-time job. (isn't that everyone's goal?)

I think doing an honours year or postgraduate degree in pharmacy, physiotherapy or radiography would be really interesting, however I am still considering medicine, teaching or even honours.

Still unsure about career pathways I will take, undergrad science has opened up [an] overwhelming amount of opportunities.

I am unsure of what my qualifications will be and what jobs I can apply for.

I am currently unsure about what career I want to go in, so thought a broad course like science would be a good way to test the water and see what I like.

I am unsure between finding a job after graduation, and further study, Further study may increase employability but it also may not.

I am not sure whether I will be able to attain a full-time job - more study may be required. Considering many career options.

I am uncertain as to whether after the degree I would try to further my education or to get a full-time job using the degree alone. However, I do take an interest in science and the research that goes into it.

Depends on my grades.

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***Table 3**. Reasons students provided as to why they were uncertain or undecided about their top career priority.*

Reasons provided for their uncertainty	Number of students
Had a few career options but cannot select one	16
Unsure of career pathway	11
Not sure of options	6
Unsure which field or area of study	5
Uncertain of direction of course	5
Grade dependence	4
Unsure of qualifications	4
Waiting for more opportunities	3
Aims for honours degree for more options	1
Doesn't want to be worried	1

Attaining a place in graduate medicine as the top career priority
An average of 22% of the survey respondents selected graduate medicine as their top career priority. As shown in figure 1, fewer final year PHY3072 (2017) students (15%) wanted to attain a place in a medical program compared with the second year PHY2011 (2016) students (23%). A possible explanation for this could be that by their third year these students have realised that their grades will not get them an interview for graduate medicine, so they selected another choice instead, possibly a full-time job or a graduate allied health program, since there are increases in these career priorities between PHY2011 (2016) and PHY3072 (2017). This trend was not observed between the PHY2011 (2017) and the PHY3072 (2018) cohorts. The written rationales for students selecting graduate medicine as their top career priority were thematically analysed. The most common reasons for students selecting graduate medicine were that they were interested in or passionate about medicine, or that they thought this profession had good career prospects (Table 4). Here are some of the written statements from PHY2011 students:

Medicine is important to society and I want to contribute.

I have a desire to demystify what goes on within the human body when it is confronted with disease, and to identify ways of treating those conditions.

I have an interest in helping people, and a career in medicine allows me to combine that desire with a passion for physiology.

Doctor: high pay, well respected, get to help people, improve lives, make a difference.

I have always wanted to become a GP to treat patients in underprivileged rural communities as I am from a semi-rural background.

I want to be able to fix people who are sick and feel that nursing does not have the responsibility, pharmacy is too retail and physio isn't medical enough.

Because medicine is my end goal hence I chose physiology as a subject.

***Table 4**. Main themes for 'Explain why you have selected this as your top career priority' for students who selected graduate medicine (% of student responses for each theme, with highly ranked themes shaded in gray). There were not enough written responses on this topic for PHY3072 in 2018. (PHY2011 = Neuroscience of communication, sensory and control systems subject and PHY3072 = Muscle and Exercise subject).*

	PHY2011 2016	PHY2011 2017	PHY3072 2017
Academia	2%		
Physiology a pathway into medicine	2%		
Career prospects	23%	9%	9%
Interest	17%	19%	17%
Job	5%	2%	
Money/security	2%	11%	4%
Passion	20%	37%	52%
Self-education/ fulfilment	7%	4%	
Societal contribution	15%	14%	13%
Unsure	8%	2%	

Getting a full-time job as the top career priority
Fifteen percent of students selected a full-time job as their top career priority. Slightly more students taking PHY3072 in 2018 selected a full-time job (14%) compared with the PHY2011 (2017) students (11%) (Figure 1). This trend was not observed for the PHY2011 (2016) and PHY3072 (2017) cohorts. Full-time jobs reported by the students included analytical chemistry, data research, soldier, journalist, editor, commerce/economics, lab technician, and biotech investor. The student rationales for selecting a full-time job were mainly financial, as illustrated by these PHY3072 student comments:

I need to pay off my HECS debt [Higher Education Contribution Scheme = university fees].

I have done 6 years of study and will be wanting $$$.

I need to earn a living.

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Attaining a place in a graduate allied health program as the top career priority

A tenth of the students selected a graduate allied health program as their career priority. This increased as they progressed through their degree, with 8% of the 2016 PHY2011 cohort and 15% of the 2017 PHY3072 cohort selecting graduate allied health (Figure 1). This trend was, however, not observed between the 2017 PHY2011 and 2018 PHY3072 cohorts. Students who selected graduate studies in allied health were asked to specify (with a free text option) which areas of allied health they intended to pursue and the following were provided: audiology, biotechnology, dentistry, dietetics/nutrition/food science, embryology/reproductive sciences/IVF, epidemiology/public health, health management, genetic counselling, nursing/midwifery, occupational therapy, optometry, paramedicine, pharmacy/pharmaceutical sciences, physiotherapy, prosthetics, psychology, radiography, speech pathology, sports science/exercise physiology, and veterinary sciences. The main reasons students provided for selecting graduate allied health programs were because they were interested/passionate about this area or because they wanted to work in the clinical environment. Many students mentioned that physiology was a prerequisite for the allied health graduate program. Here are some selected student comments:

PHY2011 student: *I have an interest in helping people, and a career in medicine/any allied health field allows me to combine that desire with a passion for physiology.*

PHY2011 student: *Because I have an interest in health sciences and helping people. It fascinates me to learn functions of the body and how they interact with each other.*

PHY2011 student: *To fulfill my goal of becoming a neurologist. I really want to work in a hospital and help people overcome difficulties related to brain development.*

PHY2011 student: *Paramedicine: physiology is important for my career.*

PHY3072 student: *I want to work in a hospital, and actually enjoy learning about the physiology of the human body especially the cardiovascular system.*

Attaining a place in a science honours (research) year as the top career priority

Ten percent of students selected an honours year as their top career priority, with more year three students (PHY3072) selecting an honours year in 2017: 10%; in 2018: 16%) than the year two (PHY2011) students in 2016: 6%; in 2017: 8%; (Figure 1). Student comments indicated that they were predominantly interested in honours as a pathway into graduate medicine, and did not get an offer for graduate medicine in their final/third year. An honours year increases a student's grade point average (GPA) and consequently their ranking for selection into graduate medicine is higher. Some students also felt that an honours year would improve their employability. PHY3072 student comments about this:

I am doing honours to increase my WAM [weighted average mean]/GPA for grad med.

The honours year will provide a pathway to achieving a place in graduate medicine.

Because it seems impossible to get a job without honours also not sure yet what career path I want.

So that I have a greater qualification for future job prospects (honours).

Few physiology students selected a PhD as their top career priority

Only 5% of the students selected an honours year and PhD in science research as their top career priority. In Australia, you cannot undertake a PhD without an honours year. Most of these students intended to pursue a career in research, as illustrated by these selected written comments:

PHY2011 student: *I am interested in research as I am a person who constantly questions the world around and why things are like they are.*

PHY2011 student: *I believe it suits my strengths and will be an interesting and engaging career.*

PHY2011 student: *I would like to research neuromuscular cell contraction pathways for sports science and cardiac physiology.*

PHY2011 student: *I want to go into the field of marine biology research, specifically animal ecophysiology.*

PHY2011 student: *This is an area of study [physiology] that I have been greatly interested in. Working in this area will be both knowledgeable and fascinating.*

PHY2011 student: *I like studying and would like to be an expert in my field. Afterwards, I would like to use my physiology knowledge in the workplace.*

PHY3072 student: *I would like to pursue a career as a researcher where I can make a difference.*

Few students selected attaining a place in a graduate teaching program (primary or secondary) as their top career priority

An average of only 3% of the students selected teaching as their top career priority (Figure 1). Their reasons for selecting teaching included that they enjoyed working with children and that they wanted to help their pupils to succeed with their learning. This is illustrated by the student comments below.

PHY2011 student: *Love to teach others and see them succeed.*

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PHY2011 student: *I work casually/regularly at a school in various departments including the school's boarding house. I really enjoy working with kids and think a career in teaching would be very rewarding.*

PHY2011 student: *I wish to work in education and want to be able to do this in the scientific field.*

PHY3072 student: *Always been interested in teaching; would be an interesting career choice.*

Careers confidence and careers awareness of physiology students
The students' ratings for the four career development statements significantly increased from year two (PHY2011) to year three (PHY3072) for statements 2 *(I know how to develop experience and skills in preparation for my career*), 3 (*I am confident of my ability to communicate my current skills, knowledge and abilities to potential employers*) and 4 (*I am confident of my ability to independently manage my career development*), but not for statement 1 (*I am certain of what career path I want to pursue when I graduate)* - Figure 2 and Table 5. Despite being near the end of their degree program, PHY3072 students were no more certain of their career paths than the PHY2011 students at the start of the second year of their degree program.

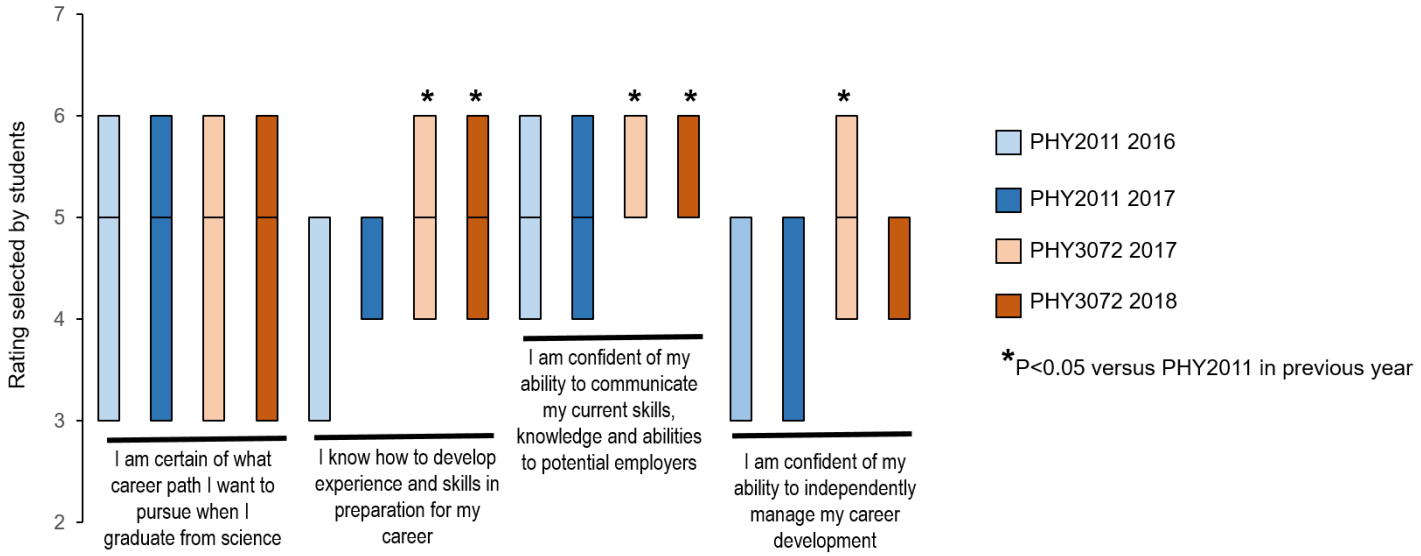

Figure 2. *Student responses to four career development statements (7-point Likert scale from strongly disagree to strongly agree) Data are expressed as the median (black line in box) and the 25 and 75 percentiles. The maximum and minimum have not been plotted as they were always 7 and 1, respectively, for all cohorts (PHY2011 = Neuroscience of communication, sensory and control systems subject and PHY3072 = Muscle and Exercise subject).*

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Table 5. *Student responses to four career development statements (7-point Likert scale from strongly disagree to strongly agree). Data are expressed as the % of students that selected agree and strongly agree (PHY2011 = Neuroscience of communication, sensory and control systems subject and PHY3072 = Muscle and Exercise subject).*

	I am certain of what career path I want to pursue when I graduate from science	I know how to develop experience and skills in preparation for my career	I am confident of my ability to communicate my current skills, knowledge and abilities to potential employers	I am confident of my ability to independently manage my career development
PHY2011 2016	37	22	25	18
PHY2011 2017	42	21	32	21
PHY3072 2017	37	38	47	38
PHY3072 2018	34	30	43	20

Discussion

The most commonly selected career priority was that the student was uncertain or undecided about their future career, followed by graduate medicine and getting a full-time job. This is consistent with our hypothesis that increasing physiology enrolments in the BSc are being driven by the physiology prerequisites for graduate medicine. The uncertainty about their future career direction, as ascertained by students' career priorities (or lack thereof) and their career confidence, suggests that career development needs to be embedded into the physiology major of the BSc degree program.

The Bachelor of Science is a non-vocational degree program with diverse career outcomes

The Australian BSc degree program is considered non-vocational, with a diverse range of career outcomes. Many students choose to study science because they do not know which career they want to pursue and they are interested in science (Harris 2007; Skatova and Ferguson 2014). Indeed, we found that about a quarter of Monash BSc physiology major students indicated that they were undecided or uncertain about their career, even near the end of their final physiology subject (PHY3072 (Figure 1). At this time point most students would have been notified if they were successful at obtaining a place in a graduate degree program. This uncertainty about their future career is reflected in their responses to the first career development statement 'I am certain of what career path I want to pursue when I graduate', with no consistent change in the rating for this statement between year 2 (PHY2011 foundational physiology subject) and year 3 (PHY3072 final year physiology subject).

A need for undergraduate career development

Given the degree of student uncertainty and indecision about their career, it is clear that we need to educate BSc physiology major students about their career options. This idea is supported by the PY2011 student comment that "*undergrad science has opened up [an] overwhelming amount of opportunities*"; the non-vocational aspect of the BSc, with diverse career outcomes, could make it difficult for students to develop specific career goals. Career development and improving their employability is a key focus for many students entering higher education (Kandiko and Mawer 2013). This is especially important for a non-vocational undergraduate degree program, such as the BSc, that has no fixed, single career outcome.

Career development learning, including self-awareness, occupational exploration, decision-making and career management, is considered to be a key component of graduate employability (Watts 2006; Dacre Pool and Sewell 2007). Meta-analyses of the careers outcome literature indicates that assisting students to explore possible future careers promotes their employability and well-being (Brown and Roche 2016; Watts and Hawthorn 1992; Whiston, Sexton and Lasoff 1998). However, educating BSc physiology major students about their career options is hindered by our lack of quantitative knowledge about the graduate/career outcomes of our physiology graduates, so we cannot tell current students what the actual career outcomes for physiology graduates are.

We have been running a career development and employability workshop in the PHY2011 subject since 2016. This seems to be having an impact, as the PHY3072 (final year) students were significantly more confident than the

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PHY2011 students about their career development (Figure 2), with higher ratings for 'I know how to develop experience and skills in preparation for my career', 'I am confident of my ability to communicate my current skills, knowledge and abilities to potential employers' and 'I am confident of my ability to independently manage my career development'. It should be noted that the PHY2011 students completed this survey before their careers/employability workshop and all of the PHY3072 students had completed the workshop in PHY2011.

Many students are taking physiology subjects because they are prerequisites for graduate programs in medicine and allied health areas

Throughout all of the cohorts, a third of students (32%) selected graduate medicine (average of 22% across all cohorts) or graduate allied health programs (average of 10% across all cohorts) as their top career priority. Graduate medicine and most allied health programs require undergraduate physiology as a prerequisite subject. Therefore, these data are consistent with our hypothesis that the increased numbers of students selecting physiology in the BSc is being facilitated by their career intentions.

Currently, we educate our BSc students to be scientific (physiology) researchers. However, according to our data very few (5% on average across all cohorts) of these students progress into a research career, while a third plan to move into health-related studies and careers. This raises concerns regarding how we are educating our physiology students. Should we instead be educating them to be researchers and also preparing them for graduate health-related programs? One Australian university appears to be following this idea and has rebranded a science degree as a Bachelor of Pre-Medicine Science and Health (Biomedical Research). This degree is marketed as a "3-year degree that provides a solid foundation for those students aspiring to undertake postgraduate study or professional practice in medicine or other health or science related fields" (University of Wollongong). This degree program covers the biomedical science disciplines, research and the scientific process and also subjects like 'Cultural Competence in Health Care Practice' that prepares students for study and work in health-related areas. Similarly, a Biomedical Science undergraduate major was recently created at The Ohio State University for students interested in scientific research and health-related professions. The curriculum includes basic science and clinical research experience, skills development related to work as a healthcare professional (teamwork, problem solving and communication) and a clinical internship (see Gunn et al. 2018).

In the capstone subject of the biomedical major of the BSc at the University of Queensland, they have developed authentic assessments that reflect their students' intended career pathways. Students are required to select one of three assessment streams: Scientific research; Clinical professions (for students pursuing further study in medicine and allied health) or Biomedical industry. They found that about two thirds of students in 2018 selected the clinical stream (Young et al. 2018). This indicates that (like physiology students) the majority of biomedical students are aiming for graduate medicine or other allied health areas. These examples show how a curriculum could be modified such that it aligns with the physiology graduate career outcomes.

With about a third of our science/physiology students at Monash University aspiring to attain a place in a graduate medical or allied health program, a process which is dependent on their academic performance in their undergraduate subjects, it is likely that this will impact on student behaviour and expectations. At our university, we have found that more students are asking for remarking of assessments or querying their exam grades. There are also more students putting in for special considerations and deferral of assessment due dates. There is also evidence that levels of undergraduate science and biomedical anxiety are increasing (Larcombe et al. 2016). Student focus groups have indicated that this anxiety is associated with the competition for the high grades that will enable students to attain a place in a graduate medical program (personal communication, J.Choate). In order to address unprofessional behaviour in our biomedical science cohort, this year we introduced a compulsory professionalism practice code of conduct for the biomedical students.

Limitations and future directions

There are a number of minor limitations with the survey design and administration:

(1) Given that many students selected more than one career priority when they completed the survey, and were thus excluded from the analysis, it would be better to allow students to pick more than one career priority, or to rank them, or indicate their level of confidence for each career option.

(2) A part-time job/employment should also be on the careers list since in the modern workforce, many young people juggle multiple part-time jobs.

(3) It would have been better if we had tracked career priorities of our BSc physiology students in alignment with the increased enrolments from 2011 to 2018, not just from 2016 to 2017.

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(4) There was a lower response rate for the PHY3072 2018 survey. Of the PHY3072 2018 cohort, only 41% of students completed the survey compared to 71% from PHY3072 2017. This was probably due to the nature of the tutorial in which this survey was administered, as it was a revision tutorial, rather than a standard tutorial. This low response rate may have affected the trends observed, when compared to the higher response rate for the cohort of PHY2011 in 2017.

In the future, there is a critical need for tracking of BSc physiology major students graduate destinations, but it is currently unclear how this can be effectively achieved, especially given the large student enrollments in physiology. As physiology educators, we should also aim to embed career and employability skills development into the physiology curriculum.

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