THE UNIVERSITY OF
NEW SOUTH WALES

Maximising Potential in Physics:

Investigation of the Academic Profile of the School of Physics at the University of New South Wales

A project funded by a UNSW Equity Initiative Grant

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Contents

List of Tables

List of Figures

List of Abbreviations

ARC	Australian Research Council	
FTE	Full Time Equivalent	
WLU	Work Load Unit	
MLU	Marking Load Unit	
SSP	Special Study Program (i.e. Sabbatical Leave at UNSW)	
RTS	Research Training Scheme	
IGS	Institutional Grant Scheme	
RIBG	Research Infrastructure Block Grant	
DEST	Department of Education, Science and Training	
APA	Australian Postgraduate Award	
URSP	University Research Support Program	
FRGP	Faculty Research Grant Program	
SRGP	School (of Physics) Research Grant Program	
CATEI	Course and Teaching Evaluation and Improvement/ http://www.unsw.edu.au/learning/pve/catei.html	
APS	American Physical Society	http://www.aps.org/
IoP	Institute of Physics (UK)	http://www.iop.org/
AIP	Australian Institute of Physics	http://www.aip.org.au/
	(Note that the American Institute of Physics also is known as AIP, http://www.aip.org/)	

University Academic Levels and (tenured) staff designations

Level A	associate lecturer
Level B	lecturer
Level C	senior lecturer
Level D	associate professor
Level E	professor

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1. Executive Summary

1.1. Equity Initiative Project – academic profile data collection

The academic profile of the School of Physics has been investigated with support from a University of New South Wales Equity Initiative Grant. A review of this nature is timely in light of the recent report on gender equity at UNSW (Probert et al 2002). The Probert report, "Gender Equity in Academic Employment at UNSW" (Probert, 2002)[1], has had a significant positive impact on the development of University policies to help maximise the potential of women academics. It is clear that currently the average UNSW female academic staff member is different from the average Physics female staff member. In order to investigate why this is the case, quantitative and qualitative data have been collected. These data have improved understanding of the issues relating to women working in a traditionally male profession such as Physics and how their non-traditional career paths and choices have impacted on their academic progression. Both quantitative and qualitative information are necessary for the insightful interpretation of the data, knowledge based development of recommendations and assessment of initiatives.

The quantitative data consisted of statistical data for the period 2001-04, as initial inspection indicated that a snapshot 2004 would possibly be misleading, so data for 2001-3 (averaged) as well as 2004 data has been collected.

The qualitative data consisted of staff and student surveys, staff focus groups, individual (sometimes anonymous) submissions and interviews. Qualitative investigation aids in the insightful interpretation of statistical trends and has also proven invaluable in identifying the often unquantified and undocumented forms of academic work done by both men and women. For example, it has revealed the different practices and approaches academics have toward teaching loads and research work.

In addition to the statistical and qualitative data, *previous investigations* have informed the analysis and development of recommendations. The UNSW School of Physics Staff Equity Review, 1995 (Morrison, 1995) provides comparative data from 1990-94. The UNSW commissioned report "Gender Equity in Academic Employment at UNSW" (Probert, 2002) enables a comparison of the School of Physics with UNSW as a whole. In addition much excellent work has been done in the area of equity in academia, non-traditional fields for women, science and technology, and physics. Information is available from the literature and web (e.g. http://web.mit.edu/gep/ See also Appendix 3 and Bibliography). Literature exploring the changes in academic work in Australia also resonates with the findings of this research. Tertiary education sector reforms have transformed the way universities are organised and managed, changed student to staff ratios, academic workloads, the amount of administrative work done by academic staff, the availability of research

[1] Report available from http://www.equity.unsw.edu.au/ or please contact http://www.hr.unsw.edu.au/services/empequity.html

funding and the relationship between research and teaching (Cain et al 2004, Karmel 1995, Sharrock 2002, Hugo 2004, Currie et al 2000).

1.1.1. Quantitative Data (2001-04)

The following quantitative data have been collected.

- Gender profile/ Demographics
- Workload (by gender and level)

  Teaching and administration
  - Timetabled contact hours (laboratories, tutorials, lectures, course co-ordination)
  - Which courses (service courses, general education, physics major courses)
  - Supervision (1st year physics participation project, 3rd year physics participation project, Honours, Post Graduate)
  - Workload unit allowance

  Research
  - DEST publications
  - Internal research grants ($)
  - External research grants ($)
  - Research grants (number of applications/ number successfully funded)

  Leave
  - Special Study Program (i.e. sabbatical leave), teaching release, maternity, etc

  UNSW Service
  - Committee membership (Physics, Faculty, University).
  - Other quantifiable contributions (e.g. Open days, etc).

  External Service
  - Committee membership/ service in professional societies, conferences, etc
- Recruitment Policy
  - Merit based selection
- Promotion/ Career path
  - number of applications/ number successful
- Comparative Data
  - School of Physics in 1990-94
  - Other Schools and Universities

1.1.2. Qualitative Data (2004)

The following qualitative data have been collected.

- Anonymous Academic Staff Survey.

Demographic information, family responsibilities, career path, promotion, UNSW School of Physics work load scheme, time use, perceptions of gender equity in the School.

♦ Gender specific Focus Groups for academic staff

- Physics men (male facilitator and female note taker)
- Physics women (female facilitator and note taker)
- Individual staff submissions (anonymous or otherwise)
- Individual staff interviews

Points of Discussion: included research versus teaching nexus, promotion, perceptions of gender issues in physics, pastoral care (official versus unrecognised duties), family responsibility, career path, organisational issues.

♦ Anonymous Senior Student Survey (3rd and 4th /honours year)

Demographic information, perceptions of gender issues in physics, factors influencing the choice of research project supervisor, pastoral carers.

1.2. Summary of some results

Academic Staff by Level and Gender

- 21% (FTE) of academic staff are women. This is ~consistent with the feeder group (female undergraduate and postgraduate enrolments).
- 90% of Physics men are associate professors or professors.
- 86% of Physics women are lecturers and senior lecturers.

Qualification and Age Profiles

The Probert Report into Gender Equity in Academic Employment at UNSW (Probert, 2002) found UNSW women tend to be at lower academic levels because they are younger and less qualified (fewer have PhDs). This is not the case in the School of Physics:

- All current School of Physics academic staff have PhDs.
- The average age of both male and female Physics academic staff in 2004 was ~50 years.

Promotion

Physics men apply for promotion more than the women both in absolute and relative terms and are more successful.

Workload Allocation in 2004:

- Every member of Academic Staff is working very hard.
- Some male and female staff consistently teach well beyond their allocated load.
- Teaching and administrative workload is allocated by a transparent algorithm with each Full Time (FTE) member of staff being allocated 555 Work Load Units (WLU) in 2004 regardless of academic level.
- WLU's attempt to give recognition to actual work (including preparation) involved in teaching e.g. *3WLUs=1 hour Lecture = 2 hour Tutorial = 3 hour Laboratory*

- Reductions of teaching contact hours of up to 200 WLU (36%) can be obtained on the basis of external research income, refereed publications and student supervision.
- Most level D and E academics surveyed agreed that the workload distribution scheme was fair and transparent.
- Almost all level B and C academics surveyed disagreed that the workload distribution scheme was fair and transparent.
- Three quarters of academic men surveyed agreed that the workload distribution scheme was fair and transparent.
- All the women academics disagreed that the workload distribution scheme was fair and transparent.

Laboratories

- Levels B and C women and men have at least four times more contact hours than level D and E men during the period 2001-2004.

Tutorials

- Levels B and C women have approximately twice as many contact hours than levels B, C and D men during the period 2001-2004.
- Levels B and C women have approximately three times more contact hours than levels E men during the period 2001-2004.

Lectures

- Across levels and genders the average lecture allocation is approximately uniform within 15%. However women tend to do slightly less lecturing and men tending to do slightly more lecturing and correspondingly less tutorials and laboratories.

Workload allocation

In addition to the number of hours spent teaching and the type of teaching duties (i.e. lecture, tutorial or laboratory), it is important to investigate what staff teach which courses. Over the period 2003-2004, on average:

- Women (21% of staff) taught ~70% of physics service courses
- Men (78% of staff) taught ~30% of physics service courses

- Women (21% of staff) taught ~13% of physics major courses
- Men (78% of staff) taught ~87% of physics major courses

Note that service courses, a large proportion of which are taught by women, are a significant source of the School's income. Staff that teach the physics major courses including the senior physics courses are more visible to physics students and therefore more likely to be chosen as research project supervisors. The distribution of lecturing duties during the period 2001-2004 ensured the interaction between women staff and physics students was peripheral.

Workload allocation: contact hours

When scaled to full time equivalents and averaged over the 2001-04 period, the contact hours for physics women ranged between 190 – 260 hours. In comparison the contact hours for physics men ranged between 75 – 220 hours. These 2001-2004 figures do not include research only academics, staff on leave, nor do they include academics with large administration loads such as Head of School (level E man) or deputy director of the Electron Microscope Unit (level C woman).

Influence of the 2004 algorithm on teaching workload allocations

In general, the implementation of the 2004 algorithm did not result in significant changes in the workload of the level B and C academics (includes all female teaching staff). Physics men, on average, taught a greater number of hours of lectures than physics women, and that combined with the greater reductions males (on average) received for research, publications and supervision, meant that women filled a greater proportion of their WLU allocation with the lower workload value/ higher contact hour tutorial and laboratory classes.

Research

For work load allocation and promotion, research performance is assessed by:

Internal research grants

All but two male members of academic staff have applied for internal (UNSW) research funding during the 2001-4 period. Most staff have applied for close to the maximum available amount of funding. On average the women were awarded ~55% and the men were awarded ~65% of the amount they requested. Recently appointed women had a higher success rate that long term female staff. Funding success of the male staff was not correlated with length of service.

External research grants

Most staff have had some external funding ($10Ks-$100Ks p.a.) at some point during the period 2001-2004 except three level B and C women (i.e. 50% of FTE women). In the period 2000-4, 128 funding applications were submitted through the School of Physics at UNSW to the Australian Research Council and 35% were successful.[2] A total of 20 of the 22 male staff had an ARC funding awarded during this period. In comparison 3 out of the 7 women (i.e. 2.2 of the 6.0 FTE women) were successful. In general the physics women did not apply for external funding at the same rate, nor were they as successful as the physics men.

Refereed publications

Staff (who provided information) publish between 1-12 papers per annum. The number of publications is not a fair basis for comparison of research output as publication rates are discipline specific. Publication rates depend on the physics discipline (e.g. astrophysics, biophysics, etc) and vary widely, however on average

- most Physics men publish more than 5 papers per annum.

[2] Note however that if a UNSW staff member is a partner on successful grant applications with a lead institution other than UNSW, this successful funding may not appear in the School of Physics statistics.

- most Physics women publish less than 5 papers per annum.

The staff with higher publication rates tend to be level D or E academics and those who supervise research students, work as part of a large (possibly international) collaborative group, and/ or have significant research funding.

Number of Research students

During the period 2001-04 Physics women (co-) supervised ~15% of postgraduate students and ~13% of Honours students.

- Average number of PhD/MSc research students supervised p.a. by Physics men ~2.7
- Average number of PhD/MSc research students supervised p.a. by Physics women ~2.0
- Average number of Honours research project students co-supervised p.a. by Physics men ~0.85
- Average number of honours research project students co-supervised p.a. by Physics women ~0.45

Selection of research project supervisors

Some results from the Student Survey

Survey of year 3 and 4 (honours) students shows ~60% of respondents had 2 or less women physics lecturers (i.e. <10% of their lecturers were women)

When choosing a research supervisor

- 100% of respondents strongly/ agreed that it is important to get on well with the supervisor
- ~75% of respondents strongly/ agreed that it is important to have been taught by the academic before
- ~75% of respondents strongly/ agreed that they are more likely to consider an academic that they have had as a lecturer

In addition only one third of the respondents disagreed with the statement "Women exist on the periphery of academic physics". These findings indicate, firstly, that women academics are at a distinct disadvantage in attracting PhD/MSc research students because they do not teach upper level physics courses, and secondly, that the lack of contact between upper level physics students and women academics perpetuates the perception that women are secondary to men in the field of physics.

Sabbatical Leave

The contribution of sabbatical leave to the progress of an academic physicist's research program cannot be underestimated. Prior to 2004 only one of the current physics women had taken a session of study leave. In the period 2001-4, 68% of eligible male staff have taken sabbatical leave. Since teaching release has become an available option at UNSW, 40% of eligible women have taken a six month session of study leave.

This is an improvement from the situation in 1990-94 where 66% of eligible male staff, and 0% of eligible female staff took sabbatical leave during this period.

Factors influencing Career Progression

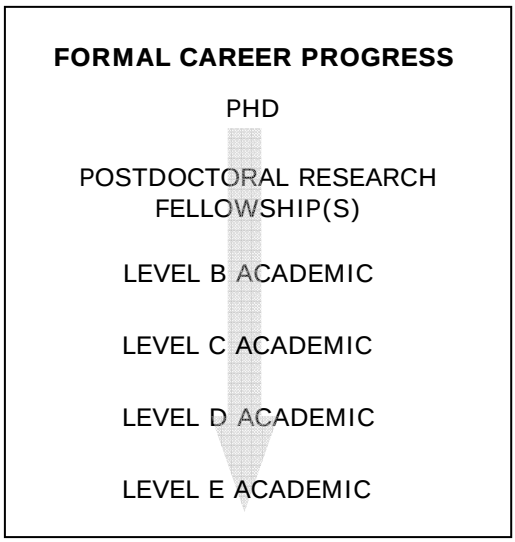
Physics Men have different career paths from Physics Women.

The typical ***Physics man*** has had a traditional career path (see Figure 1)

School → BSc → PhD → Postdoctoral Fellowship(s)/ Fellowship(s) → Academic appointment → Tenure

- Some men have children and most have not been primary carer
- Most men perceive they spend more time on research than teaching
- Most men have strategies to facilitate their research
- Many men have taken study leave

Figure 1. Traditional academic career progression



The traditional academic career progression also typically includes periods of sabbatical or study leave where research projects can be initiated and/ or progressed without interruption from teaching or administrative duties.

The typical ***Physics woman*** has had a non-traditional career path (see Figure 2);

- All women have children and have been/are primary carer at some stage during their careers. This has impacted on their career choices and progression.
- Most women took career breaks (3 months - 8 years)
- Some women have come to academic physics later in life or as a second career
- Most women have not done post doctoral/ research fellowships. Post doctoral/ research fellowships enhance career progression as they allow the opportunity to establish an independent research profile, produce a critical mass of research publications and provide research networking opportunities
- Most women perceive they spend more time on teaching than research
- Most women have not taken study (sabbatical) leave. This has sometimes been because issues related to the needs of their partner or their children (e.g. childcare, reluctance to disrupt schooling).
- Some women have made career choices based on considerations relating to their partner's careers. These partners are usually older, have not had career breaks and therefore are usually more senior and established in their own careers. The choices made by some women in the context of the "two body problem" might not necessarily be best for their career development/ progression.

Based on the findings of this research, women have to contend with external factors and competing responsibilities in relation to their academic careers. The interplay between some organisational and non-organisational (economic/family responsibilities) factors and their effect on career progress was consistently described by women academics as creating "downward spiral". This dynamic can be graphically represented as follows in Figure 2. Note in particular the non-traditional academic career path via teaching (tutor/ academic level A) rather than postdoctoral fellowship.

Figure 2: Factors influencing the career progress of women

1.3. Summary of some key conclusions

Best management practices will maximise the human potential of the academic staff within the School of Physics. Quantitative and qualitative data reveal significant gender related differences in the academic profile and workload distribution in the School of Physics.

Some of the observed gender related differences in the career progression of Physics women can be attributed to

- a "non-traditional" career path in which research is not underpinned by the opportunities provided by postdoctoral fellowships or revitalised by the opportunity of sabbatical leave.
- the marginalisation of women in high contact time, low workload unit, junior level service lecture courses, tutorials and laboratories impeding access to research resources and leading to student perception that "women are on the periphery of academic physics"
- the "snowballing" negative impact of work load allocation with high contact hours means less time for research.
- the generally less effective strategies physics women have dealing with teaching-research nexus in comparison with their male colleagues.
- the (historical) emphasis in promotion of research over teaching and related achievements by the University

Physics women work in a non traditional field, and do not face the same issues as other academic women within the University. UNSW gender equity strategies have been developed from the findings of the Probert report (Probert, 2002) and some programs are directed towards supporting completion of PhDs and the provision of maternity leave/ childcare. Whilst these valuable programs may effectively address the concerns of young or early career academics, they do not address the particular needs of most of the current population of Physics women because these women already have PhDs and their children are generally old enough to no longer need childcare. PhD qualifications are a necessary criterion for academic appointment in the School of Physics, and therefore PhD completion scholarships are not relevant. Childcare needs of Physics academic staff may change in the future as new academic staff are recruited.

During the course of the Physics Equity Project research, consultation with staff has lead to actions being taken prior to official recommendations. For example, the recommendation that a School of Physics Equity Committee be established within the School of Physics committee structure was immediately supported and instigated by the then Head of School, Prof John Storey. In addition, women have been encouraged to plan to take study leave/ teaching release (and some have taken it), and apply for promotion (and some have been successful).

1.4. Summary of some key recommendations

See Section 7 for a more detailed explanation of recommendations.

Many of the following recommendations relate to fostering the research activities of staff. Of course not all staff agree with all recommendations. It is clear however that some staff have been unable to sustain their research because of their high level of teaching, administration and (unrecognised) pastoral activities.

It is also noted that some women were appointed as teaching academics, but all women academic staff members within the School of Physics have PhDs in physics and expressed their strong desire to participate fully in research as well as teaching activities. The difficulty of establishing of a research profile for most Physics women relates to their non-standard career path, where breaks for child rearing, lack of opportunities to do postdoctoral fellowships and take sabbatical/ study leave have impacted through out their careers.

Postdoctoral fellowships enable a researcher to build up research networks, establish a publication record, apply for grants, and develop a research leadership profile. Most Physics women have not done postdoctoral fellowships, unlike the majority of their male colleagues who have followed a more traditional career path (see Figure 1 for example), which includes postdoctoral appointments and sabbatical leave and the opportunities to concentrate on and refresh their research program. Those women have subsequently not been promoted at either the rates or to the levels of their male colleagues. There is no evidence that these women are less able or less talented, however there is evidence that they have had less opportunity to succeed. Because they did not do post doctoral fellowships, their research profile was less established, they therefore had less initial and subsequent success attracting research funds and therefore were given a greater teaching load than their well funded research active colleagues. This situation can - and there is evidence that it has - become self perpetuating.

1.4.1. Summary of Recommendations relevant to the School of Physics

Establishment of a School of Physics Equity Committee.
This was achieved during the early stages of this research project in 2004 as a result of consultation with the then Head of the School of Physics, Prof John Storey. The School of Physics is currently the first and only School in the Faculty of Science with an Equity Committee.

Access to various types of leave should be equitable.
Staff who have not had the benefit of SSP (sabbatical leave), internal/teaching release and other leave etc, should be encouraged to take these opportunities to revitalise their research. Staff who have not had the benefit of SSP, teaching release and other leave entitlements should be given priority over staff who have made frequent use of these programs in the past. Staff should be better informed of their entitlements. A formal process for application and approval for SSP etc, should be developed within the School to ensure equity.

Development of School of Physics mentoring strategies within the Career Development Scheme
The aim of this program would be to provide staff support in setting up and balancing research, teaching, and service commitments.

Review of Workload Allocations Scheme - More equitable distribution of teaching duties.
A more equitable distribution of formal contact hours as well as teaching activities is recommended. Staff should be allocated an ***equal proportion*** of lectures, laboratories and tutorials. The current WLU Scheme does not provide a mechanism to improve a research profile/ become research active.

Review of Workload Allocations Scheme - Recognition of new teaching practices.
The workload allocations scheme should be regularly reviewed to reflect and encourage new teaching practices.

Review of Workload Allocations Scheme – Internal research grant funding.
An allocation for competitive internal research funding (e.g. School Research Grant program, Faculty Research Grant Program) should be included in the workload allocation scheme.

Recognise Women in Physics
The profile/ recognition of women in physics should be improved. It is recommended that properly framed biographies of some high achieving women physicists should be displayed in prominent positions in the School of Physics corridors.

Equity in School committee membership.
It is desirable that female staff be represented on key decision making committees in preference to the more administrative type committees. In particular, it is

recommended that there should be an Equity Committee representative on the committee that allocates undergraduate teaching duties.

Development of School of Physics recruitment policy
Affirmative action is not recommended but a recruitment policy mindful of equity issues could increase the diversity and ensure proportionate gender representation in the School.

Equity in allocation of technical support.
Some academic staff have the additional benefit of technical support within their research laboratories which has to some degree been funded from the School budget. Any allocation of technical support paid from the School budget should be on the basis of a transparent process.

Reduce the cost of buying out teaching
In 2005 the cost of buying out one WLU is $135, which is prohibitive in most cases. The possibility of buying out excessive lower WLU value/ high contact hour laboratory and tutorial duties or the provision of a strategy that would allow staff with large teaching loads to reduce some of their laboratory and tutorial duties is desirable (subject to approval by the Head of School). This is emphatically not a recommendation to allow well funded individuals with relative low teaching loads to buy out the rest of their teaching.

1.4.2. Summary of recommendations relevant to the Faculty or University

Recognition of service and pastoral activities
Those involved in essential but unrecognised pastoral activities have less time to do research.

UNSW Career Advancement Fund - Equity Initiative research start up fund.
A program which would provide funding to revitalise research program would be beneficial to some physics women and help aid their career development. The recipient of funding should be required to submit an external funding grant application within 12 months of receiving the funding.

Carer Assistance Fund
Assistance for academics on study leave schemes could be extended to cover carer as well as child care responsibilities.

Equity in committee membership at Faculty and University levels.
It is desirable that female staff be represented on key decision making committees.

Promotion at UNSW
Demonstrated and genuine recognition of teaching and service in the promotion process would encourage more staff to apply, and would result in more successful applications. The University has recognised the shortcomings in the promotion system

that has contributed to inequality of opportunity for promotion as evidenced in the School of Physics. For example new promotion guidelines have and are being developed, that give more equitable recognition of teaching contributions.

It must be recognised that staff that do a greater proportion of teaching and service work indirectly support the research efforts of their colleagues who have more time and opportunity to devote to research.

Notes

As a result of the consultative processes during the compilation of data, prior to submission of the final report, a number of the recommendations have been enacted. The School of Physics staff have had the opportunity to discuss the recommendations and most of the recommendations have been agreed to with the support of the then Head of School, Prof Warrick Couch.

For example, as described above, a School of Physics Equity Committee has been established. Representatives of the School of Physics Equity Committee have been invited to attend key decision making School of Physics meetings such as those involved in teaching allocation. The recommendation that women be encouraged to take the opportunity for sabbatical leave/ teaching release is also being actively implemented. For example two women took study leave and teaching release in 2004, one took teaching release in 2005, and another woman will take study leave in 2006. In addition it is noted that the three Physics women Lecturers (level B) have been promoted to or appointed at Senior Lecturer (level C) during 2005 and one Senior Lecturer was promoted to Associate Professor (level D) during 2006.

2. Context and Background

2.1. Women in Science and Academia: Context and Concerns

2.1.1. Introduction

A broad and comprehensive collection of quantitative and qualitative data relating to the academic profile and the academic staff of the School of Physics at UNSW has been collated and presented in this report. This investigation has revealed significant gender related differences including but not limited to teaching workloads, time management, attitude to the service-teaching-research nexus, level of research student supervision, success in obtaining research funding and producing research output (including peer reviewed publication). These differences can to some degree be related to the non-traditional career paths of the majority of the women in the School of Physics.

The School of Physics data particularly relates to mid to late career rather than early career academic women. Mid to late career women in particular have experienced disadvantages throughout their career. For example, all of the physics women are mothers, and many of them did not have access to the (generally inadequate) childcare services available today which are still generally do not meet demand..[3]

The collected data has identified specific issues and has allowed the informed development of a series of recommendations (see Section 7). These recommendations have been developed with reference to the extensive literature on women in science, some of which is discussed in this section.

2.1.2. Women in Science and Academia: International programs and context

Biological determinism has been used as recently as 2005 to explain why women do not perform at the same level as men (Summers, 2005). Generally however, the value of women academic scientists is not in dispute in the 21st century, and it is recognized that “rather than confronting open opposition from institutions, (women) are struggling with subtle inequalities stemming from the unconscious attitudes of individuals” (Lawler, 1999), and the unintended cumulative disadvantages due to policies and procedures developed in the context of a traditional career path. A traditional academic career and the perception of what constitutes “competence and success” in academia has been established around the life experiences of men. Bailyn discusses how these perceptions may be social constructions rather than necessary attributes of an academic career, and may lead to “unintended negative consequences”

[3] For example, UNSW childcare services are oversubscribed.

for women academics (Bailyn, 2003). The cumulative effect of slight inequities for women impacts on their academic progression relative to their male colleagues.

Within the past 10 years in particular, a number of government sponsored programs have been developed internationally to improve the participation, retention and advancement of women working in science and engineering. The development of these programs has been motivated by economic (human resources) and ethical considerations. Some notable examples include

- Chairs for Women in Science and Engineering backed by Natural Sciences and Engineering Research Council of Canada (NSERC) was introduced in **1996** to increase the participation of women in science and engineering and to provide role models for women active in and considering careers in these fields. NSERC matches funding provided by corporate sponsors to support academic women scientists or engineers in Canadian Universities for up to 8 years.
  http://www.nserc.gc.ca/programs/wise_e.htm
- Professional Opportunities for Women in Research and Education (POWRE) grant program initiated in **1997** in the USA has been replaced by the Advance funding program (**2001**) of the National Science Foundation (NSF).
  http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5383
- Athena Project (**1999**) is an initiative of the United Kingdom government with the backing of the Office of Science and Technology.
  www.athenaproject.org.uk/
- European Technology Assessment Network (ETAN) projects on developing science policies for the European Union which promotes excellence through mainstreaming gender equality (**2000**).
  http://cordis.europa.eu/improving/women/documents.htm

These formal government sponsored programs and initiatives have been developed in recognition of the general failure across society to fully engage half the world's human intellectual capacity: Women have been identified as the "*biggest single most undervalued and therefore under-used human resource (in science, engineering and technology)*" (HSMO, CM2250, 1993) The push to engage women in science is seen as an economic as well as an ethical imperative, as it is seen as economically desirable to provide a return on the training investment by retaining women who have qualifications in science and engineering. These national programs aim to improve the participation of women in Science and Engineering by addressing issues of promotion, recruitment, retention, and facilitating partnerships with industry, enabling flexible work practices allowing a work-life balance, improving the visibility of women and enhancing the confidence of women by development and mentoring programs. Some of these programs have resulted in measurable successes at the grass roots level[4].

[4] For example Advance funded recruitment and retention programs at the University of Michigan in the USA have improved the hiring of tenure track academic women from ~14% to 34% over a five year period to 2005. (http://sitemaker.umich.edu/advance) These programs have been integrated into the institutional structure. The Advance program at the University of Washington, WA USA, has concentrated on career development, mentoring and leadership. UoW has institutionalized programs supporting these initiatives, and have received a US Presidential Mentoring Award for their efforts *(http://www.engr.washington.edu/advance/)*

The European Technology Assessment Network (ETAN) has developed science policies for the European Union. The ETAN Report on Women and Science (Osborne, 2000) addresses the need to transform the treatment of women in science at all levels, from treating individuals with *equality* (equal treatment with respect to salary, etc), to instituting *"positive action"* programs which address particular problems that women as a group experience (child care facilities, re-entry programs, family friendly policies etc) and extending to *gender mainstreaming* which focuses on altering the systems and structures themselves transforming organisations to accommodate their diverse population of men and women (i.e. changing institutional practices). The ETAN Report (Osborne, 2000), has identified that the equal treatment approach that underpins European Union legislation is "necessary but insufficient" to allow women to take an equal role in science. Gilbert argues that science, technology and masculinity are enmeshed and educational programs which aim to produce equality or "sameness" between the genders as a way to address the "problem of women in science" do not recognize diversity (Gilbert, 2001).

While many of the programs concentrate on the recruitment of women into academic positions, there is recognition that accurate statistical information about the participation and retention of women within individual institutions is essential before the causes can be investigated and effective programs can be developed to address the imbalance.

Women leave scientific careers in disproportionate numbers at every stage of their careers (Rees, 2001). Rees attributes sex stereotyping, exclusionary mechanisms and patronage and nepotism for the observed attrition in the participation of women in science (sometimes referred to the "leaky pipeline" (Osborn, 2000)), and for their generally less successful career trajectories in terms of level and pay when compared with their male colleagues (Rees, 2001). Gender-disaggregated statistics are identified as an important management tool to aid gender mainstreaming and realising the more effective use of (all) human resources.

An awareness of an inequitable situation can be a motivation for grass root change within a department staffed with fair minded sympathetic individuals; however the importance of the role of leaders in fostering a fair and equitable workplace is seen to be paramount. The importance of leadership was highlighted by the ground breaking Massachusetts Institute of Technology (MIT), USA study where the sympathetic Dean of Science, Prof R. J. Birgeneau, (a condensed matter physicist), was seen to be "the hero" who listened, and recognized problems were "systemic" and then worked tirelessly and effectively for institutional change (Lawler, 1999). It is noted without further comment that Prof Birgeneau is the father of three daughters.

At the conclusion of the study the MIT President, Prof C.M. Vest admitted in 1999 that the university had been guilty of systematically depriving distinguished women scientists of resources, and he made an institutional commitment to improve this situation. It is interesting to note that the junior/ early career women had fewer complaints than the senior women. The more senior women have a longer experience in the system and have felt the cumulative effects of being isolated, marginalized (in

terms of status, access to research resources, and decision making) and have been pushed to do more teaching than research. It is also significant that because of their "poor quality of life" the senior women can "actually become negative role models for younger women" (MIT, 1999). There is a strong resonance with this situation in the School of Physics at UNSW. The women appear marginalized or as peripheral staff members to the student body. One example of why this is may be the case is because the women generally do not lecture senior physics courses. The women teach between two or three times more laboratory and tutorial classes than their male colleagues. Tutorial and laboratory classes which are also taught by honours and postgraduate students are perceived to be lower status teaching duties compared with (senior) lecture courses.

The MIT study lead to public hearings at US Congressional committee level, and focused attention on the status of women in science in the USA and elsewhere. Following a special meeting of nine US research universities in 2001 (including MIT, Harvard, Caltech, Stanford, Yale, Princeton and others) a statement was released recognizing that barriers still exist; "Institutions of higher education have an obligation, both for themselves and for the nation, to fully develop and utilize all the creative talent available." (MIT news office, 2001) See also Rosser, (Rosser, 2003).

The unintended consequences of seemingly minor differences in the impact of practices and policies established in the context of a traditional career path can adversely impact on and reverberate throughout a non-traditional career. The "Women, Work, and the Academy" Conference (Women, Work, and the Academy Conference, 2004) highlighted the effects of "a diffuse set of barriers to women's participation: small scale, often unintended differences in recognition, support, and response that can generate large scale differences in outcome for women." Transparency in the policies and practices of the organization is seen to be crucial to improving the situation of women. Female (and male) staff members need to be aware of the opportunities available to them to be able to reach their full potential (Sargent, 2001).

In addition to the cumulative effect of minor differences in the impact of policies and procedures, the influence of unconscious bias may also be significant. A brief overview by Handelsman et al (Handelsman, 2005) has described the barriers to women in science and strategies developed to help address them in the University context. This report noted the effect of unconscious bias where people unintentionally or inadvertently behave in a discriminatory manner. Examples are given of studies where resumes, journal manuscripts etc., were given lower ratings on average if they were believed to be authored by a woman rather than a man.

In addition to national (government) and institution based initiatives, professional scientific societies have recognized the need to improve the representation and retention of professional women in their disciplines. For example, due to concern at the relatively small percentage of female physics students and staff, some active women members of the American Physical Society (APS; the American professional society for physicists), designed its "Climate for Women Site Visit Program" with the support of the APS. This program has been developed to help physics departments improve the "chilly climate" that women in physics sometimes

experience in the workplace. Upon request for a site visit, the team of women physicists confidentially evaluates the effectiveness of a physics department in supporting their women by interviewing the staff and students.[5]

2.1.3. Women in Science and Academia: Australian programs and context

In Australia the Office for Women of the Federal Government contributes to gender equity through national policies and strategies that promote gender equality for women and enhance women's status in general. Australia does not have specific government sponsored programs targeted at women participating in science or engineering, such as the Canadian NSERC WISE chairs or the NSF Advance program in the USA. The Australian Office for Women has an information program entitled "Women in Science" aimed at encouraging female secondary school students to consider a career in science.[6]

The Universities Australia[7] which is the organization of Australian University Vice Chancellors/ Presidents has officially endorsed an action plan to support an inclusive culture and improve the employment situation for women working in Australian Universities[8]. Critical targets relevant to this work include the commitment to increase women at Level E from 16% in 2004 to 25% by 2010; and to increase women at Level D from 24% in 2004 to 35% by 2010.

Unfortunately neither the School of Physics nor UNSW have reached the 2004 targets. In 1995 the representation of women on academic staff generally was 26% (Gray, 2003) which increased to ~29.5% of UNSW academic staff in 2004. In 2004, 15.8% of Level D academic staff and 11% of Level E academic staff were women[9]. UNSW was also one of the lowest ranked Australian universities with respect to representation of women in Academic staff. In particular, in 2004 UNSW with representation of women in academic staff of ~30% (excluding the Australian Defence Force Academy, ADFA[10]) was below the national average of ~40% and below other Go8 universities including the University of Sydney, University of Melbourne and Monash University which all have levels exceeding 40% (Winchester, 2005).

Various innovative programs developed by the UNSW Equity and Diversity Unit[11] have encouraged and supported women to apply for promotion and there is

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5 http://www.aps.org/educ/cswp/visits/summary.cfm

6 (http://ofw.facs.gov.au/women_in_science/index.htm).

7 Formerly known as the Australian Vice-Chancellors' Committee (AVCC)

8 The Australian Vice-Chancellors' Committee Action Plan for Women Employed in Australian Universities 2006-2010 can be downloaded from http://www.universitiesaustralia.edu.au/content.asp?page=/policies_programs/women/index.htm

9 (IAR UNSW, 2004) see http://www.planning.unsw.edu.au/.

10 The representation of women academic staff was <20% at ADFA in 2004 (Winchester, 2005)

11 In 2007 the Equity and Diversity Unit was disbanded. Human Resources has responsibility for all equity and diversity issues relating to employment at the University, while the Student Equity and Diversity Unit in the Division of the Deputy Vice Chancellor (Academic) has responsibility for all equity and diversity issues relating to students at the University.

good evidence that this is having a real impact. For example, in 2005 UNSW women's representation had increased to 31% with women comprising 19% of Level D academic staff and 13% of Level E academic staff.[12] In addition the representation of women on academic staff has marginally increased from 26% in 1995 (Gray, 2003) to ~29.5% of UNSW academic staff (including ADFA) in 2004. (IAR UNSW, 2004)

When investigating the reasons for the lower representation of academic women in the senior academic levels, Probert report (Probert, 2002) found that on average UNSW academic women tended to be younger than their male colleagues and less qualified (i.e. a greater proportion of male academic staff have PhD qualifications). Further it was found that at UNSW in general more women than men did their postgraduate degrees on the job and part time over an extended period. In general men tended to be better qualified on appointment. The level of entry appointment and the qualifications at appointment were found to be correlated with subsequent academic progression (Probert, 2005). In the School of Physics, all academic staff have PhD qualifications, and this has been the minimum standard for an academic appointment in the School for many years. Some of the Physics women were appointed to junior academic level teaching intensive positions shortly after they were awarded their PhD in physics. These women had not completed a postdoctoral fellowship prior to their appointment, and therefore had not had the opportunity to develop a research publication profile. In contrast the male academic staff members were more likely to have completed a postdoctoral fellowship prior to their appointment. The data collected in this report shows that the completion of postdoctoral research fellowship(s) prior to appointment is correlated with subsequent academic progression. The subsequent strong connection between research performance and promotion tends to further disadvantage women. Advancement in an academic career is linked in part to early career "choices"

In the Australian context, the introduction of corporate managerialism in the university sector over the past 10 years and growth of the international export market in higher education has impacted on academic workloads and careers (Lafferty, 2000). Institutions whose aims were previously aligned with research and education have been transformed by the introduction of an economic rationalist approach where students contribute to the costs of their education directly or via a levy on their subsequent income. In addition full fee paying (including overseas) students are given university places, and research funding is driven by the needs of business. The previous collegial forms of management have been replaced by hierarchical line management with perceptions amongst academic staff of both a significant increase in administrative work load (including clerical duties) and a lack of consultation on the management of core academic tasks including research and teaching.

The senior management profile of universities in Australian is generally not diverse. This may have a negative impact on women and other minority staff who are not represented in significant numbers in senior management. The negative impact may occur as a result of a lack of awareness: men tend to be unconscious of their own gender and assume masculine work habits are the standard. Gender tends not to be an

[12] Equity and Diversity Unit, UNSW. Update On UNSW Gender Equity In Academic Employment Project, July 2006, http://www.equity.unsw.edu.au/ or please contact http://www.hr.unsw.edu.au/services/empequity.html

issue for men because University policies, practices and promotion structures have been developed around the circumstances of men, who originally made up the vast majority of academic staff (Chesterman, 2003).

Academic staff who are well educated and able people, are significantly motivated by interest in their work and the "academic freedom" to pursue it: remuneration is not necessarily a major driver for Australian academic staff. The reduced autonomy and decreased opportunity to pursue research reduces the morale and commitment of academic staff. There is also evidence that women academics have suffered disproportionately under these market driven organizational structures despite legislated Equal Employment Opportunity (EEO) policies, as emphasis has shifted from equity to "efficiency" (Lafferty, 2000).

Performance indicators based on benchmarks relating to research output, can disadvantage staff with family (child or carer) responsibilities and in particular those (women) staff who have experienced interruptions in their research careers to have children. While teaching, administration and family responsibilities typically cannot be postponed, research programs are more flexible and can be deferred and therefore tend to suffer. Women with children reported that their research was suspended when they were overloaded with other aspects of their academic duties (teaching and administration) and family responsibilities (women tend to have primary responsibility for childcare). When UNSW academic staff were asked what was needed to facilitate their research output, ~50% of the women compared with ~35% of the men nominated teaching release. (Probert, 2005).

In agreement with Probert et al, (Probert, 2002), UNSW Physics staff noted the increase in working hours. Working on weekends and evenings was seen to be necessary by many staff to keep up with the sheer volume of work to be done and the lack of time or opportunity to do it during nominal "working hours". A number of studies (Lafferty, 2000), (White, 2003) confirm that Australian university staff perceive that academia has become a more stressful and demanding workplace. The teaching and administrative workloads have increased, including office work (including for example, data entry and photocopying) which had previously been done by office support staff. The extra teaching, administrative and office workloads are coupled with the same (or heightened) expectations of research output. The increasing workloads in higher education has resulted in an increase in stress levels, particularly as the increased duties are either not recognized by promotion panels and/ or take away time for research. In addition the workplace organizational structure has changed within Australian university sector in response to funding, from a collegial to a more corporate structure where decisions are made by senior management, and staff feel they have less control over their lives (Lafferty, 2000).

2.1.4. Women in Science and Academia: Work-Life balance

Consistent with the perceptions of younger UNSW academics, recent US studies show that female academic staff aged in their twenties and thirties are less likely than lawyers or medical doctors to have children because of the volume of work required, despite the supposed flexibility of academia (Wilson, 2005). Furthermore a

national study conducted by the University of California in 2003 found that women academics were less likely to have children than their male colleagues, and were more likely to be single, or single with child(ren) (Wilson, 2003). Significantly Probert (Probert, 2005) found in a national study of the Australian academia, that ~90% of the female academic staff had partners in full time employment, while for male academic staff this figure was less than 60%.

The 2001 International Study of Women in Physics surveyed women physicists from 34 countries. The demands of a physics career precluded a significant number of women from marrying or having children. (Ivie et al, 2001). This extensive international survey found that one third of women physicists over age 45 from developed countries did not have children.

The issue of the dual career (or the "two body problem" using a physics analogy) can impact on the career of scientists. The traditional academic career is predicated on a single career family, however a dual career family is increasingly common (This is particularly the case for younger staff at UNSW, where Sydney housing prices necessitate a dual income). Many female physicists have physicist partners (for example in the School of Physics at UNSW, 60% of the women are married to academic physicists, and the remainder have either scientist or engineer partners). In contrast because of the relatively low percentage of women physicists, the partners of male physicists are generally not female physicists. In general women tend to be younger than their partners, and if there are children the woman is more likely to have taken career break(s) to look after them. The women therefore tend to be less senior than their male partners. As the junior partner, job choices (and opportunities to take sabbatical leave) may be restricted due to consideration of the more senior partner's (better paid, more established) situation. For example, in a dual career survey conducted by the American Physical Society, it was found that ~50% of women physicists are married; and ~70% of these were married to other scientists while in contrast <20% of male physicists were married to other scientists. I t was also found that 45% of the married women physics were married to other physicists, while in contrast only 4% of male physicists were married to women physicists. Approximately 85% reported they had experienced some adverse impact on their career goals due to dual career issues.[13].

Despite the acknowledged difficulties with balancing children and career, all the School of Physics women are mothers (of between 1 and 4 children). While the majority of the current School of Physics women academic staff members have children in their teens or older, the need for work based childcare is strongly supported by physics women. Many of these staff have experienced negative impacts on their careers because of problems with of childcare (availability, location, cost, etc). At UNSW there is a undersupply of workplace based childcare for which there is a long waiting list. UNSW women staff members report being having been on the waiting list "for years". The undersupply of suitable childcare facilities disadvantages the career progression of the primary caregiver, and also discourages the recruitment or retention of primary caregivers (i.e. usually women).

[13] http://physics.wm.edu/dualcareer.html

The report of Probert et al (Probert, 2002) indicated that some younger UNSW academic women felt that an academic career was incompatible with having children. This is opposite to the experience of some UNSW academic men (Gray, 2003) and some of the Physics men (see Section 5.5.5) who acknowledged the support of their partners enabled them to combine/ balance a successful academic career with having children. Many of the women in Physics were unable to take career enhancing overseas postdoctoral fellowships and sabbatical leave because of the combination of their childcare responsibilities and their partner's commitments.

A study of British and Swedish women physicists concentrating on career progression rather than recruitment highlighted the fact that while the postdoctoral period is critical for establishing a career, but it is also the period when most women are having their children (Hodgson, 2000). This contrasted with the situation of some of the Physics men who attributed their success to the support of their partners who were able to accompany them and/ or care for their children during overseas (postdoctoral or sabbatical) research postings. From the international perspective, male academic physicists routinely have families but women find it much more difficult, and either opt not to have families or experience difficulties with their career progression. (Bailyn, 2003).

Family friendly policies which assist staff to achieve a work-life balance are sought after by prospective employees (men and women) and enable the best staff to be recruited and retained. For example the University of California "Faculty Family Friendly Edge" is an initiative designed to develop and implement a comprehensive package of innovative work-family policies and programs for junior faculty in the University of California system[14]. The aim is to "recruit the best and brightest". The initiatives include recruitment policies, childcare, re-entry programs, family friendly scheduling, flexible part time working options, etc.

The UNSW Gender Equity Project reference group has developed a range of excellent initiatives and recommendations to improve the profile of women academic staff at UNSW and work towards a more gender inclusive and family friendly culture. These initiatives, reports and updates are listed on the UNSW Human Resources website[15], and include child care support for women to attend conferences, "start up" funding for women returning from maternity leave, promotion workshops, etc.

2.1.5. Women in Science and Academia: Attitudes and interactions

Advancement in an academic career is linked in part to early career choices and policies and procedures but is also impacted upon by the attitudes and work practices of the individual. Women's progression may be undermined by the "subtle inequalities stemming from the unconscious attitudes of individuals" (Lawler, 1999). Some of these attitudes may be those of the women themselves.

[14] (See http://ucfamilyedge.berkeley.edu/press.html for an excellent list of papers pertaining to family issues in academia).

[15] http://www.hr.unsw.edu.au/services/equity/epolicies.html

As both women and men typically perceive women to be more nurturing and approachable, it is sometimes implicitly expected that the women assume the pastoral work. Students may also approach women staff in preference because of this perception. Pastoral care can be very time consuming but is hard to quantify. It is also undervalued in the promotion process. (Chesterman, 2004). It was found that some UNSW women physics staff had an attitude of "duty of care" to students and were available for individual student consultations virtually on demand. In contrast some of the UNSW male physics staff had a more strategic approach to this aspect of student pastoral care, setting regular consultation hours so that they were able help their students, but also planning periods of time for their research that were less likely to be interrupted. While it is of course important to maintain some flexibility, there is evidence that the structured approach to time management employed by some of the male staff has enhanced their research productivity and thus their career progression.

Women are believed to be less effective in promoting their own achievements. They have (naive) faith that if they produce high quality work, it will be recognized and rewarded (White, 2003). This may be a contributing factor in the reduced promotion rate of Physics women relative to their male colleagues. Data obtained during the course of this research has given some women a real knowledge of their situation relative to other colleagues in the School. This may have contributed to an increase in confidence that has lead to women to apply for promotion, request teaching release/ sabbatical leave for research renewal, and request "start up" research funds. There is a now a better recognition that if "you don't ask, you don't get" and that women need to be stronger advocates for themselves.

The MIT study found that "women are often the harshest critics of other women…for fear they will reflect badly on all women" (MIT, 1999). In the School of Physics at UNSW, the women were generally as mutually supportive of each other as time permitted. The Physics women were wary of being seen as "troublemakers" or to "complain" about their situation. The workload allocation system in Physics is transparent and nominally equitable (i.e. every staff member is assigned the same number of workload units). The data collected for this research have revealed significant differences in the allocation of types of duties. While ~95% of UNSW School of Physics academic staff were formally deemed research active during the time period of data collection, this data also demonstrate that the (mostly female) teaching intensive academic staff underpin the research output of the School by freeing up the (mostly male) research intensive academic staff from significant amounts of formal teaching duties (laboratory and tutoring classes in particular), and associated unquantified student pastoral care. It is significant that every School of Physics academic staff member has a passion for and a strong commitment to their own physics research, which they pursue to the best of their ability within the limitations of funding and the availability of time.

The process of Equity Initiative Grant (EIG) data collection in the School of Physics has enabled the staff to have a better appreciation of the situation of their colleagues. Some male staff now have a better understanding of the extra issues that have confronted their female colleagues because of their home based responsibilities and non-traditional career paths. Some women have expressed the opinion that they appreciated the opportunity the EIG project has given them to discuss these issues

with their female colleagues. Balancing career and family responsibilities is a major challenge for families and often female scientists perceive they have compromised in both areas.

Many international studies of women in science and engineering have stressed the importance of setting up networks of support for women particularly in male dominated disciplines where the relatively few women may feel isolated (For example see the UK Athena programs instituted by Queen's University Belfast, and Oxford University). This is considered particularly important for women in disciplines which have been traditionally dominated by men, such as engineering and physics where the percentage of women continues to be low. There is evidence that women cope with stressful situations using "tend and befriend" mechanisms and can gain support particularly from female colleagues in similar situations (Taylor, 2000).

In addition to the acknowledged benefits of networking, mentoring is also valuable as it provides information on processes, constructive feed back on performance, and advice and guidance (Gray, 2003). Mentoring is identified as very important in the success of academic careers. Mentoring is more effective if there is empathy between mentor and mentee, but such opportunities are not always available. Formal mentoring programs have been identified in many international reports as of great value in encouraging and nurturing women academic staff (Oxford University, Athena Report and Action Plan, 2001).

2.2. Background

2.2.1. School of Physics Gender Equity Project

In 2004 a UNSW Equity Initiative Grant was awarded to fund research into the development and assessment of initiatives to address the under-representation of women in senior academic positions in the School of Physics. As part of this process, a research project was designed to develop a gender profile of the School, investigate factors that may impact on teaching, research and employment activities of academic staff and recommend strategies that would address any identified issues. Comparative and contextual data was provided by a previous study of the academic profile of the School of Physics for the period 1990-1994, by Jane Morrison completed in 1995 (Morrison, 1995). The results of the current research may also be used in a wider context via the dissemination of relevant and appropriate recommendations to other Schools and Faculties in UNSW and other universities, nationally and internationally.

The School of Physics Gender Equity Project exists within the larger context of the UNSW Gender Equity Project, begun in 2001 with the commissioning of the investigation into the employment patterns of staff across UNSW (Probert, 2002).

2.2.2. International Physics

A brief contextualisation of the gender profile of physics is required on several levels. Physics is a non traditional area for women and women make up a relatively small proportion of professional physicists. Women's membership of the professional

physics societies in the USA, Australia and the UK give some indication of the profile of women in physics internationally. As the 2005 figures below show, the proportions are small (data supplied by the respective societies following a direct request for information);

American Physical Society (APS) ~10% (membership 43,000)
Australian Institute of Physics (AIP) ~17% (membership 1,550)
Institute of Physics (UK) (IoP) ~18% (membership 33,000)

In Australia, the post doctoral/ research fellow pool is the major feeder group from which academic physicists are recruited. Australia wide data indicates that 24% of postgraduate physics students are women (Jennings, 2003). In the UNSW School of Physics in 2004, women comprised approximately 25% (14 out of 55) of PhD students and almost 10% (4 out of 35) post doctoral/ research fellows. It is noted however that the postdoctoral population is relatively mobile and in 2002 for example, ~23% of post doctoral/ research fellows were women.

The percentage of full time equivalent (FTE) female academic staff in the School of Physics (21%) is comparable to the number of female postgraduate students and postdoctoral research fellows at UNSW and nationally. Increasing the percentage of women staff beyond what is available from the feeder groups may not be possible nor it may be argued, desirable. Increasing women's participation in academic staff may need to be preceded and underpinned by an increase in women postdoctoral, PhD graduates and undergraduate students. The demonstration of successful academic careers for women is necessary to support an increase in enrolment of women in academic physics programs. The perceived peripheral participation of academic women in physics does not provide a good model to prospective female physics students and will discourage enrolment by women in senior physics courses and postgraduate programs.

2.2.3. Australian Academic Physics

Table 1 below compares the Physics staffing situation at UNSW, other Group of Eight (Go8) Universities[16] and other selected Australian universities. On average the female staff in most of the university physics departments tend to occupy less senior levels than the male academic staff. This is certainly the case at UNSW. In contrast in 2005, the University of Sydney had three professors and one associate professor who are women (i.e. almost half of the senior physics academic staff are women). The career progression of these women academics vary: the associate professor was appointed at a more junior level and has been promoted through the system; one of the three professors was appointed at professorial level within the last 5 years and was subsequently awarded an ARC Federation Fellowship; the second professor was promoted to professor upon receiving her ARC Federation Fellowship; whilst the third professor is an ARC funded research only academic and has been

[16] The Group of Eight is a formal grouping of eight likeminded research intensive Australian Universities http://www.go8.edu.au/

promoted through the University of Sydney system.[17] Macquarie University also had excellent representation of women in senior academic levels in 2005 with three associate professors who are women such that three quarters of the senior physics academic staff are women. In 2005, the head of department was a woman. The senior women have all been appointed at more junior levels and have been promoted through the Macquarie University system.[15]

Table 1: Gender profiles of Physics Schools / Departments in some Australian universities

University	*Academic staff*		*% women*	*level D & E*		*level A, B & C*	
	men	women		men	women	men	women
UNSW	22	6(FTE)	***22***	19	1	3	5(FTE)
ANU	16	4	***20***	7	0	9	4
UMelb	18	4	***22***	11	2	7	2
USyd	17	5	***23***	9	4	8	1
*UAdel	14	2	***13***	10	1	4	1
UWA	13	0	***0***	7	0	6	0
UQ	18	2	***10***	9	1	9	1
**Monash	23	4	***15***	14	2	9	2
Macquarie	7.5(FTE)	4	***35***	1	3	6.5(FTE)	1
RMIT	20	2	***10***	9	1	9	1
QUT	13	1	***7***	2	1	11	0
UTS	7	2	***22***	4	0	3	2

Adapted from (Foley, 2005)
**Physics and Chemistry combined department. Only Physics academics are listed here.*
***Physics and Materials combined department. Only identified Physics academics are listed here.*

2.2.4. UNSW and Academic Physics

The 2002 gender profile of academic staff at UNSW compared with the academic staff in the School of Physics is shown in Table 2. All male academic staff in the School of Physics are 1.00 full time equivalents (FTE). In 2002 one female academic staff member in the School of Physics had a 0.8 FTE fractional appointment. In 2004 there was one 0.8 FTE level B and one 0.2 FTE level C. The remaining 0.8 FTE responsibilities of this level C academic were externally assigned to the UNSW Electron Microscope Unit which is a research and research training unit supporting advanced microscopy within the UNSW.

[17] Private communication from University of Sydney physics staff member.

Table 2: Percentage of UNSW and Physics male and female academic staff at each level (2002).

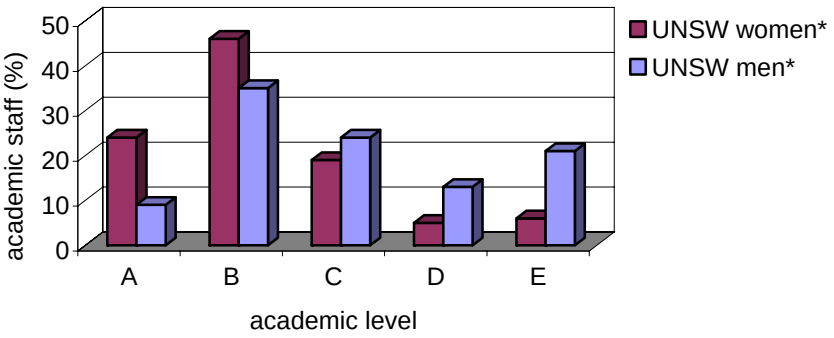
level	*UNSW women* 28%*	*UNSW men**	*Physics women ~20% (FTE)*	*Physics men*
A	24	9	0	0
B	46	35	48	8
C	19	24	34	17
D	5	13	0	42
E	6	21	17	33
total	***100%***	***100%***	***100% (5.8 FTE)***	***100% (24)***

**UNSW data (Probert, 2002), p. 3*

In 2002 ~30% of UNSW academic staff members were women (in the School of Physics, 5.8 of the 29.8 or ~20% full time equivalent staff members were women). The majority of the women occupy the more junior academic levels such that women dominate academic levels A and B, while men dominate levels C, D and E. For example one third of men are Professors or Associate Professors, but only one tenth of women have achieved these same senior levels (Probert, 2002). In general the academic levels of staff in School of Physics are significantly higher than those of both male and female UNSW academic staff. In 2002, 33% of UNSW men compared with 75% of School of Physics men were associate professors and professors. A fifth of UNSW women and a quarter of UNSW men are level C academics, but more than a third of School of Physics women are level C academics. The anticorrelation between the profiles of male and female academic levels is more pronounced in the School of Physics than in UNSW as a whole (compare Figures 3 and 4).

In comparison, 21% of FTE academic staff members in the School of Physics were women in 2004. This is approximately consistent the gender profiles of undergraduate, postgraduate students and postdoctoral/ research fellows but is at a lower level than the average UNSW staffing situation. In the School of Physics the male academic staff members are performing at a particularly high level: In 2004 90% of School of Physics men were associate professors and professors. In contrast ~85% of women academics in the School of Physics were lecturers and senior lecturers (compare Figures 5 and 6).

Figure 3: UNSW academic staff by gender and level (2002)



** data from (Probert, 2002)*

Figure 4: School of Physics academic staff by gender and level (2002)

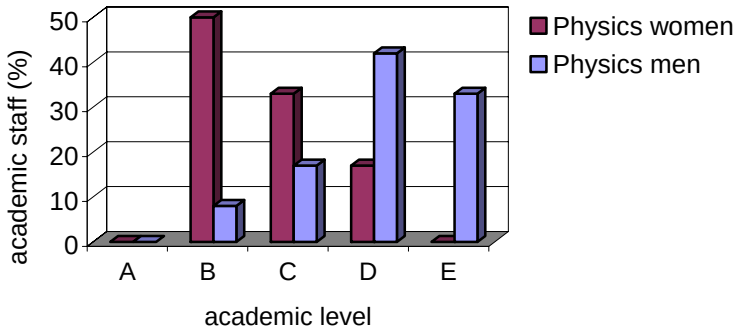


Figure 5: UNSW academic staff by gender and level (2004)

**(IAR, 2004)*

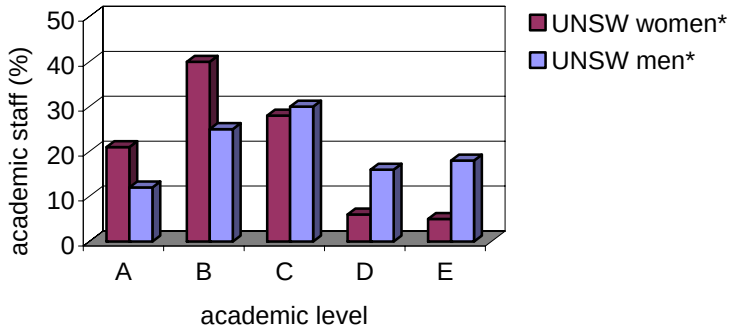
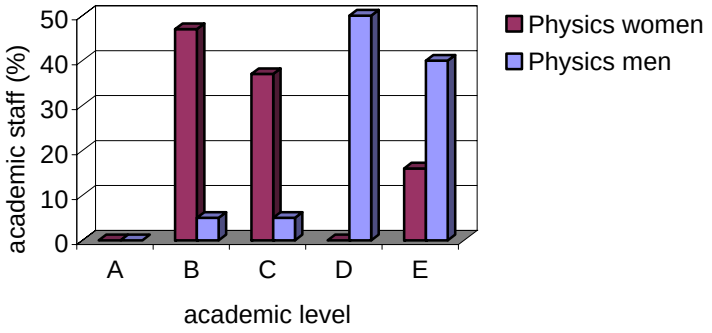
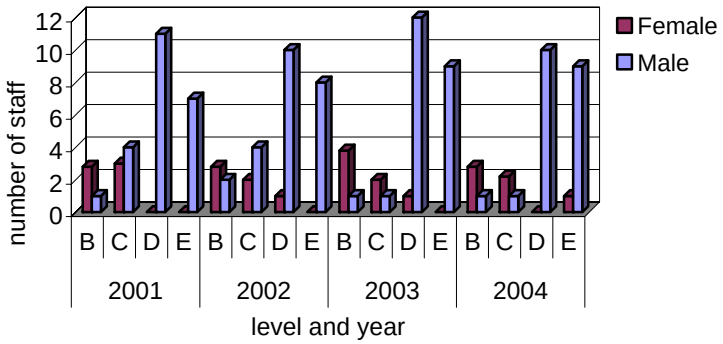


Figure 6: School of Physics academic staff by gender and level (2004)



When the gender and academic level of School of Physics academic staff members are considered during the period 2001-2004 a number of trends can be seen (see Figure 7).

Figure 7: School of Physics staff by gender, level and year (2001-04)



The number of staff members has remained approximately constant (29, 28, 30, 28), however staff promotion, retirement and mobility is evident over this period. (For example, it is noted that there is a net increase in the number of male professors, despite retirements, and only one woman has been promoted during this period. This woman is exceptional and has been promoted from level C to D and then to E and been awarded an ARC Federation Fellowship during this period).

Tables 3 and 4 below indicate show the School of Physics academic staff by gender and level for the period (1990-94) and the corresponding 5 year period a decade later (2000-04). The average representation of FTE women in the School of Physics has almost tripled since the period 1990-94 from an average of ~7% to ~20%. These changes have been achieved by the combined effects of an increase in the number of women and a decrease in the number of men (mainly due to retirements).

Table 3: School of Physics academic staff profile (1990-94)

level	1990		1991		1992		1993		1994	
	F	*M*	*F*	*M*	*F*	*M*	*F*	*M*	*F*	*M*
E		6		6		7		6		7
D	1	7	1	7	1	9	1	9	1	8
C		12		13		11		13	1	14
B	1	5	1	6	1.8	8	1.8	6	1.8	5
total	2	30	2	32	2.8	35	2.8	34	3.8	34
total staff	*32*		*34*		*37.8*		*36.8*		*37.8*	
%women	6.3%		5.9%		7.4%		7.6%		10.0%	

Source: Staff Equity Review, School of Physics UNSW (Morrison, 1995)
**The 1990-94 statistics do not include the associate lecturers. These were primarily, though not solely, part-time PhD students.*

Table 4: School of Physics academic staff profile (2000-04)

level	2000		2001		2002		2003		2004	
	F	*M*	*F*	*M*	*F*	*M*	*F*	*M*	*F*	*M*
E		8		7		8		9	1	9
D		9		11	1	10	1	12		10
C	2	5	3	4	2	4	2	1	2.2	1
B	2.8	2	2.8	1	2.8	2	3.8	1	2.8	2
total	4.8	24	5.8	23	5.8	24	6.8	23	6	22
total staff	28.8		28.8		29.8		29.8		28	
%women	16.7		20.1		19.5		22.8		21.4	

In the period 1990-94 the academic levels of male staff were more senior on average than the academic levels of female staff (Figure 8). In the period 2000-2004, despite recruitment of more women and the promotion, retirements and resignations of both male and female academic staff, the situation has generally not improved (Figure 9). Comparison of the data for male staff members shows a general progression through the academic ranks with a trend of increasing number of professors despite retirements (e.g. see Figure 9). The female staff including those who have been long term employees (>10 years) of the University have not been promoted at the same rate as their male colleagues. In the period 1990-95 on average ~45% of male teaching staff were associate professors and professors. In 2004, 90% of male teaching staff were associate professors and professors. All female teaching staff including long term employees were lecturers and senior lecturers. The only female professor is relatively recently recruited ARC Federation Fellow (research academic).

Figure 8: Academic staff by gender and level (1990-94)

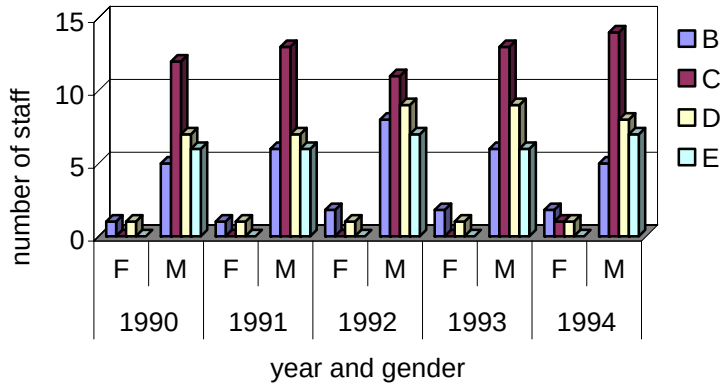


Figure 9: Academic staff by gender and level (2000-2004)

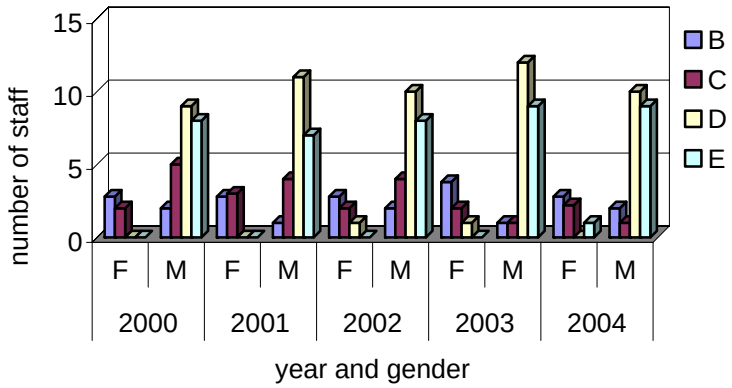
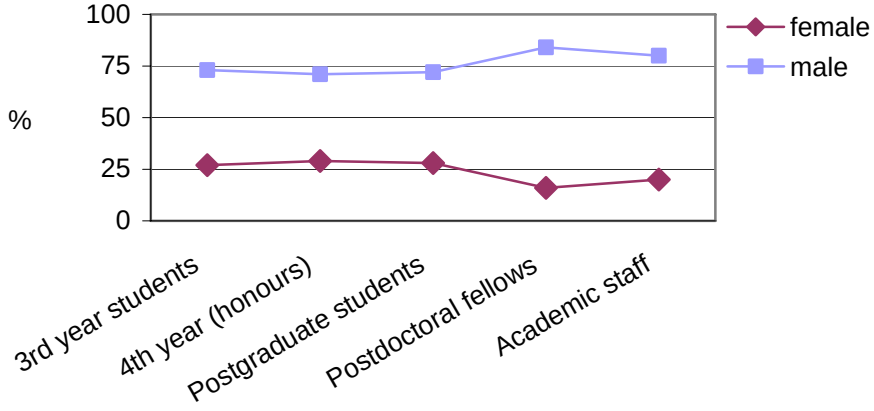


Figure 10 shows the UNSW gender representation for different student and staff groups in academic physics over the period 2000-05.

Figure 10: Percentage gender representation Physics, UNSW (2000-05)



Often when these types of data are plotted for the sciences and engineering, the resultant graph is described an “attrition” plot, as the percentage of female participation usually drops with seniority. It can be seen that on average, in the School of Physics, the women make up between 20-25% of students, postdoctoral fellows and academic staff over the 2000-05 period. The gender representation in the academic staff of the School is currently consistent with the gender representation in the feeder groups.

It is interesting to note that in the period 2000-05 an average of ~35% (range of 18-71%) of the 3rd year male students continued their studies into 4th (honours) year. In contrast over the same period an average of ~50% (range of 8-100%) of the female students continued their physics studies into 4th (honours) year. A larger percentage of the male students are double degree students and do not pursue their physics studies beyond 3rd year. As it is a non traditional area of study for women, those women who persist in their enroilment in (advanced) science as a physics major may have an particular commitment to pursuing physics to honours level and beyond. This result underlines the importance of demonstrating good role models to the female students and encouraging them to continue with physics.

3. Methods and Methodology

In addition to a review of relevant literature, three research methods were used in four phases of empirical research. Ethics approval was sought and obtained from the relevant UNSW committee for the collection of some types of qualitative data.

The four phases of research are as follows:

Phase 1: Statistical data on employment patterns and demographic information over the years 2000-2004 gathered and analysed and compared to data from existing report on the School of Physics from 1990-94. Data was gathered on all FTE academic staff employed in the period 2000-2004.

Phase 2: Survey of academics conducted.

Phase 3: Focus groups and individual interviews conducted, and submissions collected.

Phase 4: Online anonymous survey of 3rd and 4th year students conducted.

The aim of using of these different methods was to gain a comprehensive understanding of the employment, research, teaching and domestic activities of academics within the School of Physics. The assumption behind combining methods is that different methods lend themselves to exploring the various aspects of organisational operation, individual experience and informal work culture that contribute to the current employment conditions and career status of both male and female academics within the School. Furthermore, the findings of each phase can be verified against each other. As Bryman notes, combining research methods can facilitate the interpretation of the results of a particular method(s), as well as permitting the study of different aspects of a phenomenon (Bryman, 2001, p 452). The interpretation of the quantitative data are informed by the qualitative data.

The representativeness of survey and focus group findings are influenced by the self-selection respondents and participants. For the academic men this accounted for just under half for the surveys, and just under a third for the focus groups. Almost all the women participated in both the surveys and the focus group.

Two of the researchers working on this project are academic women in the School of Physics and one is a general (administrative) staff member. This may be perceived as a conflict of interest and as potentially skewing the qualitative research findings however the two academic women comprise approximately a quarter of the female academic staff within the School of Physics and therefore to exclude their input and career experiences would be equally misleading. The participation of all female staff including researchers in this project in the surveys and focus groups is one of the reasons why great effort has been made to ensure transparency and accountability. Averaged and anonymous data has been collected in all cases. Confidentiality has been preserved by the employment of an external research associate (Ms A. Woo) who collected and collated the data. The focus groups for men and women were respectively facilitated by a specially employed male research associate and the female research associate. It was thought that it was desirable to have a male facilitator for the male staff focus group and to have a female facilitator

for the female staff focus group to minimise gender related responses. These research associates consulted closely to ensure the same topic areas were addressed during the focus groups. One female staff member has subsequently noted that she felt restricted by the presence of one of the researchers at the focus group, however all staff were encouraged to make anonymous submissions via the research associate if they did not feel comfortable in the group situation. Some staff did take this opportunity. Staff have been informed of findings and have been given the opportunity to comment and discuss the research findings. In the course of the research it has become apparent that the staffs' in-depth knowledge of School and University procedures and regulations has significantly contributed to an understanding of the research as well as being crucial to the interpretation and analysis of findings. The staff have been pivotal in producing research of this breadth and depth within the limits of the grant budget.

Although the number of participants in the research is small (due to the size of the School), the sample is a significant proportion of the School: data was gathered on all academic staff employed over a four-year period, and around half the academics participated in the focus groups and survey. While quantitative data collected is not statistically significant, the research does provide insights specific to the School, its organisational history, and to the practices identified by the findings as contributing to gender disparities. It is noted that in 2005 the School of Physics at UNSW had the largest number of FTE academic staff members of any physics school or department in an Australian university, and as such and in this context, is a worthy subject of this research.

The number of academic staff and the number of academic women in particular was of concern in terms of maintaining anonymity. Throughout the report direct quotations are identified only in terms of gender.

The support of the Head of School (both Prof. John Storey in 2004 and Prof. Warrick Couch in 2005) was pivotal to the effectiveness of the research and encouraging the participation of the staff.

Phase 1: Statistical data collection:

Statistics on a range of employment indicators was collected from the School of Physics, the University Planning Office and the Human Resources Unit. This included data on promotions, publications, contact hours, courses taught, teaching hours, voluntary work done for the School, grants, leave taken. Demographic data gathered included gender, age range, time of employment and qualification.

Data was collected for years 2000-2004 because our initial studies indicated that data from a single year can be a misleading indication of staff activity (staff research, teaching and publication output can vary dramatically from year to year depending on whether staff are on leave, researching overseas etc.). The four year period also enabled investigation of patterns of change that may have occurred in response to organisational changes. Data collected was referenced to a profile of School of Physics activity from 1990-94 (Morrison, 1995). Thus a comparison could be made between the two profiles, giving insight into changes that have occurred over the ten year period. Significant changes have been observed.

Preliminary findings were presented in a School meeting in November 2004. In addition a briefing document summarising these findings was distributed to all academic staff, and input requested. Statistical data collection continued throughout the duration of the project in response to the findings of other research methods. Findings were also presented to a (standing room only) session at the Biennial Australian Institute of Physics 2005 Congress in Canberra on 3rd February 2005, and at several seminars at UNSW. See Appendix 4 for listing of associated presentations.

Phase 2: Questionnaire of Academic staff

Anonymous questionnaires were sent by internal mail and email, accompanied by a cover letter from the Head of School, to all the twenty nine individual members of academic staff in the School (29 in 2004)). Sixteen responses were received, corresponding to a 55% response rate.

Ten out of twenty men and six of seven women responded to the staff survey. Of the men, three are professors, five associate professors, one senior lecturer and one lecturer. Of the women, one is a professor, three are senior lecturers and two are lecturers.

The staff were asked about external caring responsibilities, their employment history, their perception of time use and their opinions about the work load unit scheme and gender equity within the School.

The length of the survey and the detail of the questions was limited by the need to keep the survey short in order to prevent discouraging the busy academic staff from completing it (see Appendix 2).

The purpose of the questionnaires was to collect information that could not otherwise be gathered from School and University records, such as proportion of domestic responsibilities carried, perceptions of time use, opinions on the School of Physics Work Load Unit scheme and perceptions of gender equity within the School. Again, numbers were limited by the size of the School and findings may not be statistically significant, although the response rate to the survey was excellent. The results provide focussed, relevant (and consistent) data for comparison with the statistical information collected from School records, and generate important points for consideration.

Phase 3: Focus Groups

A letter was sent by both internal mail and email to academics in October 2004 inviting them to participate in focus groups. The letter was accompanied by a letter from the Head of School encouraging staff to participate.

Two academic staff focus groups were held in November 2004: a women's focus group with 6 participants and a men's focus groups with 7 participants. The women's focus group had an external female facilitator while the male focus group had an external male facilitator with the female facilitator present as an observer/ note taker. The same topics were explored in each group, but the perspectives or responses were sometimes different.

While there is no overt friction between academic men and women, focus groups were differentiated according to gender, on the premise that this would enable the discussion of potentially sensitive topics based on gender equity issues. This method proved fruitful because, while groups certainly shared many views on gender equity in the School, there were particular issues raised that may not have been mentioned otherwise.

Focus groups were held to ascertain what issues were significant for Physics staff in the context of gender equity and career advancement, as well as explore in greater depth findings from the staff survey and data collection.

Staff who wanted to participate in the focus group but were unable to, were interviewed instead. Staff also made confidential and/ or anonymous submissions to the research associate.

Phase 4: Student Survey

Senior students (in the third and fourth year of their course) were sent an online survey after the academic focus groups were conducted. The aim of the survey was to ascertain student's perceptions of staff pastoral care work, and the role of the academic women in the School of Physics, and to cross check student experience with statistical data (relating to the gender of physics staff giving senior level lecture courses). In addition factors influencing students' choice of research supervisors were investigated.

The physics women disproportionately teach service courses rather than physics major courses, and therefore it was found the senior physics students had not experienced the level of interaction with the women physicists that the academic profile of the School of Physics would reasonably imply. Thus it was found a truly representative gender related assessment of student perception of pastoral care provided by staff was not possible from the survey of the senior student group as their contact with women had been minimised throughout their studies at UNSW. Student experience corroborated the statistical data and useful information about the perception of role of women physicists at UNSW and the factors influencing choice of research project supervisor were obtained.

4. Summary of Statistical Findings

4.1. Comparison of Age Profile of Academic staff in the School of Physics (1990-94 and 2001-04)

The Probert report into Gender Equity in Academic Employment at UNSW (Probert, 2002) found UNSW women tend to occupy lower academic levels because they are younger.

In the School of Physics in 2004 women were within the age ranges encompassing 35-60 years of age. There were level B women across three of the occupied female age ranges, including the two more mature occupied age ranges (see Figure 11). Thus age and academic level is not correlated for female academic staff in the School of Physics. In 2004, the one level E female staff member was also the youngest female academic staff member. In contrast, the one level B male staff member is the youngest academic staff member (see Figure 12). In general, age and academic level is correlated for male academic staff (see Figure 12). Note in 2004 there were no level A academic staff in the School of Physics.

Figure 11: Physics women by age and level (2004)

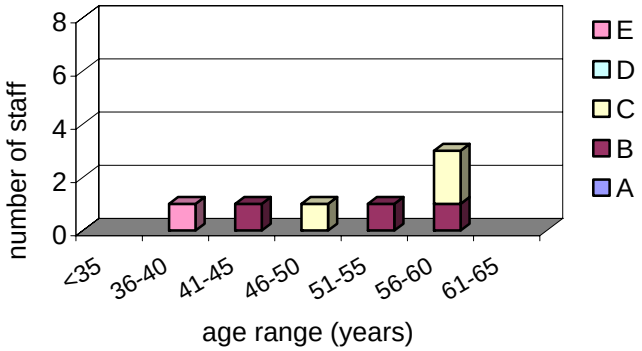
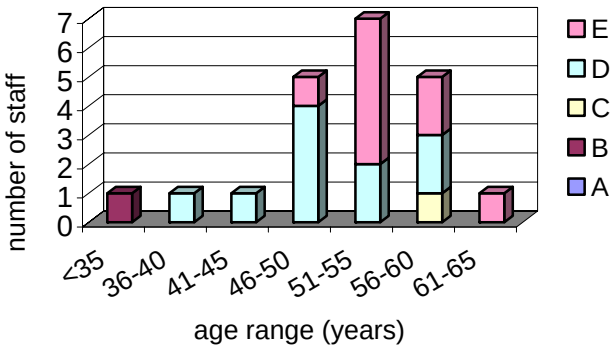


Figure 12: Physics men by age and level (2004)



In comparison in 1994, there were fewer women but some evidence of the correlation of academic level with age: the two (1.8 FTE) level B women were within

age range between 41-50 years of age, the one level C woman within 46-50 years of age and the one level D woman between 56-60 years of age (see Figure 13). In comparison a higher proportion of level D and E male academic staff are in age ranges over 45 years than age ranges below 45 years (see Figure 14). The level B academic men did not have PhDs and were teaching only academics.

Figure 13: Physics women by age and level (1994)

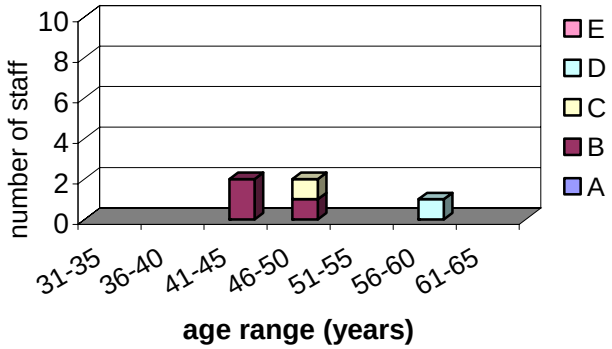
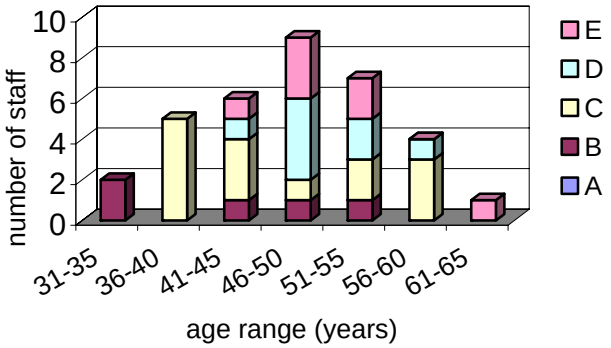


Figure 14: Physics men by age and level (1994)



In the School of Physics in 1994 there were 39.8 FTE members of physics academic staff, 4 (3.8 FTE) or 12% of whom were women (see Figure 8). Since 1994, one woman has retired and there has been a net gain of 4 (3.2 FTE) women. In 2004, there were 28 members of staff, of which 7 (6.0 FTE) were women (see Figure 9). This combined with a decrease in the overall staff numbers has increased the percentage of women staff members to 21% (FTE). Since the mid 1990's the School of Physics academic staff has been reduced due to both retirements and resignations which have exceeded recruitment.

A shift in the age profile of staff in the School of Physics reflecting the maturing of the staff is clearly shown in Figures 15 and 16. Comparison of the age range of physics men and women shows that both in absolute (see Figures 15 and 16) and percentage (see Figures 17 and 18) terms the women are not significantly younger than the men, particularly in 2004.

Figure 15: Physics academic staff by age (1994)

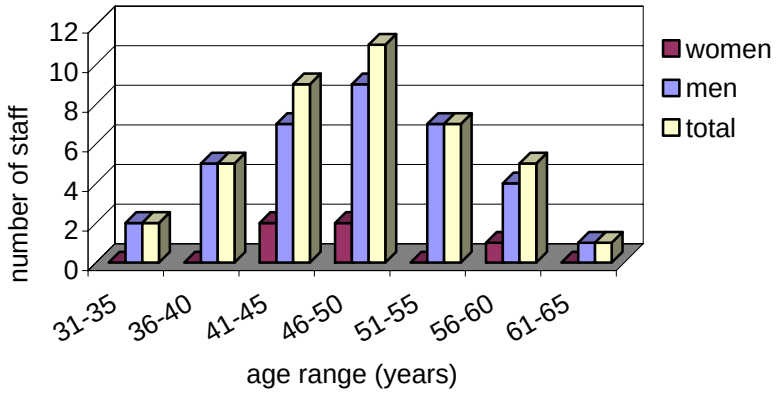
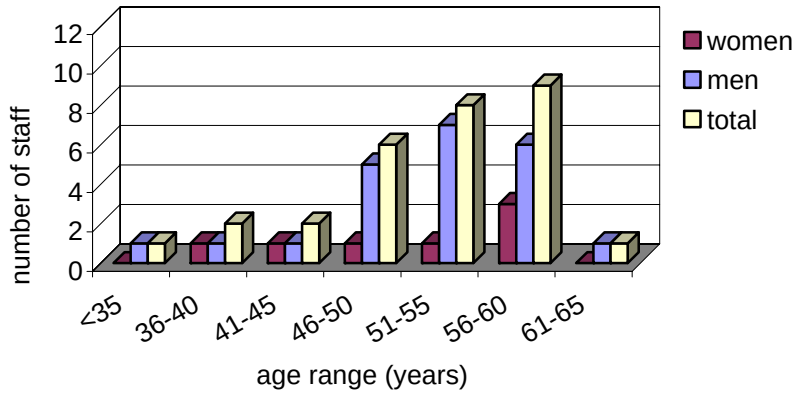


Figure 16: Physics academic staff by age (2004)



Contrary to the situation of UNSW women in general, age is not correlated with the academic levels of Physics women. In 2004, the average age of male and female academics was ~50.3 years and ~50.1 years respectively. The corresponding average age data for 1994 are not available for comparison; however the median age ranges for both male and female academics are the same. The median age range for both male and female academics was 46-50 years in 1994 and 51-55 in 2004 (see Figures 15 and 16).

Figure 17: Percentage of Physics academic staff by age (1994)

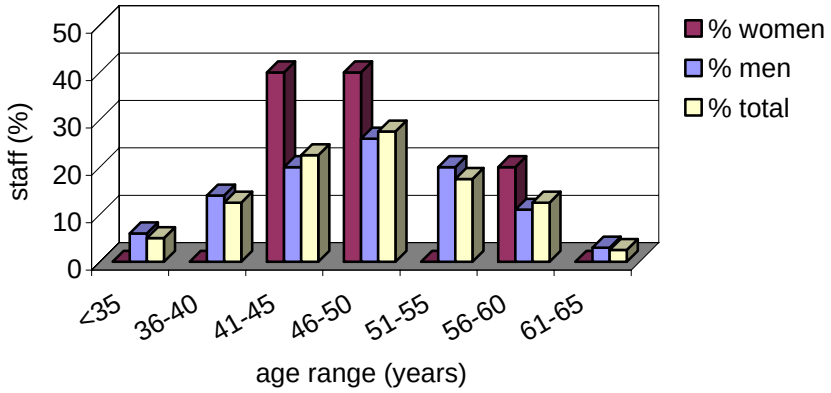
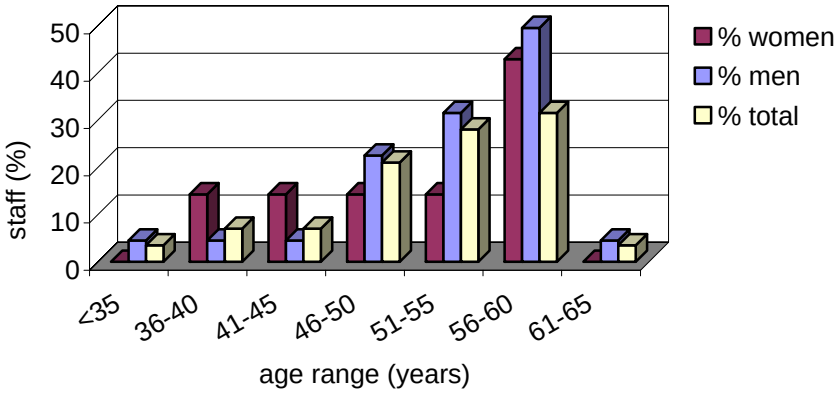


Figure 18: Percentage of Physics academic staff by age (2004)



4.2. Qualifications of Academic staff in the School of Physics

The report into Gender Equity in Academic Employment at UNSW (Probert, 2002) found UNSW women tend to be at lower academic levels because they are less qualified (i.e. fewer UNSW women academics have PhDs). PhD qualification is now an essential criterion for recruitment as an academic staff member of the School of Physics. All current School of Physics staff have PhDs, however the career paths of the men and women have generally been significantly different (see Section 5.1 and Section 5.5.5 for more details). In the past a number of (male) staff members without PhDs have been employed as teaching only academics (see Figure 14). These staff members have now all retired.

4.3. Promotion

4.3.1. Academic Staff Promotion by Level and Gender (2001-04)

In the period 2001-04, there were 9 promotion applications from male staff and 7 were successful (78% success rate). Over the same period, there were 3 promotion applications from female staff and 2 were successful (67% success rate). The two successful promotions of female staff involved only one (exceptional) woman who was promoted from level C to D to E and was awarded an ARC Federation Fellowship during this period.

Level E academic staff members are no longer active in the promotion process. When this is taken into account, the equivalent of approximately two thirds of eligible male and less than one third of the eligible female staff applied for promotion over this period. Thus the data indicate that the men apply for promotion more than the women both in absolute and relative terms. This is in agreement with the findings of the report of Probert et al (Probert, 2002). More information on (gendered) approaches to career advancement can be gathered from Probert et al (see Table 2.14, p. 15).

When years of service is compared with current academic level, it is clear that none of the long term women staff members have been promoted beyond the level of senior lecturer (level C). This is despite the fact that all the women in Physics have PhDs and have been employed in the School of Physics at UNSW for periods ranging between 12 and 34 years). In comparison 95% of male physics staff with service of 12 years or more have been promoted to associate professor or professor (level D and E).

4.3.2. Academic Staff Promotion by Level and Gender (1990-94)

In the period 1990-94 a total of 23 applications for academic promotions were submitted and 13 were successful. Men comprised an average of ~92.5% of academic staff, and ~87% of the total applications submitted and ~83% of the successful applications were from male academic staff. A total of 20 applications for promotion were submitted by male staff and a total of 10 of the applications were successful (50% success rate). In comparison a total of 3 applications (i.e~13% of the total number of applications) for promotion were submitted by female staff who comprised ~7.5% of academic staff during this period. A total of 2 of the applications were successful (66% success rate).

While data from the 1990s show women have been promoted from level A to level B and in some cases up to level C, the recent data show women who have been long term members of staff have not been promoted beyond level C. In contrast their contemporary male colleagues have been promoted to level D and higher.

4.4. Workload Unit Scheme

The Workload Unit (WLU) scheme is open and transparent system that aims to ensure that the workload of academic staff is distributed fairly between teaching, research, pastoral care and administrative duties by setting a maximum WLU requirement for timetabled teaching (including lectures, labs, tutorials and some pastoral care) and providing WLU allowances for administrative and research activity. For this reason the WLU scheme is relevant to a consideration of the time constraints that teaching pose to research work in the School of Physics. See Appendix 1 for a thorough explanation of the current WLU scheme. While the WLU scheme allocates allowances both for classroom teaching and research student supervision activities, discussion of contact hours refers only to the time spent in classroom teaching activities – lectures, tutorials and laboratories.

4.5. Teaching Allocation by Level and Gender

The statistics for 2001-4 show that all School of Physics staff were working very hard. All staff were teaching at least their full allocation of lectures, laboratories and tutorials, and some were consistently teaching beyond that allocation. Some male staff in particular had a large workload unit carry over and have taught more than 6 months in excess of their allocation. Three School of Physics men have recently received University awards for their teaching.

For the purposes of comparison it is noted that under the School of Physics workload allocation scheme, teaching duties are in general credited on a sliding scale. This reflects the number of hours involved in preparation.

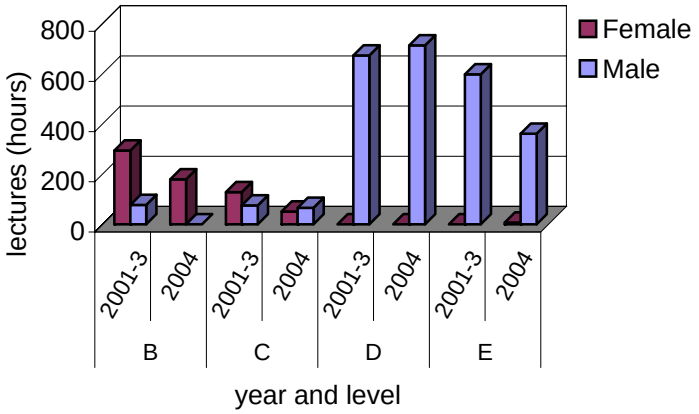
1 hour Lecture = 2 hour Tutorial = 3 hour Laboratory

This weighting means that a staff member with a teaching load with predominantly lecturing responsibilities will have less face to face contact with students than a staff member with a teaching load with predominantly tutorial and laboratory responsibilities.

4.5.1. Lectures

Male level D and E staff members are lecturing the majority of courses in absolute terms (see Figure 19). This is expected as more than 75% of academic staff members are male and/ or level D and E.

Figure 19: Lecture hours by level, year and gender



When contact hours are averaged over 2001-04 it is evident that across academic levels and genders generally the average lecture allocation is approximately uniform within 15% (see Figures 20 and 21).

Figure 20: Average lecture hours by level, year and gender

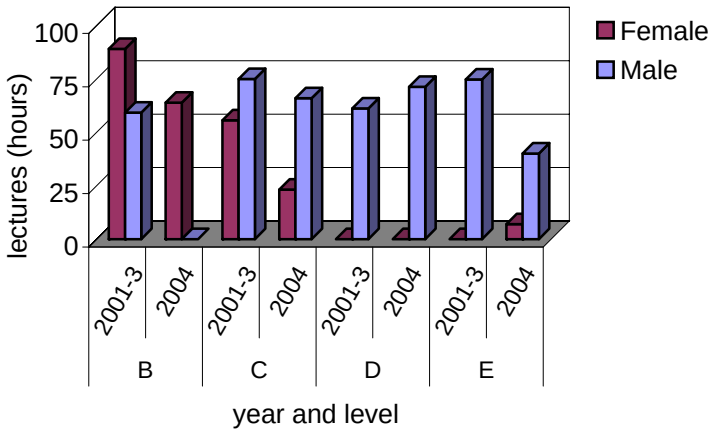
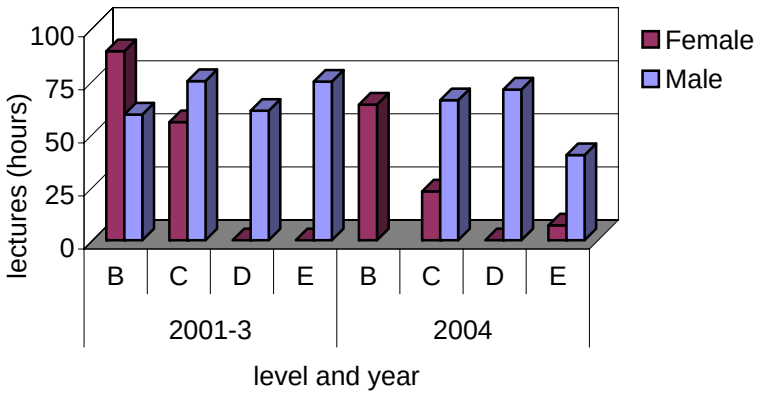


Figure 21: Lecture hours by level, year and gender



Departures from this can be attributed to a number of factors.

- The long service leave in 2002/3 and subsequent retirement in 2004 of a level B academic (male) staff member who taught first year courses.
- The employment of a level B academic (female) staff member who primarily taught first year courses in 2002 and 2003. This woman has subsequently left UNSW to take up a physics academic appointment at another university.
- Two level C women took teaching release or study leave during one session in 2004.
- The onerous administrative duties associated with being Head of School and Director of First Year, reduce the teaching duties allocated to these level E and D (male) members of staff, respectively.

Women and/ or level B and C academic staff members generally tend to lecture ~10% fewer hours than male and/ or level D and E academic staff members. Despite the introduction of the revised workload allocation scheme in 2004, women staff members were still lecturing significantly less than their male colleagues even when the factors listed above are taken into consideration.

An individual submission was received from a woman staff member whose allocations shifted from predominantly laboratory duties in 2004 to a teaching allocation that included more lecturing in 2005. She noted that a teaching allocation that included more high value lecturing duties reduced her official contact hours and gave her more *usable blocks of time* to devote to research, even though her teaching WLU allocations over the two periods were approximately equal.

4.5.2. Tutorials

Data show the total hours of tutorials taught by male academics and in particular the group of level D male academics, exceed those taught by female academics in absolute terms (see Figure 22 and 23) Once again this is expected as 79% of academics are male. Over the period 2001-04 however, individual female academics teach more hours of tutorials on average, than male academics (Figure 24 and 25). This is the case not only when one compares male and female academics in the same levels, but also across all academic levels. Statistical data also indicate that in 2004 there has been an increase in the number of tutorials hours taught by level D male academics and a decrease in the hours taught by women.

Factors such as the resignation of a level B woman at the end of 2003, and the teaching leave and study leave of two level C women academics for one session each in 2004 has impacted on these data. Essentially the tutorial classes usually taught by the absent female staff were largely allocated to the level D male staff. When the factors listed above are taken into consideration, in 2004 the level B and C women staff members are still teaching as many tutorial classes their male level D colleagues during the time they were teaching active. In 2004, the level E academic staff taught about a third the number of tutorial classes than any other academic level.

Figure 22: Tutorial hours by year, level and gender

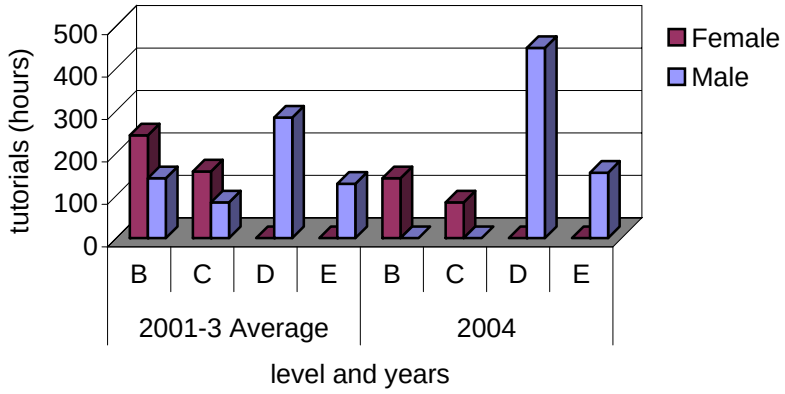


Figure 23: Tutorial hours by level, year and gender

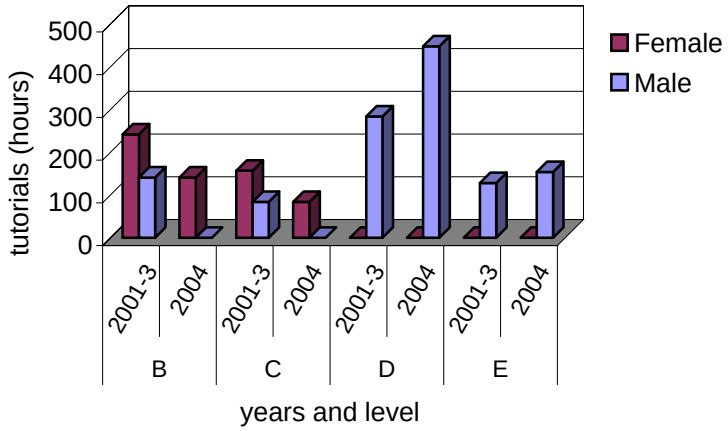


Figure 24: Average tutorial hours per person by year, level and gender

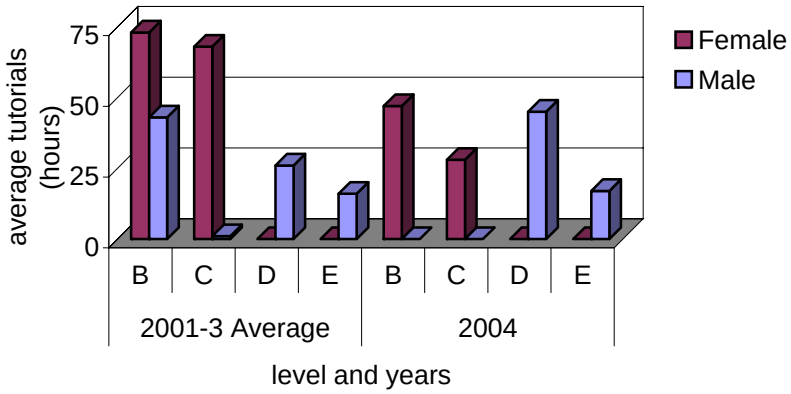
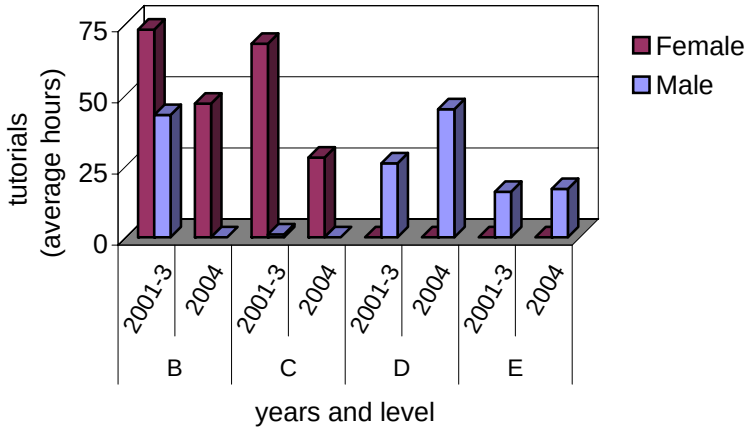


Figure 25: Average tutorial hours by level, year and gender

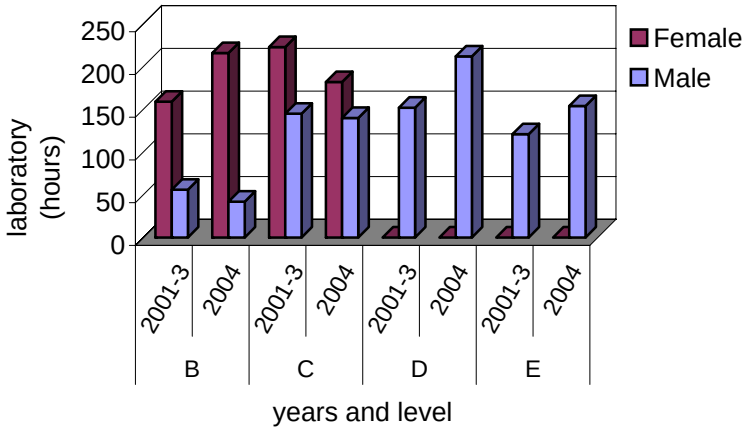


In summary over the period 2001-04, levels B and C women had up to twice the tutorial contact hours of levels B, C and D men and had up to three times more average contact hours than levels E men (see Figures 24 and 25). In 2004, level D men are teaching more tutorial classes on average than in previous years, bringing their average tutorial based contact hours up to that of the levels B and C women. It is not clear whether this change is due to introduction of the revised workload allocation scheme or whether it is a temporary response to the reduction in level B and C women available for teaching in 2004. It will be instructive to observe the average tutorial class allocations in ensuing years.

4.5.3. Laboratory Classes

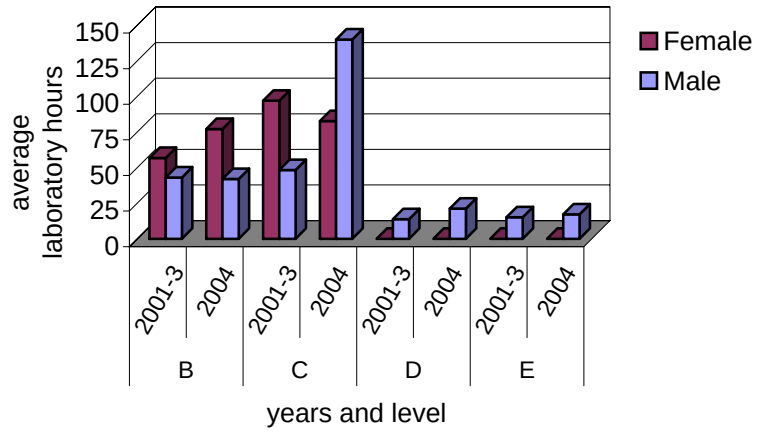
Data show the total hours of laboratories taught by male academics is only approximately 15% more than those taught by female academics in absolute terms. This is despite the fact there are nearly four times as many male academics than there (see Figure 26) are female academics.

Figure 26: Total laboratory hours, by level, year and gender



Over the period 2001-04, level B and C academic staff (which includes all female teaching staff) taught at least four times more hours of laboratory classes on average than level D and E academic teaching staff (see Figures 27 and 28). All level D and E teaching staff are men. Statistical data also indicate that in 2004 there was an increase in the number of laboratory hours taught by both level B female staff and in particular level C male staff, offset by a ~15% reduction in the total hours taught by level C women (see Figure 28). Once again these data are influenced by factors such as the teaching release and study leave of two level C women academics for one session each in 2004. These women were not available for laboratory duties during this time, but taught their usual relatively high level of laboratory classes during the periods they were teaching active during 2004.

Figure 27: Average laboratory hours, by level, year and gender



In summary over the period 2001-04, levels B and C staff (both men and women) had up to four times the laboratory contact hours of levels D and E men. Despite the implementation of the new WLU allocation scheme in 2004, there is not a significant difference in laboratory class allocations from previous years.

Figure 28: Average laboratory hours by year, level and gender

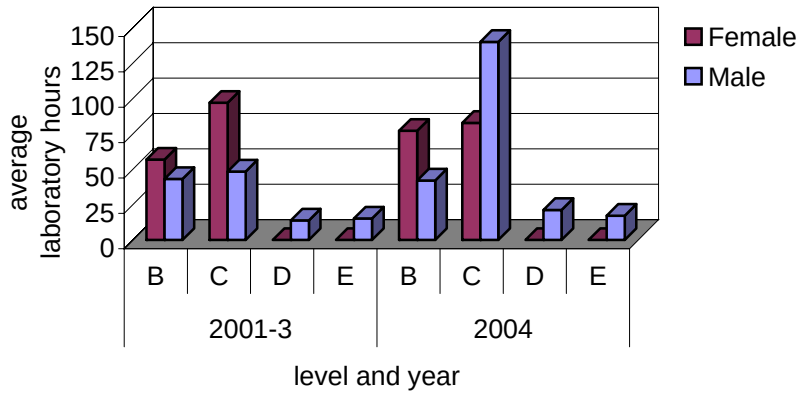
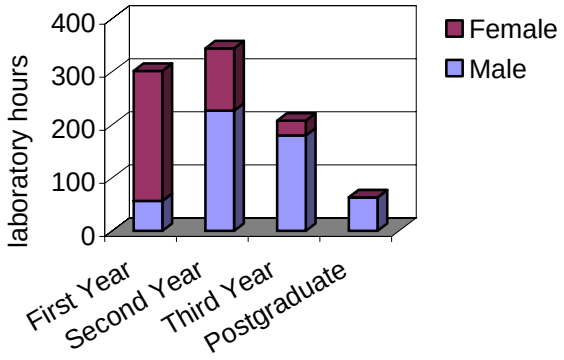


Figure 29 shows the allocation of laboratory hours taught to the first year, second year, third year and postgraduate students averaged over the years 2000-04. It is noted that over this period, substantial amounts of first year demonstrating has been done by part-time teaching fellows, honours teaching scholars and postgraduate assistants.[18] It can be seen that the female academics teach the majority of first year laboratory classes taught by academic staff. The majority of first year laboratories are for service rather than physics major courses. Women taught 100% of the first year laboratory duties allocated to academic staff in 2002 and 2003.

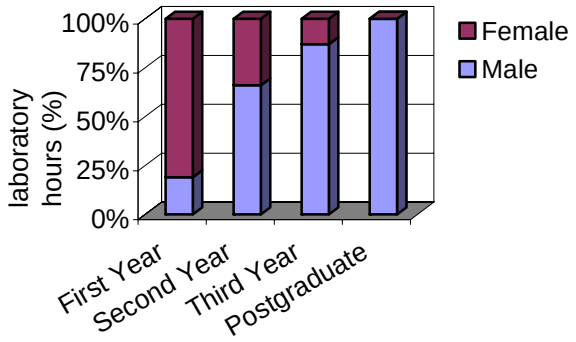
Figure 29: Average number of laboratory hours taught to cohorts of students by female and male academic staff (2000-04)



The involvement of the female academics progressively decreases in the more senior laboratories for students majoring in physics. This is more clearly shown in Figure 30 where the percentage of laboratory hours taught by male and female staff is compared. It can be seen that the female staff teach disproportionate amounts of first (81%) and second (34%) year laboratory classes in comparison with their ~20% staffing level. These data also show the reduced visibility of physics academic women to third year physics students, although they are allocated only 13% of the senior laboratory duties on average.

[18] ***Honours Teaching Scholarships and Postgraduate Assistantships*** are special programs that allow honours and postgraduate students to supplement their income by contributing to the teaching programs in the School. In addition to being enrolled as a student in either an undergraduate honours or postgraduate program, students awarded an Honours Teaching Scholarship or a Postgraduate Assistantship take part in the School's undergraduate teaching activities at a mutually agreed to level during session times thereby gaining valuable formal teaching experience. The Assistantships are subject to a probationary period and are annually renewable.

Figure 30: Average percentage of laboratory hours taught to cohorts of students by female and male academic staff (2000-04)



4.5.4. Other Teaching Duties – Duty Tutor

Other teaching duties include that of duty tutor. Duty tutors are available at set times to provide individual assistance to students. Staff members receive one WLU credit per hour of duty tutoring performed. Data show that in both absolute and average terms the staff at lower academic levels and particularly the women staff do the majority of this teaching/ service work (see Figures 31 and 32).

Figure 31: Other teaching duties, total hours by level, year and gender

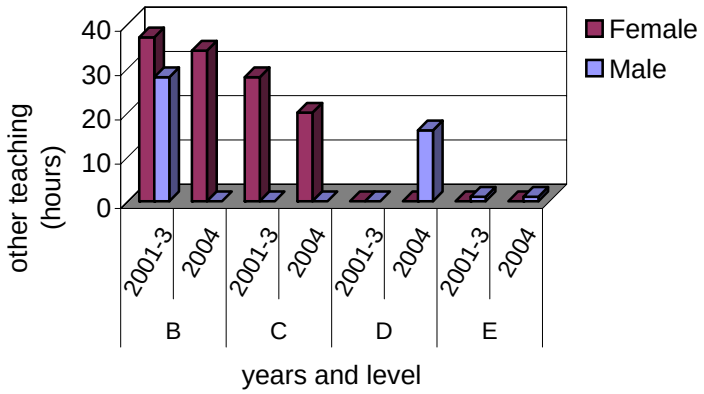
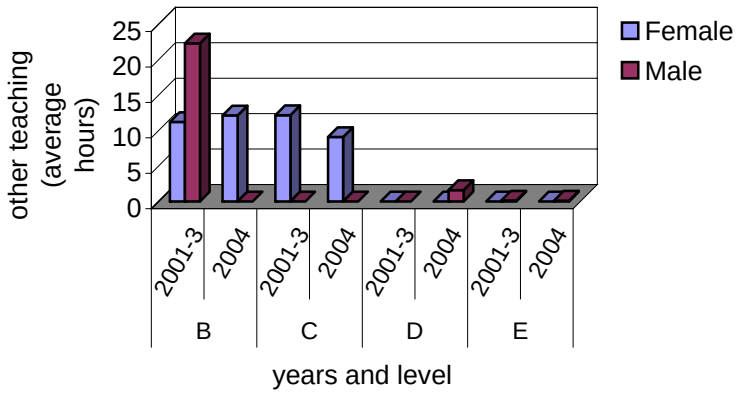


Figure 32: Other teaching duties, average hours by level, year and gender



Note that the level B male academic staff member indicated in the 2001-03 data, is a teaching only non-PhD academic who has since retired.

4.5.5. Contact Hours (2001-04)

The data indicate that in absolute terms the contact hours of level D and E academic staff exceeds the total contact hours of level B and C academic staff (see Figure 33). This is as expected as >70% of academic staff are level D and E. Guest lectures by research academic staff have not been included. When the average contact hours per academic are considered it is clear that level B and C staff average significantly more contact hours per year than level D and E staff (see Figure 34). It is noted that the long service leave and subsequent retirement of a level B male academic and the SSP/ teaching release two level C female academics for 6 months have particularly influenced the data in 2004.

Figure 33: Total contact hours by level, year and sex

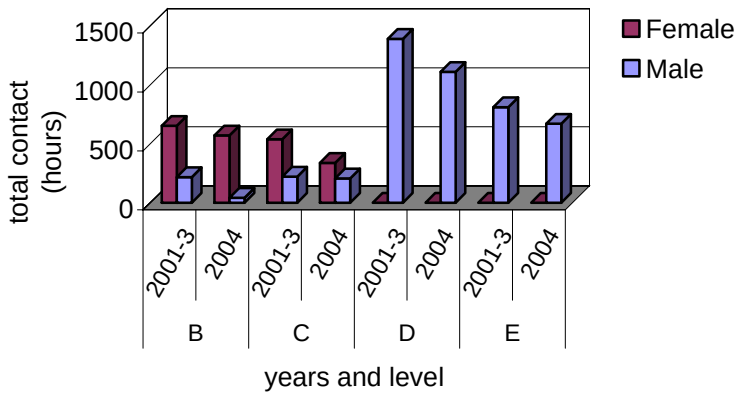
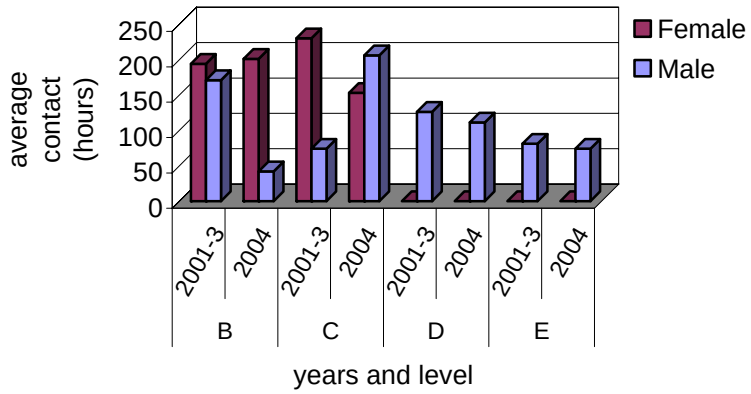


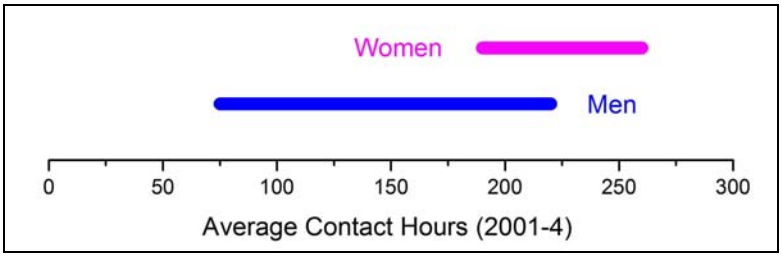
Figure 34: Average contact hours by level, year and sex



The 2004 contact hours (i.e. >150 hours) of the two level C women academics who were on study leave or teaching release for 6 months exceeded the typical level D (i.e.~110 hours) and level E (i.e.~75 hours) contact hours for the whole year even though these women were only teaching active for only half the year due to Special Studies program (SSP)/ teaching release.

The data in Figures 33 and 34 are by necessity averaged; however there is a large range of contact hours. When scaled to full time equivalents and averaged over the 2001-04 period, the contact hours for physics women ranged between 190 – 260 hours. In comparison the contact hours for physics men ranged between 75 – 220 hours (see Figure 35). These ranges do not include research-only academics including ARC Federation Fellows (a level E man and a level E woman), staff on various leave, nor do they include academics with large administrative loads such as Head of School (level E man) and Deputy Director of the Electron Microscope Unit (level C woman).

Figure 35: Average class contact hours (2001-04)



4.5.6. Contact hours (1990-94)

Table 5 shows a comparison between average contact hours for formal teaching duties (lecturing, tutoring and laboratory demonstrating) between the period 1990-94 and 2001-04. Table 5 shows that since the 1990, the average contact hours per annum have been reduced in all cases, despite a reduction in physics academic staff numbers from an average of ~36 in the period 1990-94 to an average of ~28 in the period 2001-04. The drop in contact hours reflects a drop in number of courses (including physics elective courses for higher year students, and physics service

courses) offered by the School of Physics. It is noted that 15 male academics and up to 2.8 female academics were employed as level B or above during the 1990-94 period and were still employed in the School of Physics over the period 2001-04. The School of Physics at UNSW has generally seen as a desirable place to work, and the relative stability of the workforce is evidence of this.

Table 5: Comparison of average contact hour per annum by gender, level and time period

	Average contact hour per annum (±5)			
	1990-94		*2001-04*	
	men	*women*	*men*	*women*
Level B and C	250	320	210	225
Level D	155	170	110	-
Level E	100	-	75	7*

**Note the female professor is an ARC Federation Fellow and therefore a non-teaching academic, who never the less does give some coursework lectures to (4th year) honours students.*

4.6. Gender related differences in teaching workload allocation

4.6.1. Allocation of teaching duties

As previously discussed, under the School of Physics workload allocation scheme, teaching duties are in general credited on a sliding scale such that 1 hour of Lectures = 2 hours of Tutorials = 3 hours of Laboratory classes. This reflects the number of hours involved in preparation. The female staff members generally have many more contact hours than the male staff because female staff are allocated many more tutorial and/ or laboratory classes as part of their teaching workload allocation. There is strong evidence (see Sections 4.7 and 5.3 on gender related differences in research activity) that greater number of contact hours seriously impacts on the research output of female staff as more spent time teaching means less available time for research. As academic staff with less active research programs receive less teaching reductions, this situation can be reinforced over a period of years establishing a ***self-perpetuating cycle*** from which it is difficult to escape.

4.6.2. Influence of the 2004 algorithm on teaching workload allocations

In general, the implementation of the 2004 algorithm did not result in significant changes in the workload of the level B and C academics (includes all female teaching staff). This is because the high status, higher workload unit valued lecturing duties were allocated to the level D and E staff (all male) who also generally had substantial teaching reduction due to their excellent research output. In contrast, a much higher proportion of lower workload unit valued laboratory and tutorial duties

were allocated to the level B and C staff, resulting in higher contact hours, and therefore fewer useful blocks of uninterrupted times available for research.

4.6.3. Gender related differences in workload allocation (2001-04)

In 2004 regardless of academic level, teaching and administrative workload allocation was set so that each Full Time Equivalent (FTE) member of staff was allocated 555 Work Load Units (WLU). Prior to 2004 there was a graduated system of workload allocation where the academic staff at more senior levels had lower WLU allocations. Thus the introduction of equal work load unit allocations across academic levels in 2004 should have improved the relative situation of the junior level staff (including women) in particular.

In 2004, reductions of teaching contact hours equivalent to up to 200 WLU (36%) was possible on the basis of *external* research income, refereed publications and research student supervision. When the number of ***formal*** contact hours is considered as a fraction of timetabled workload it was found that the Physics men spent about a third of their allocated workload time formally teaching students while Physics women on average spent almost half their allocated workload time formally teaching students, despite the equalisation of WLU allocation across academic levels in 2004. See Table 6.

Table 6. Comparison of timetabled student contact hours as a fraction of formal workload.

Teaching contact as a fraction of timetabled workload	*Physics men **	*Physics women (FTE)*
Average contact hours/WLU	0.32	0.46
Range	0.19 - 0.50	0.35 - 0.65

* Does not include Head of School or non-teaching academics (e.g. ARC Federation Fellows)

These data are contrary to the findings of the report of Probert et al (Probert, 2002) into Gender Equity in Academic Employment at UNSW (2002) who found "*no evidence to support the commonly articulated contention that women carry significantly larger teaching loads than men"*

While it is clear the Physics women have significantly more contact hours than the Physics men, it is also instructive to investigate ***who is lecturing to whom.*** Academic staff who lecture not only have fewer contact hours, they are also more visible to a wider range of students and their interaction with the students has a perceived higher status. Student survey data have revealed that visibility is an important factor when students are selecting research project supervisors (see Section 5.3.3 on Student Perceptions).

In the School of Physics both service physics and physics major courses are taught. Physics is a core or enabling science and many non-physics degrees require knowledge of physics. The Physics service courses are specially constructed and taught by School of Physics academic staff to meet the needs of students enrolled in other (science, engineering, etc) courses throughout the University. This is important from an educational perspective as students are receiving instruction from qualified expert physicists. Service teaching also provides valuable income for the School.

Physics courses are offered to students majoring in Physics. These students will be the physics PhD students and professional physicists of the future. The data in Table 7 show that in 2003-04, on *average* Physics women (21% of staff) teach ~70% of service courses and Physics men (78% of staff) teach ~30% of service courses. In contrast Physics Women (21% of staff) teach ~13% of physics major courses and Physics Men (78% of staff) teach ~87% of physics major courses.

Table 7: Lecturers of Physics courses by gender (2003-04)

Undergraduate course	*2003*		*2004*	
	men %	*women %*	*men %*	*women %*
first year service	***22***	***78***	***50***	***50***
first year physics	85	15	100	0
second year service	***25***	***75***	***25***	***75***
second year physics	90	10	86	14
third year physics	100	0	93	7
physics (honours)	75	25	64	36

A simple comparison between the workload allocation in 2003 and 2004 is not straightforward as improvements in equitable distribution of teaching loads were not uniform across courses. The *average* distribution in 2004 was perhaps more equitable than in 2003, however this is not entirely or even primarily due to the revised workload allocation scheme: The resignation of a level B woman at the end of 2003 who primarily taught first year physics courses and in addition teaching release and study leave of two level C women academics for one session each in 2004 has impacted on these data. Unfortunately women taught a very small proportion of third year physics major course (3.5% on average 2003-04), reducing their status and visibility to students in the year that they are making choices for honours year research project supervision.

4.6.4. Gender related differences in workload allocation (1990-94)

Prior to 2004, teaching allocations were determined using a graduated system of WLU on the basis of academic level. The higher academic levels were allocated fewer teaching duties. For example, in 1994 the teaching loads were 275 WLU for Professors, 420 for Associate Professors, 480 for Senior Lecturers and Lecturers. The differences in average contact hour as a fraction of timetabled workload are more divergent when academic levels and genders are considered. In 1994, the average range of formal student contact as a fraction of timetabled workload was 0.37 – 0.52 for male staff and 0.40 – 0.66 for female staff. The more senior academic staff not

only had less WLUs allocated initially, they also had fewer allocated formal teaching contact hours with students.

Table 8: Comparison of timetabled student contact hours as a fraction of formal workload (1990-94 and 2001-04)

Teaching contact as a fraction of timetabled workload Average contact hours/WLU		
years	***Physics men***	***Physics women (FTE)***
1990-94*	0.47	0.60
2001-04	0.32	0.46

** For example, in 1994 the average contact hours/WLU for the*

- *average female senior lecturer/lecturer (level C and B)* *0.66*
- *average male senior lecturer/lecturer (level C and B)* *0.52*
- *average female associate professor (level D)* *0.40*
- *average male associate professor (level D)* *0.37*
- *average professor (level E)* *0.37*

The differences in average contact hour as a fraction of timetabled workload are more divergent when academic levels and genders are considered. In 1994, the average range of formal student contact as a fraction of timetabled workload was 0.37 – 0.52 for male staff and 0.40 – 0.66 for female staff. The more senior academic staff not only had fewer WLU allocated initially, they also had fewer formal teaching contact hours allocated with students.

Table 9: Lecturers of Physics courses by gender (1994)

Undergraduate course	***1994***	
	men %	***women %***
first year physics	87.5	12.5
second year physics	100	0
third year physics	94	6
physics (honours)	100	0

In 1994, women made up ~10% of academic staff. The records do not distinguish between service courses and physics major courses. However, service courses were concentrated in first year and to lesser extent second year. It is noted that the practice of allocating junior and service courses to women academics was an established practice in the early 1990s, and this practice has persisted into the 2001-04 period which is the subject of this investigation. The evidence suggests that this practice has developed from an unconscious habit rather than a deliberate policy; however it is important for equity and for the status and visibility of women physicists within the School, that the disproportionate allocation of junior and service duties to the female academic staff members be redressed.

Data from the 1990s show women were promoted from level A to level B and in some cases up to level C. The 2001-04 data show women who have been long-term members of staff have not been promoted beyond level C, in contrast with their contemporary male colleagues who have been promoted to level D and higher. The differences in the promotion rates may be partially attributed to the men's lower teaching loads when they were level B and C academics (e.g. see Table 8).

4.7. Research

4.7.1. Research – Internal grants (2001-04)

A variety of internal schemes were available including the Gold Star Awards, University Research Support Program (URSP), Faculty Research Grant Program (FRGP), School of Physics Research Grant Program (SRGP), the Vice Chancellors Teaching Research Award and the Teaching Research Initiative Grants.

All 7 Physics women applied for internal funding during the period 2001-04. All but two Physics men (i.e. 20 out of the 22 male academic staff) applied for internal funding during the period 2001-04. The two men who did not apply for internal funding were recipients of significant external funding. Most applications submitted from either male or female staff members requested close to the highest level of funding allowable under the various internal schemes, which was typically $20,000 per annum over the 2001-04 period.

The Physics women's average funding allocation for URSP, FRGP and SRGP over the period 2001-04 ranged from 13-91% of the amount requested with an average of 54%. The success rates of the Physics women were bimodal, with the higher success rates achieved by the more recently appointed women and the lower success rates achieved by the longer serving women. In particular the academic staff member who was the recipient of the most internal research funding over the 2001-04 period was one of the recently appointed women level B staff members. This woman received an UNSW Vice Chancellors Teaching Research Award in addition to URGP, FRGP and other internal support.

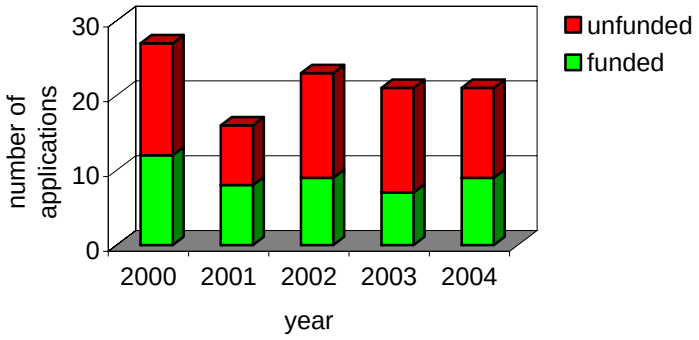
Physics men's average funding over the period 2001-04 ranged from 0-100% of the total amount requested with an average of 66%. Funding success for men was not correlated with length of service.

4.7.2. Research – Australian Research Council External Funding (2000-04)

In the School of Physics over the period 2000-04, a total of 128 applications for Australian Research Council (ARC) funding were lodged with UNSW as the host institution. These applications included applications for funding to support research projects, equipment and infrastructure, research centres, national research networks, international collaborations, fellowships, postgraduate, postdoctoral professorial (including Federation) fellowships, etc. (http://www.arc.gov.au/arc_home/default.htm). Figure 36 shows the number of applications per annum over this period. The School of Physics with a staff of 28

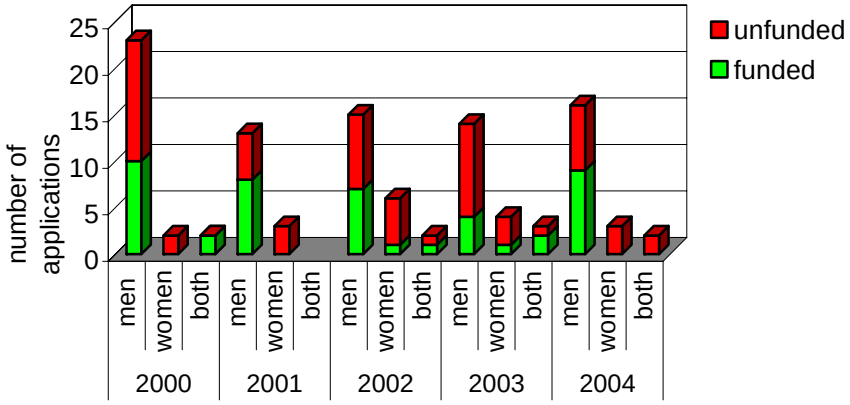
averaged ~20 applications to the ARC each year and on average ~7 were funded per annum.

Figure 36: Total number of (ARC) external grant applications (2000-04)



A total of 45 out of the 128 applications (i.e. 35%) were successful. A total of 20 out of the 22 men had an ARC grant awarded during the period 2000-04. In comparison 3 out of the 7 (i.e. 2.2 of the 6 FTE women) were awarded ARC funding during this period. Figure 37 shows the number of applications by gender per annum over this period.

Figure 37: Total number of (ARC) external grant applications by gender of School of Physics applicants (2000-04)



note "both" indicates that at least one male and one female staff members were partner Chief Investigators on these applications.

During the period 2000-04, there were 18 applications lodged by female School of Physics staff of which only 2 were successful (i.e. 11%). There were 80 applications with one or more male only members of the School of Physics staff, of which 38 or ~48% were successful. There were 9 applications with at least one male and one female member of School of Physics staff of which 5 or 50% were successful (note there were no applications with at least one male and female academic staff member in 2001). Male academics were (co-) chief investigators on 95.5% of the funded applications. Women were (co-) chief investigators on 15.5% of funded applications. At least one male and one female academic were both (co-) chief investigators on 8% of funded applications. Male academics comprise ~79% of staff

and 84.5% of successful applications had male only applicants. In contrast, women comprise 21% of staff and 4.5 % of successful applications had women only applicants. These results are summarised in Table 10.

Table 10: ARC applications by gender 2000-04.

applicants	Applications (% of total)	funded	Success rate of applicants	% of total grants funded
Women	18 (17%)	2	11%	4.5%
Men	80 (75%)	38	48%	84.5%
Both	9 (8%)	5	56%	11%

Of the 18 applications made by School of Physics women a Discovery Project and a Federation Fellowship were funded in the period 2000-04. Note that if a staff member is a partner on successful equipment grant applications with another University as the lead institution this may not appear in the School of Physics statistics.

Of the 80 applications made by School of Physics men, 26 out of 59 Discovery Project applications and 1 Federation Fellowship out of 3 applications were funded in the period 2000-04. Of the collaborative Linkage type funding (international, industry, CSIRO), 3 out of 4 equipment and infrastructure grants, 3 out of 6 industry linkage project grants and 5 out of 7 CSIRO/ student grants were successful.

Of the 9 applications made by at least one male and one female staff member in the School of Physics, 2 out of the 6 Discovery Projects, one Centre of Excellence, one equipment and infrastructure grant, and one national network grant were successful.

In general the male staff were more successful than female staff in achieving and sustaining national competitive funding from the Australian Research Council; 91% of the male staff compared with 43% of the female staff had external funding commencing during the period 2000-04 The research funding success rates of Physics women were bimodal, with the higher success rates generally achieved by the more recently appointed women and the lower success rates achieved by the longer serving women with high teaching loads. Previous success appears to be an indicator for current success. It is noted that success is not strongly correlated with academic level for either the male or female staff, with funding achieved by staff from level B to E.

4.7.3. Publications (2001-04)

The number of publications is not a fair basis for comparison of research output. The field of study, the quality of the journal, the impact of the journal and the number of co-authors and therefore the contribution of the individual authors, etc., all have a bearing. For example the data collection for a biophysics or environmental physics research project which relies on a complete life cycle or climate cycle may take longer to complete than some theoretical physics projects or an experimental physics project for which the data are immediately available. Thus within the Physics discipline there can be wide differences across fields in the average numbers of publications produced per annum. While noting the shortcomings in the simplistic comparison of numbers of publications, there are significant differences between the publication rates of average male and average female academic staff members, and some insight into the possible reasons for this may be inferred from the data.

Not all staff have reported their publications, therefore the listings of publications is incomplete. The 4 women who reported their publications published between 1 and 4 papers per annum between 2001-04 averaging 2.2 per annum. The 15 men who reported their publications over the same period published between 1 and 12 papers per annum averaging 6.3 per annum. (It is noted these data do not include publication output for the research-only ARC Federation Fellows). There are significant differences in the publication rates between the average male and average female academic staff members, with women on average tending to publish less than 5 papers a year, and men on average tending to publish more than 5 papers per year. There is not a strong correlation between numbers of publications and academic level.

Those staff with the higher publication rates tend to

- have more research students *and/or*
- be part of a large collaborative group[19] *and/or*
- have significant international collaborations *and/or*
- have significant research funding *and/or*
- be senior academic staff (i.e. level D or E).[20]

Some of the female academic staff do not fit into any of these categories.

[19] Particular fields of physics which often are structured around shared facilities and collaborative group work have relatively high publication outputs (e.g. astrophysics, nuclear physics). Some fields of physics such as biophysics and atmospheric physics that rely on biological or climate cycles typically have relatively low publication outputs.

[20] Staff with higher numbers of publications are more likely to be promoted.

4.7.4. Research student supervision (2001-04)

Honours Supervision

During the period 2001-04 there were 88 single session (i.e. six month) honours projects supervised or co-supervised by academic staff. Female members of staff supervised or co-supervised a total of 11.12 (~13%) honours students (see Figure 38 and 39).

Figure 38: Honours student supervision by gender and year

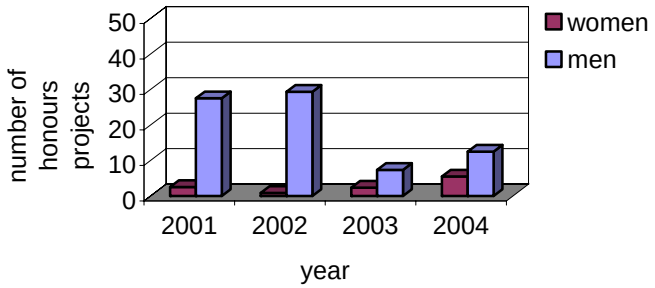
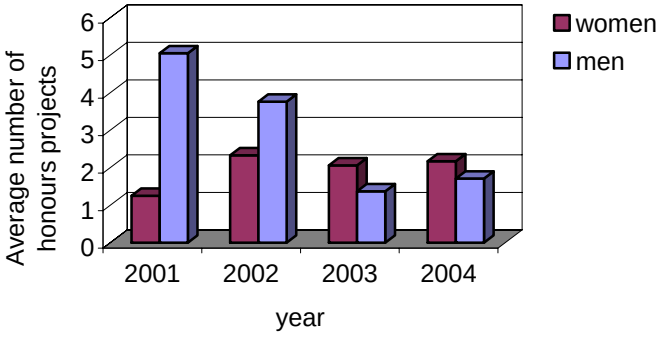


Figure 39: Average honours student supervision by gender and year



Postgraduate Supervision

During the period 2001-04 there were 181 postgraduate (PhD or MSc students) student years (i.e. 1 FTE student supervised for 1 year) supervised by School of Physics staff. Female members of staff supervised or co-supervised a total of 26.75 (~15%) postgraduate students (See Figures 40 and 41).

Figure 40: Postgraduate student supervision by gender and year

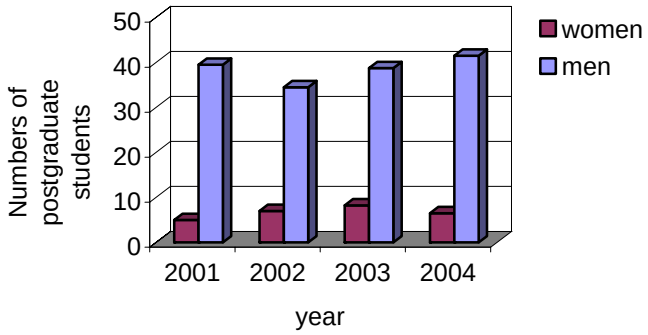
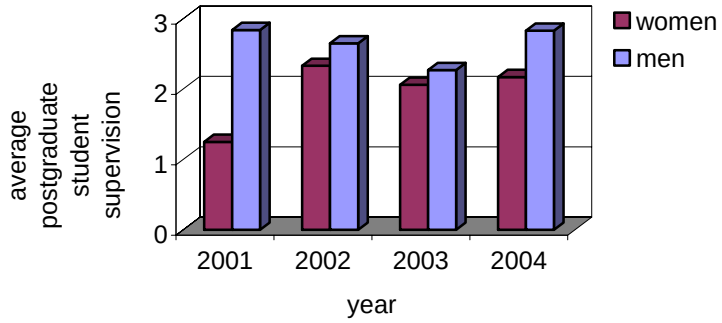


Figure 41: Average postgraduate student supervision by gender and year



4.7.5. Research student supervision (1990-94)

Honours Supervision

During 1990-94 there were 86 single session honours projects supervised by academic staff. Female academic staff supervised 7 (8%) of the honours students during the period 1990-94, which is approximately in proportion as the averaged percentage of female staff was ~10% during that period.

Postgraduate Supervision

Throughout 1990-94 there were 311 PhD student years (i.e. 1 PhD student supervised for 1 year) supervised by School of Physics staff. 6 PhD student years were supervised by women. Thus only 1.9% of PhD supervision was done by female academic staff which is disproportionately low given that the average percentage of female staff during this period was ~10%.

Since 1990-04 the number of female academic staff has doubled and there has been a marked improvement in the absolute and relative numbers of postgraduate research students supervised or co-supervised by women academic staff. In comparison the fraction of honours research projects supervised or co-supervised by women has not significantly improved.

4.7.6. Sabbatical Leave (2001-04)

The contribution and value of sabbatical leave towards the progress of an academic physicists' research program cannot be understated. Sabbatical leave during which teaching and administrative duties are suspended allows the academic staff member to concentrate on progressing and revitalising their research program. In addition the opportunity to visit and work with external (often international) colleagues enables collaborative networks to be refreshed and strengthened. Sabbatical leave is known as Special Studies Program (SSP) at UNSW.

Few of the female academics, were able to take sabbatical leave because of their family responsibilities. This was particularly the case when their children were young. In addition the spouses or partners of the women tended to be older and more established in their careers and were therefore female staff did not have either the flexibility nor the availability to travel as the SSP system requires at UNSW. *Until 2004, only one of the current physics women academic staff had previously taken a session of SSP*.

The recent option of teaching release is much more compatible with the personal situation and responsibilities of most of the physics women. Since this option was made available one long term physics women academic staff member has taken leave for six months in 2004, and other eligible women are negotiating their options for the future.

During the 2001-04 period, 5 women were eligible for SSP or teaching release. One level C woman took a 6 month session of SSP, and one level C woman took 6 months teaching release, both in 2004. In comparison of the 19 men eligible to take SSP or teaching release, 9 took 13 six month sessions of leave (i.e. 5 men took 7 six month periods of SSP and 4 men took 6 periods of other leave, including long service leave and teaching release). Three male academic staff took two or more periods of leave. The SSP/ leave rate per eligible academic staff member was 68% for men and 40% for women.

4.7.7. Sabbatical Leave (1990-94)

During the period 1990-94, 19 six month sessions of SSP were taken by male academic staff in the School of Physics. During this same period no sessions of SSP were taken by female staff. The SSP rate for eligible academic men was ~65% consistent with the 2001-04 data, however 0% of eligible female staff took SSP during this period.

4.8. Service

4.8.1. Committee Membership (2001-04)

The data in Figures 42 and 43 show that in contrast with previous years, in 2004 the committee membership of the female academic staff has increased to levels commensurate with their percentage representation in the School of Physics. Figure 42 shows that the increase in female representation was due more to addition of female members to committees rather than the replacement of male staff with female staff members, as male committee member numbers remained approximately constant over the 2001-04 year period.

Figure 42: Total committee membership, by year and gender

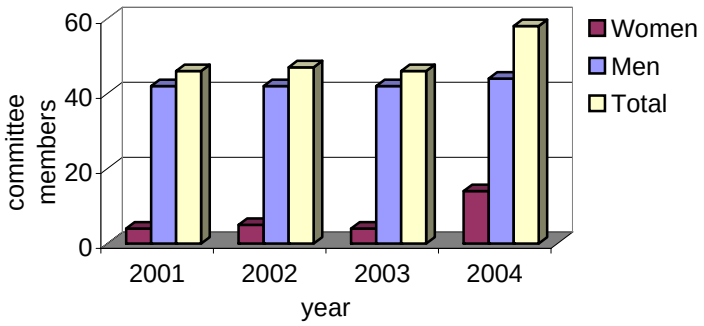
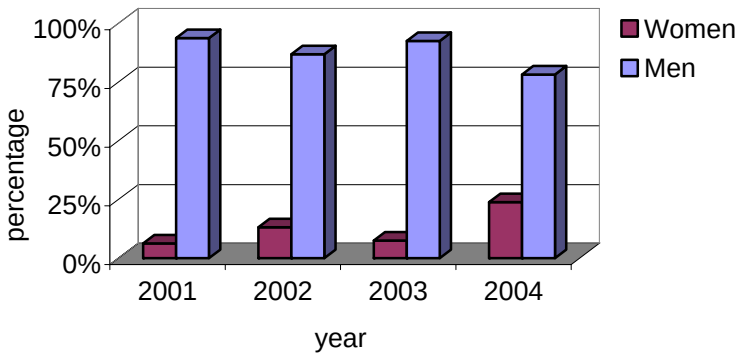


Figure 43: Committee membership as percentage of total membership, by year and gender



In Table 11 compares the percentage of female and male academics as a proportion of the total female and male academics respectively. For example, the School of Physics Gender Equity Committee constituted in 2004 has two female academic staff members (1.2FTE), one male academic staff member and one female general staff member (1FTE). It is noted that the two fractional academic staff (both female) are given full rather than fractional voting rights on these committees and therefore they are represented in the Table as one full academic member. Table 11

indicates that in general academic women are not represented in committees in equal proportion to the representation of academic men. This may relate to the relatively small number of female academic staff compared with the number of committee positions.

Gender equity in Committee membership is an interesting issue to consider. As there are approximately three times more male staff than female staff, the female staff may find their non-teaching times dominated with committee responsibilities if full gender equity was implemented on every committee (i.e. equal percentage representation of genders). This may not be a desirable outcome. For example because of the necessity of having a female member for a properly constituted merit based selection committee for staff appointments, some women are frequently involved in these duties not only within the School of Physics but also for other Schools within the Faculty of Science and Faculty of Engineering.

Table 11: Female/male committee membership as a percentage of total female/male academic staff

	2001		2002		2003		2004	
Committee	Female	Male	Female	Male	Female	Male	Female	Male
Executive Committee	17	22	17	28	0	26	14	32
Postgraduate Committee	0	30	33	39	14	43	29	45
Research Management Committee	0	26	0	33	14	22	14	23
School Safety Committee(2003-)	-	-	-	-	14	4	14	5
Workloads Committee	0	26	0	33	0	13	0	14
Honours Committee	17	30	33	50	14	43	43	45
Undergraduate Teaching Committee	0	35	0	50	0	30	29	18
Gender Equity Committee (2004-)	-	-	-	-	-	-	29	5
Space Committee	33	13	-	-	-	-	29	14

Table 11 indicates that academic women are not equally represented in committees in comparison with the representation of academic men, particularly in the key decision making committees (e.g. Executive Committee and Research Management Committee). This may be due to the ex officio membership and the requirement to cover different research fields in those committees. However from an equity standpoint, it is desirable that female staff be represented on key decision making committees in preference to the more administrative type of committees. Staff with special interests relating to the considerations of a particular committee should be encouraged to attend meetings as ex-officio members.

4.8.2. Committee Membership (1990-94)

In the period 1990-1994, women comprised between 5.9 -10% of academic staff in the School of Physics. During this period there were 29 Committees, 5 of which had a female member of staff. Thus only 17% of committees had a female member, and it is noted no committee had more than one (academic) female member at any time.

From 1990-94 there were 242 elected and non-elected positions on School of Physics committees. Only 5 of these positions were filled by female academic staff. Thus female staff had a disproportionately low representation of 2% of committee membership. Given the very low numbers of female academic staff during this period (i.e. between 2 and 3.8 FTE), this observation is not unexpected. The Undergraduate Teaching Committee (established 1993), Honours Review Committee, Space Allocation Committee and Postgraduate Committee had no female committee members during those 5 years. Female academic staff did serve on the Executive Committee, Research Management Committee and Computing Committee (established 1993). Compared with 1990-94, the numbers of women serving on School committees in 2004, has improved and is commensurate with their representation in the School of Physics.

4.8.3. Open Days

Staffing the Physics booth on open days is a voluntary component of service. During the 2001-04 period a total of approximately 100 staff hours were spent on this activity, which often falls during holiday periods. A total of 11 male academic staff (46% of male staff), 2 female academic staff (33% of female staff) and the Physics Friend (see Section 5.4.2) served at the booth. When the total number of hours provided by academic staff are compared, male staff provided 79% and female staff 21% of the total hours consistent with the academic gender profile of the School of Physics. It should be noted that the same academic staff members often assisted every year, whereas other staff members did not assist with this activity at any time. The Physics Friend provided the greatest individual support for this activity. See Table 12.

Table 12: Open days (2001-04)

staff	number of staff	total hours	average hours per staff member	average hours per staff member per annum
Men	11	61.8	5.6	1.4
Women	2	16.5	8.25	2.1
Physics Friend	1	17.25	17.25	4.3

5. Summary of Qualitative Findings

5.1. Traditional versus Non-Traditional Career Paths

5.1.1. Traditional career path

As part of the questionnaire, staff were presented with a model of the "traditional" academic career path, this being an uninterrupted transition from an undergraduate degree in physics, to a PhD, post-doctoral studies and full time professional employment in research then academic physics. All male respondents reported that their career had followed this path. Two thirds of female respondents did not follow this path because they had career breaks to raise children. One female academic initially worked in another profession in addition to taking time off to raise children. These career breaks range from 3 months to 8 years, with an average of 5.5 years.[21]

The male focus group participants' traditional career path is characterised by a continuous engagement with full time physics research from undergraduate or post-graduate studies to professorial academic appointment, represented thus:

Undergraduate → PhD → Post-Doctoral Fellowship(s) → Academic Position

They did not have a career break (for child rearing or family responsibilities, for example) nor did they experience a period of working part time work in physics either teaching or researching.

After undergraduate and postgraduate degrees, an individual completes post-doctoral research, either at a university or research institute, publishes their research and thus begins establishing their personal research profile. Having achieved an academic appointment within a university, the individual then progresses through the academic levels ideally up to professorial level. While academic staff typically have a combination of duties including teaching, research, administration and service, research achievements have been the most important factor contributing to promotion success. If the individual does have a family and dependent children or others, they do not carry primary carer responsibilities. Their spouse or a paid carer (e.g. day care nanny, long) cares for the children, or, more rarely, carer duties are shared.

Focus group participants agreed that the first benefit of following the traditional career path comes from completing post-doctoral research. This is usually undertaken when an individual is in their late twenties or early thirties, the advantage being that at this age individuals have just finished their post-graduate research and are usually more mobile and ready to travel for research opportunities. As participants from the men's focus group remarked, international research experience is favourably considered by universities and opens up networking opportunities. It is noted that the majority of women did not have (the opportunity for) international postdoctoral experience.

[21] Every current Physics academic woman is a mother of between 1 and 4 children.

5.1.2. Post-Doctoral Research

Post-doctoral research gives individuals the opportunity to develop a field of research, as well as establish a publication and a funding record early on in their careers. These are key elements to success at a research intensive School such as the School of Physics at UNSW because they positively influence ones chances of attracting funding and post-graduate or post-doctoral research students, both of which increase research output. The formal systems of resource allocation – grant allocation and work load allocation – and the informal ways in which post-graduate or post-doctoral students choose their supervisors, are advantageous to established research academics and disadvantageous to those who have do not have established research careers. A research student is much more likely to choose as a supervisor an academic who works in a department with good infrastructure and who is able to fund their (the student's) research. Therefore, an academic with large and consistent research grants will attract research students, who in turn contribute to and reinforce research productivity.

All the male survey respondents and focus group participants followed a traditional career path. Interestingly, two academic men changed research fields mid-career and compared the consequences with being absent for a few years, and beginning all over again – similar to women's experiences as primary carers.

5.1.3. Non-traditional career paths

The non-traditional career paths are characterised by a lack of post-doctoral experience and/or a break in engagement with full time physics work (usually as a result of family responsibility). The non-traditional career is often a predominantly teaching focussed career. Research is an activity that is difficult to pursue on a part time basis. In the UNSW School of Physics there are slight variations in the pathways of the non-traditional careers, however all feature restricted or hindered research involvement. In some cases, individuals were initially employed by the University as (teaching only) tutors and, with a change in UNSW's employment agreement, were made full-time teaching academics. This has had long term repercussions for their employment and work at the University. These academics have not had leave to complete post-doctoral research and thus have not had equivalent opportunities to build research profiles or publications records. This, combined with the perception of their academic roles as being primarily teacher/tutors, has meant that individuals have not have research foundations to build upon, and their current research is swamped by heavy teaching loads perpetuated by the work load unit allocation scheme and lack of funding.

In other cases, individuals hold primary carer responsibilities for their household (one individual also worked for ten years in another profession prior to doing a PhD in Physics), and thus have had to take career breaks to raise their families. One female academic followed the traditional career path with the support of her partner, but has had such high teaching loads that her research has been stifled.

5.2. Workloads

5.2.1. Workloads: Teaching versus Research

> *The School could be described as a supportive and inspiring environment for research. For teaching? Not so much.* [Male academic]

In the course of the women's focus group, participants stated that they felt they had very heavy teaching workloads (which is confirmed by quantitative data) and that their teaching duties often prevented them from developing their research. Almost all the female academics at the School have been employed initially as teaching staff. Their role at the School has therefore come to be perceived as primarily a teaching role rather than as a researcher role. A female academic, who was initially employed in a teaching capacity before being promoted to academic staff, stated that in these cases, *"there may…be an assumption [in the School] that you are more interested in your teaching anyway"* [Female academic, submission]. As a result, research is very difficult:

> *Starting [research] from scratch or from a little work on the side while carrying a heavy teaching load makes things very hard.* [Female academic]
>
> *Most of time was swallowed by teaching…[at one point] I'd come in the morning and have things to do, but I would have so many interruptions that I wouldn't have any time to do it. So I'd go home with a bigger list [of things to do] than I came with. So I'd end up sitting here on a Sunday doing them. So I felt that I was enormously overworked and I didn't have time to do research. There were just too many teaching hours and on top of that if you have to prepare something more it's more work.* [Female academic]

This academic staff members experience indicates that heavy teaching loads also erode time that can be spent on less easily quantifiable activities that are important to the operation of the School, such as participation in meetings, symposiums and other less formal activities. A lack of time affects the ability of academic staff to participate in these processes and interactions. Those affected can become separated from the life of the School and their colleagues and "fall out of the loop". This can exacerbate miscommunication and misrepresentation of academic staff as well as affect decision making processes.

The tension between research and teaching was consistently apparent in the focus groups, interview and submissions. In both focus groups, the participants perception was that teaching was not highly valued by the University – and thus by the Faculty and School – especially in the context of promotion. In the words of a male focus group participant:

How does teaching affect your [career] progress? Well… negatively. It is very difficult to do both teaching and research. [Male academic]

The study found that academics saw this as being manifest firstly in terms of time (teaching and administrative workloads compete for time with research) and secondly due to a lack of recognition of "*the plain hard work of teaching"* [Female Academic]. The women's focus group also critiqued the University's attempt to recognise teaching efforts.

5.2.2. Workloads: Distribution

Qualitative findings indicated contrasting opinions on the fairness of workload distribution in the School. The contrast was consistent with academic level and gender. In the survey, staff were presented with a statement regarding the Workload Unit Scheme (see Appendix 2): "The Physics Workload Unit (WLU) teaching Scheme fairly distributes teaching and administrative duties amongst academic staff". Almost all level B and C academics (including male and female academic staff) felt that the WLU scheme did not fairly distribute teaching loads, whilst most of the higher level academics did. In terms of gender, almost three quarters of the male survey respondents agreed or strongly agreed with the statement, whilst no female academics agreed.

When asked whether they thought the WLU scheme achieved its objectives and why, focus groups participants initially had contrasting responses. While the more junior academics (both men and women) said that the WLU scheme was unfair and did not achieve its aims, most senior academics with a strong research profile thought it was "*a fair attempt to balance out teaching and other work*" [Male academic]. However there was general agreement that the WLU scheme was an improvement on what came before.

The focus group discussion was constructive in that it identified how the WLU system could be improved. The comments of participants indicate that the WLU scheme was seen to create unfair conditions several ways: by using measures that do not accurately reflect research work or output; by scaling teaching activities; and by not recognising some forms of academic work.

The women's focus group agreed that the calculation of WLU allowances needed to be addressed in terms of WLU discounts for research grants. Currently only external research grants earn WLU allowances, this can be a misleading measure of the work that goes into grant applications because it overlooks internal grants. It was argued that because internal grants are competitive and take time to apply for, they should be included.

It was also pointed out that whilst allowances for external grants were weighted by the number of investigators, such allowances could still be inaccurate because dollar input does not always reflect research output because, for example, "*experimental projects often require more [money] than theoretical [projects]"* [Academic woman]. The suggested solution was to measure research work using output, in the form of publications, instead of dollar input. However, as one academic

woman pointed out, care must be taken in considering publication numbers and such a measure should take into account differing publication rates in different fields, or the nature of the research. Also the time and effort involved in writing a successful external research grant and the opportunity it gives for the support of postgraduate students, deserves recognition.

Academics from both focus groups felt that the weighting of various activities stratified academics according to workload rather than redistributing workloads. On the one hand, academics with a strong research profile and with research resources benefited from the scheme, whilst academics with more teaching hours and less research activity had no way of reducing their teaching load in order to enhance their research:

> *If someone is research active – pumping out papers and has a group of three or four research students – they'll be winning on the WLU scheme because that will reduce the teaching hours…you could say that that had a snowballing affect on their career progress.* [Male academic]

Thus participants felt that teaching work was not valued in the WLU scheme. In the words of a male academic:

> *When you spend hours of research and put out a publication and that brings money into the department, [that is counted]. But when you spend a month of Sundays developing a new course, it doesn't bring more money into the School and it won't bring the individual direct recognition. That's not (counted) within the workload unit scheme.* [Male academic]

In terms of teaching activity, the scaling of WLUs favours lectures over laboratories, tutorials, other work (e.g. duty tutorials) and some work is not acknowledged (e.g. staffing information booth on open days). This scaling operates on the assumption that more preparation time is required for lectures, and a premium work load allocation is given for the first time a course is given (i.e. 5 WLU versus 3 WLU.) However this is often not the case, senior academics with established core courses have the advantage of giving lectures for long running courses that require less preparation, while junior academics with less research funding must make up their WLU requirement in more time-consuming activities such as laboratory and tutorial classes. Furthermore, since senior academics are more likely to lecture in core courses and not elective courses, this limits the opportunities for junior academics to take on more highly weighted WLU teaching activities, such as lecturing.22

> *[The WLU scheme] does lead to stratification…because labs are worth a third of a lecture and you end up with junior academics doing all the lab work.* [Male academic]

Co-supervision of research students was also an important consideration. One of the women noted that whilst co-supervisors do not receive a WLU allowance, some

[22] It should be noted that each academic has different preferences as to how to fulfil their workload allocation.

women academics who were co-supervisors, felt they spent just as much if not more time with the student. According to statistics, women are more often co-supervisors, whilst men are more often primary supervisors. Thus, women would benefit from a WLU scheme that recognises the work done in a co-supervisory role.

5.2.3. Time use

Academics were asked to graphically symbolise their perceptions of how their time was split between research, teaching, administrative duties, service and family time/housework (using a pie-graph). Of the valid responses by male academics, most (three quarters) estimated they spent more or equal time on *research* than teaching. In contrast, all but one female academic (who is a research academic) spent more time on *teaching* than research. Proportions of time spent on housework/family varied unpredictably over all responses, if it was included at all.

5.2.4. Workloads and University restructuring

All the participants commented on increased workloads in light of organisational restructuring. With the cutting of administrative staff, as well as the decrease in numbers of teaching academics due to retirement, workloads were seen as becoming potentially unsustainable:

> *The amount of things each of us have to do continues to go up. The number of responsibilities, whether it's teaching, research, writing reports, managing – the whole lot – is steadily rising from year to year. The resources we've got to do our job are actually diminishing, we aren't replacing from year to year.* [Male academic]

> *There's a whole level of staff – the tutors, general assistants and secretaries – that has disappeared. We should have them again. We could use these people. I think we should have a full time technical officer, and have access to a secretary. I spend a lot of time standing in line to Xerox.* [Female academic]

Using highly trained academic staff to do office work is an inefficient use of university resources. As indicated above, increases in administrative and teaching work negatively affect research productivity, and teaching time which in turn impacts on career progression.

Concerns were raised by both the male and female academics regarding the funding priorities of the University, Faculty and School. It was felt that decisions were often made on basis of budgetary priorities rather than on the basis of what is in the best interests of staff or students; learning, teaching or research.

Funding and budgetary concerns in turn affected the School working environment. A participant in the women's focus group felt that "*the working environment, workload, 'School politics' and competitiveness had taken a turn for the*

worse because of funding problems".[Female academic] Similarly a male academic said that this is exacerbated by an inability to plan long term with the budget: "*tied to this problem is the insecurity that comes with not being able to predict what will happen in three years time, or even next year, and thus not being able to plan beyond that time period*" [Male academic].

5.2.5. Physics major courses and physics service courses

> *I'm not sure that we'd even have a physics department on its own here if we didn't do the service teaching. I think people would be happy to see it as part of the school of physical sciences or as even part of engineering, as has happened at other Australian universities.* [Male academic]

The School of Physics teaches two different types of students: physics majors, from who the feeder group for honours and eventually PhD students are derived; and non-physics majors from other Schools and Faculties (e.g. Engineering) who must complete prerequisite physics courses for their degree. It follows that there are two different types of courses taught at the School: core physics courses, taught to the physics majors, and service courses, for those students majoring in areas other than physics. Although the students in service courses do not stay in the School of Physics, service courses are financially important to the School because they are a key source of income.

Empirical data for 2003-4 (see Table 7) shows a stark difference in the proportions of service courses and core physics courses taught by academic women and men. Women teach most of the service courses (e.g. ~65% of the first year service courses and ~75 % of the second year service courses although women only comprise 21% of academic staff), while men teach most of the core physics courses (93% of first year physics major courses, 88% of second year physics major courses, ~97% of third year physics major courses and 70% of honours/fourth year physics major courses). Whilst service courses are important for the School in terms of income, teaching only service courses creates visibility problems for academics on an individual level and may impact on student perceptions of women in physics.

> *Physics students have so little to do with us…and when they do see us, it's in the first year labs…they don't even see us in lectures!* [Female academic]

Indeed, it is currently possible for a physics major student to complete the basic three year physics degree at UNSW without ever being lectured by a female academic. Female focus group participants felt "*almost invisible"* to physics students due to their lack of contact with them. The main concern was that this affected how students perceived the role of women in physics.

> *All they will see us as is either tutors or lab demonstrators...And even if they don't think about it explicitly, implicitly they're going to assume that we're a lower tier of staff that don't have research. Every now and then I get hints that that's the case.* [Female academic]

In addition, and consistent with the perceptions of many of the female academic staff, female PhD students within the School of Physics independently expressed to gender equity researchers their concern at the lack of female academic role models for students.

Lack of exposure and resulting low profile of female academic staff members to physics major students also affects the probability of supervising a PhD or honours student. The survey of physics majors conducted as part of this project found that ~75% of students agreed that when it comes to choosing a supervisor for an honours or PhD project, it is important that they have been taught by that person before. Supervision of honours or PhD students is pivotal to developing and producing research output, which in turn helps career advancement.

A final consideration is the level of satisfaction that a teaching academic derives from educating keen physics major students in comparison with students who are only doing physics as a requirement or prerequisite for their non-physics degree. In the words of one female academic:

> *We do service teaching and the students don't really want to do physics so you can knock yourself out trying to teach them but they just don't want to do it and they often don't appreciate what you do. It can be rewarding, but it's exhausting.* [Female academic]

While academic staff do have the opportunity to show expressions of interest in teaching particular courses, there is uncertainty amongst the participants as to how these expressions of interest are taken into account in the course allocation process. Some women were concerned that there was belief that lower level academics, predominantly women, were not capable of teaching higher-level core physics courses. A male academic (politely) expressed this assessment to a female academic, despite the fact that all physics staff have honours degrees and PhDs in Physics and all are capable of teaching undergraduate Physics courses. Female participants agreed that the allocated proportions should change to be representative:

> *Women should be teaching 20% of physics courses in first, second and third year. We're 20% of the staff. That's the minimum we should be teaching. We're all equally qualified as the men, and we're all as able to teach.* [Female academic]

5.3. Research

5.3.1. Funding

Research funding plays a pivotal part in establishing oneself as an academic as well as progressing professionally. All focus group participants felt that the ARC grants process was arbitrary and non-transparent. The academic women also expressed some concerns over aspects of the internal grant process and its relation to ARC grants process. For example, it was felt that the use of ARC rankings as part of the application criteria compounded the disadvantage of academics who were unsuccessful in applying for ARC grants.

Someone might get a low ranking from the ARC because you don't have that many publications. Rather than compound that disadvantage, the University should provide some help to people to get their publications up. [Female academic]

The academic women also questioned whether School staff could maintain objectivity in the assessment of applications for internal funding, not only because staff were competing against each other for grants, but also because academic staff may not have the expertise required to knowledgeably judge applications from other fields. It is noted that the opportunity to request external reviewers for FRGP and similar internal research grant applications was offered from 2004. Academic women also felt more constructive feedback for applicants is required of the internal grants process.

5.3.2. Publications

A good publication record is essential for career progression. Some of the female focus group participants commented that some staff members without significant external research funding or research students were managing to continue to do their research at a level that resulted in one or more refereed journal publications per year. Since publication is almost synonymous with research output, the pressures of teaching, administrative and pastoral care workloads have the same negative effects on publication record as with research. The area of physics research also influences publication record;

depending on your area of research, it may take a while [to publish]…if you're doing time-scale things, over the space of twelve to eighteen months or two years, you can't be producing something every six months…That is recognised in your field, but not within the School. [Female academic]

Academic women felt that the area of physics research should be taken into account when assessing research productivity using publications output.

5.3.3. PhD students

There is no doubt that I do much of my research through my grad students. I couldn't do otherwise. [Male academic]

Supervising graduate students provides academics with a valuable "research resource" because supervisors can delegate research work to their student/s and thus increase research and publication productivity. With a team of graduate students, one can maintain a large teaching load and still be research productive and thus increase chances for promotion. If students have a scholarship such as an Australian Postgraduate Award (APA) it is a further bonus because the student does not need to be supported by the academic staff members own research funding.

The focus groups and the student survey show that certain factors influence what kind of staff are more likely to become graduate research supervisors. These factors are: a) contact (as a lecturer) with 3rd and 4th year physics majors (the main feeder group for graduate students), b) one's research funds and c) informal academic networks within the School.

The student survey results show that ~75% think it is very important that they have been taught by their supervisor before. Thus, lecturing a compulsory upper level physics course increases one's chances of being approached to supervise. Conversely, those who lecture in service courses or elective courses, and those who do predominantly laboratory or tutorial work (i.e. the majority of physics women) are not as visible to students. Female focus group participants expressed concern that these lower status, lower profile roles are disproportionately filled by female academics.

> *We're not involved in the high level courses, somehow the guys occupy all the high level courses and make them compulsory…my course is not compulsory and only runs every few years…students would probably take it but they have to do the compulsory things first…so I don't get to see many students at the higher level, so I don't get many students coming to me to do a PhD.* [Female academic]

Empirical data collected is consistent with this perception showing that male academics teaching upper level compulsory courses supervise two postgraduate students and one honours student per year on average. In comparison female academic staff (co-)supervise an average of one postgraduate student and ~1.5 honours students per year. It is interesting to note that some male academic staff members have expressed a reluctance to supervise honours students as it can be an onerous time commitment that is less efficient in generating research output. This is consistent with the empirical data.

Research grant funding also influence one's ability as a supervisor to attract and retain graduate research students. Such funds can be used to support students through the provision of equipment and technical support. Thus academic staff with less research funding than their peers may be further disadvantaged. For example, a female focus group participant reported directing an honours student who had approached her for supervision to an academic staff member with more funding on the basis that it would better for the student's research. Directly funding research students using competitively awarded research funding is a strategy employed to increase research productive and profile. Obviously, academics without research funding cannot employ such a strategy to attract postgraduate students and build a research team.

5.3.4. Academic networks

When asked how they perceived supervisors were selected for postgraduate research students, female academics stated that there was a process by which students were recommended to academics within along informal academic networks within the School. The women felt that they were not part of these networks and that this

reduced their chances of supervising students.[23] Student networks are just as (if not more) important, but the physics women chances are further reduced as they are not as visible as their male colleagues due to the disproportionate allocation of physics lecture courses to male academics.

One female academic said that she does not get students from within the School, but in common with most staff is independently approached by international students who contact her from overseas. As neither she nor the student has funding, the student cannot study at the University. The lack of support funding would of course preclude both women and men from having students referred to them.

As with pastoral care, the nature of supervisory work can differ between academics. For example, the women academic staff reported that the "difficult" or "weak" students are directed to them, on the premise that they have the skills, time and inclination to "handle" and "tolerate" them. They also perceived that the time and work they did as co-supervisors outweighed the organisational returns and recognition they received.

5.4. Service: Qualitative Findings

5.4.1. Pastoral Care

Pastoral care is an unquantifiable component of academic work because it is not timetabled contact time and is often left to the discretion of academic staff. Nonetheless, any research into academic work and career must take pastoral care into consideration, not only as an aspect of time use, but also as an indicator of whether an academic focuses on teaching or research duties. When academics are under the time pressure of increased administrative, teaching and research demands, pastoral care is often the first teaching responsibility to be cut back on.

Pastoral care was an important issue to the women because they felt they did more pastoral care than necessary for their teaching loads and that this negatively impacted on their research time. In addition, they felt it was a form of academic work that was not easily calculable and therefore unaccounted and unrecognised by the School[24] and indeed by the University as indicated by the value given to teaching and service in the promotion process.

There was a contrast between approach and strategies of male and female academics to balancing research and teaching work. While participants from the men's focus group clearly stated that the workload for the whole School was heavy, including the teaching, they did not state that teaching prevented them from researching. Rather, they emphasised the importance of clear delineations between the time spent teaching and the time spent on one's own research.

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[23] It would be constructive to clarify the process by which students and supervisors are matched to ascertain whether and in what way it can be altered to promote female academic's research potential.

[24] Although quantitative research for this study has included a comparison of volunteer pastoral work such as manning the open day stalls, it was not possible to gather data on time spent in other pastoral care activities. It would be constructive to collect these data in the form of records of time spent with which students, number of emails received and responded to etc.

You've got to be very strong-minded about your research and recognise that at the end of the day that's what's going to get you a promotion. I'm not saying that you need ignore your teaching duties – you've got to do them – but I think that you've got to put more weight [on research]. If it comes to judging between 'is this hour going for research? Or perhaps polishing my notes for teaching?' I think research has got to take priority. [Male academic]

On the other hand, some female participants found it hard to set those limits. One female participant said:

I find it hard to say no [to students who approach me] unless I have a meeting or appointment. Even then, I'll sometimes be late [to the meeting] because I've been helping a student. [Female academic]

While this may indicate the need for women academics to be more steadfast with their pastoral care time, it also suggests that the women's concept of their responsibilities as teachers differed to those of some male academics.[25] One participant later wrote her thoughts:

I think women may be more willing to spend time with students, answering their questions, than the majority of males. Whether this is a gender thing or reflects the fact that they have more exposure to first years who seem to need a bit more handholding, I am not sure. [Female academic]

It is also important to take into account that some female academics have much heavier teaching loads than male academics, and would automatically have more pastoral care duties competing with their research time. As one male academic put it,

If you have a hundred students or more attending one lecture and just ten percent wanted personal attention each week that would already be too many…if you want to do a good job, you'd just be overworked! [Male academic]

The availability of academic staff to fulfil pastoral care and administrative duties was remarked on by both focus groups. A male academic noted wryly that one strategy "*that had been used to the extreme by some*" was to "*stay at home, lock your door, and avoid all teaching*". In addition, the availability of total staff hours for such duties was affected by how often their research took them away from the University.

Some staff will be away for a year or two and [when they are back] will not be assigned administrative tasks because it is assumed they will not be in School. (Male academic)

[25] It would also be constructive to consider what the consequences might be for students if those academics *did* restrict their pastoral care time.

While it was made clear that no blame was being placed on individuals, the point stated was that official staff numbers differ from staff "on the ground" and consequently workloads had to be shifted to accommodate fewer available staff; an issue that needs to be addressed by the School.

A number of female focus group participants also said that the extra time spent on pastoral care was also as a result of giving tutoring type assistance to other academic staff members' students. The female participants suggested that in their experience, students from other courses approach them rather than their course lecturers because: (a) they are proportionally more visible to service students (particularly first year service students – quantitative data shows that 70% of service courses are taught by women); (b) they may have been their tutors in the previous session(s), (c) they may be laboratory coordinators; and (d) often other academics are inaccessible or turn the students away.[26] In this way, participants of the female focus group agreed they pick up a significant proportion of the service duties of other academics and that this reduced time spent on their own research and teaching.

It is important here to also note that the significant pastoral work done by the Physics Friend is in support of upper level physics students, and thus benefits upper level lecturers (i.e. predominantly male academics) rather than first year lecturers and/ or physics service course lecturers (i.e. predominantly female academics).

5.4.2. Physics Friend

The Physics Friend is a key senior general staff position in the School of Physics providing a liaison between, and support to staff and senior physics students, as well as organisation and co-ordination of the teaching program of the School of Physics. The minimum qualification criterion for employment as the Physics Friend is a degree in physics or a related discipline. The Physics Friend is therefore well qualified to provide a particular professional level of support beyond administrative support. As the title suggests the Physics Friend also needs to be an approachable, patient and caring person with a commitment to serving the physics community at UNSW.

In terms of administration, the Physics Friend has the duty of coordinating staff teaching loads, as well as, in consultation with the Head of School, First Year and Undergraduate Directors, allocating all full time and part time staff to lectures, tutorials and laboratories. This is perhaps one of the most demanding (and sometimes confronting) roles of the position, because it impacts on the daily timetable commitments of academic staff. Teaching workload can ultimately have repercussions on research output and (therefore indirectly) promotion of academic staff members. However, as the Physics Friend is not a teacher or researcher, this can help ensure the impartial allocation of teaching loads, as there is no self-benefit or self-interest in the allocations.

[26] The female focus group participants made it very clear that not all the male staff were inaccessible to the students. They emphasised that a number of male academic staff were very devoted physics lecturers and teachers.

In coordination with the staff in the first year physics unit, the Physics Friend schedules lectures, tutorials and laboratories, organises suitable room allocations, supervises and co-approves staff absences ensuring staff availability for scheduled teaching duties. The Physics Friend has responsibility for organising upper-year examinations within the School including coordinating exam papers, scheduling internal exams, examiners, and assessors, allocating marking loads to staff, maintaining academic records and representing the School at the Faculty assessment meetings. The Physics Friend ensures that the Faculty handbooks and teaching-related material for the School's website are updated. The Physics Friend also assists with School publicity (including the very substantial Annual Report) and outreach activities. The Physics Friend is secretary of several School committees and therefore has a broad perspective of the School operation, management and policies, and as such is a unique resource to Physics staff and students.

In addition to the administrative duties of which only some have been detailed above, the Physics Friend acts as an advisor for second year and higher physics undergraduate students and physics postgraduate students. (First year physics students are looked after by Physics First Year staff). The Physics Friend receives enquiries from undergraduate and postgraduate students which can come by email, telephone or in person about anything ranging from degree coursework requirements to helping students who have missed assessments due to illness to giving careers advice. The Physics Friend can also on occasion provide anonymous feedback between students and staff. This part of the job is open ended, and the Physics Friend is expected to deal with whatever appears, when it appears, in a friendly and supportive manner as the position title implies.

> *"This can include buying 40 pizzas for a student lunch, discussing how to improve study skills, mopping up the tears of the bereaved, proofreading job applications."* [Physics Friend]

The Physics Friend also acts as a neutral academic advisor for physics students with unsatisfactory academic progression. At the end of each session students who are not progressing satisfactorily are interviewed in an effort to identify what is causing problems and what can be done to solve them, including referral to the university health service, university counsellors and/ or to the learning centre, etc. The Physics Friend does not provide physics tutoring or physics problem solving support for students. That is provided by the appropriate academic or teaching staff member (e.g. for example casual tutors and demonstrators, duty tutor, course lecturer, etc).

The position of Physics Friend was established in 2000. Prior to then some of the teaching administration and course advisory duties were performed by an academic staff member (most recently a level C male academic) who received a significant allowance for these duties. The Physics Friend's position integrated those duties performed by the academic staff member with other administrative, pastoral, marketing and outreach support tasks. The creation of the position of Physics Friend has had the benefit of freeing up academic staff to do more teaching and research.

It is clear that the Physics Friend is crucial for the delivery of well co-ordinated support including pastoral care for students in second year and above who are

majoring in Physics. Due to numbers (there are nearly ten times as many students enrolled in first year as in all upper years) and School structure the Physics Friend is less involved in the pastoral support of first year students. These students are more likely to approach the first year staff, tutors and laboratory supervisors for assistance than the Physics Friend. As the Physics men disproportionately teach students doing physics majors, their students benefit from the unique pastoral support provided by the Physics Friend, and they as academic staff members benefit from a corresponding reduction in the pastoral care they would otherwise be approached to deliver. The Physics women who disproportionately teach students enrolled in first year and/ or service courses do not benefit to the same extent.

5.4.3. Duty Tutor

Female focus group participants suggested that the absence of a part time paid duty tutor was one reason why pastoral care workloads had increased. Previously part time paid tutors filled the position of duty tutor. Now the role of duty tutor is filled by academics (which is taken into account in the workload unit scheme). However, only a few academic staff, both male and female, volunteer to be available for this, leading to an imbalanced proportion of duty tutoring being done by few people. When asked why this might be the case, one female participant suggested that

> *To some people [duty tutor] is considered to be a low level activity because previously it was a tutor's responsibility, not an academics.* [Female academic]

Those who *did* volunteer as duty tutor noted that many of the students had come because they found their lecturer inapproachable or unavailable, or because their tutors had sent them. This raises the question regarding what the responsibility lecturers and tutors might have in addressing the questions of their students.

> *I feel that [as a woman] you get stuck with the low paying things – like duty tutor. It pays very little in terms of [workload] units.* [Female academic]

5.4.4. Committee membership

While the committee membership of the female academic staff has increased in 2004, academic women are not represented in committees in equal proportion to the representation of academic men, particularly in the key decision making committees (e.g. Executive Committee and Research Management Committee).While is desirable that female staff be represented on key decision making committees in preference to the more administrative type of committees, a female academic focus group participant had a negative perspective of women's participation in committees.

> *Women don't say anything and they aren't heard.* [Female academic]

However it is hoped that wider representation on a range of key decision-making rather than administrative committees may improve the confidence and

visibility of women within the School management structure and enable the women to better contribute to decision making processes.

5.5. Gender related organisational issues

When the academics were asked whether they felt they were able to voice concerns and complaints within the School, the responses of the men and women differed markedly. The male focus group participants agreed that they could speak freely about any concerns they may have. The female participants, on the other hand, felt that when they voiced any concerns or complaints, they were not heard, not taken seriously and sometimes they were negatively sanctioned as a result:

> *You are not only not listened to, but you are made to feel stupid, that you are incompetent, that you are not organised, that you are not pulling your weight – which I've kind of wised up to.* [Female academic]

Some female participants agreed that if one were to complain about something in the School, "*things would only get worse*". They felt this was related to their gender. In the words of another;

> *I think women probably think twice about complaining because they feel they will not be taken seriously, but be seen as whingers…the problem here is that you can get a reputation as a trouble maker* [Female academic]

One woman academic related an experience in which she reported a case of bullying that she felt was not satisfactorily followed up at various levels of University management. This academic stated that the resulting situation, "*locally and institutionally, [caused] all sorts of problems for successful research output"* [Female academic] and that she perceived that in combination with other factors (e.g. lack of research funding and an inequitable workload allocation scheme) would adversely impact on her ability to get a promotion.

While the male academics did not relate such experiences or opinions, they did feel like they and the School had little voice or influence in University matters as a whole, and that a consultative process was lacking between academics and university management. Indeed, academic men and women commented on aspects of university organisation and procedures being arbitrary and unsystematic. One academic woman commented that "*University line management [does] not comply with written University policies"* [survey response]. The relationship between University management and the School, in terms of decisions that affect the School was also wryly commented upon by a male academic:

> *…recently I've heard of some very odd things happening - we don't know what really goes on "up the hill". That's not very surprising because we aren't generally told what goes on up the hill anyway. We just hear down here and that's how we're affected by it.* [Male Academic]

5.5.1. Student relations

While men did not feel that student complaints were a problem, some female participants did express concern over the way student complaints about academics were handled. They felt that students' complaints were not dealt with in a systematic or transparent manner. They felt that they would benefit from knowing what the complaint was, having an opportunity to discuss it with School management, and have the opportunity to address the issue. Women academics stated that student complaints were a problem because:

> *the women do more face to face teaching…*
>
> *so of course we're going to generate more complaints...*
>
> *and we're more exhausted too* [Female academics]

The value of teaching reviews/course evaluations was questioned by a woman academic. UNSW has a formal process for teaching reviews/course evaluations in which all lecturers are expected to participate. Course and Teaching Evaluation and Improvement/ CATEI has been developed to constructively to improve the quality of learning and teaching via anonymous student feedback.[27] Some academic women felt that these evaluations are not necessarily good indicators of student's attitudes because student opinion varies throughout the session. Surveying students in the final weeks of a session, when they have large workloads and stress, can skew results. Academics reported that students complain and are resentful about the number of times they are surveyed, again affecting feedback data. In addition, noting the disproportionate allocation of service courses to women; physics service students and physics major students have different attitudes to their course which makes the evaluations problematic to compare. Students have a particular expectation of what they expect from a "good" academic staff member and failure to meet these expectations doesn't necessarily reflect on the quality of the teaching. It was felt that care must be taken in how (CATEI) survey responses are used, particularly in comparative situations.

5.4.2. Support from the School

All the male focus group participants felt that the School was a "*supportive and inspiring environment to do research"*, and some, but not all, the women felt the same. It is important to note that those who felt unsupported carried some the highest teaching loads amongst the staff. The staff concerned were very disillusioned with the School's ability to support their efforts and meet the needs of some of its staff:

> *I've done so much teaching and I've done so much for the School…the School is not supportive back...I use to think the people above you know what they're doing and if it's necessary that you have to do this job then you should be doing it. But I no longer think so because people just don't care…*[Female academic]

[27] CATEI was introduced in 2004, before that a different form was used for surveying classes.

The research of all academic staff is indirectly supported to some extent by the School. For example, the School budget provides for computing and IT support which is essential for all modern theoretical and experimental Physics research. However, this support is not distributed equally throughout the School. Some academic staff have the additional benefit of technical support within their research laboratories which has (in some degree) been funded from the School budget. Not all staff benefit and it is not clear on what basis this support has been allocated. This is an undesirable situation in terms of equity, and may further disadvantage those who for what ever reason have not been allocated technical support. These staff must either use their own research funding to hire the technical support they need, or if they have insufficient funding, must go without.

5.4.3. Mentoring and collaboration

When asked whether they felt there were networks that supported their career development within the School, a male participant noted that "*the mentoring side of things is very poor – it's not formalised in any way*". Some female academics felt they had good mentoring support, while others felt they had no support at all. All agreed that it helps to have the support of a senior male academic within the School, with the experience and political weight that it brings, but care was necessary because sometimes the support may backfire.

One female participant stated that there was more often competition rather than support and perceived this to be the case within research groups as well as within the School in general. While some benefits were acknowledged, some female academics reported that the down side of collaboration, particularly with a male academic was the possibility of one's work being used to the other person's benefit at the cost of recognition and reward of one's own work. In some cases this occurred because other academics assumed that male academics were the principle contributors:

> *There is a perception that if you have a paper with a senior male, the senior male did everything. That's why I only publish in my own name now* [Female academic]

Some women found support from their spouses, who also worked within physics. However this could be both enabling and restrictive:

> *We've found that people assume that our husband is the senior partner or the driving force* [Female academic]

For this reason, some of the women have decided not to research or publish with their husbands.

In other cases, credit for collaborative work may be claimed by or attributed to one of the collaborators for various reasons (e.g. seniority). Thus, while collaborations in research and teaching development can be advantageous, they may also avoided be by the women because of the risk of losing credit for their own work. Unfair collaborations are of course not a unique problem for women researchers, however

many of the women had experienced this sort of exploitation previously (not necessarily at UNSW [28]). As a result, some female academics were wary or reluctant to enter into collaborative arrangements.

Such cases suggest that a formal clarification of mentoring and collaboration roles and processes is required so that the allocation of responsibility, work loads and recognition is not left to the ambiguities and misunderstandings that can arise in informal arrangements.

5.4.4. Promotion

> *Although it is never official, people [in promotions] will say off the record that they will not take teaching into account.* (Male academic)

Focus group, survey and statistical data show that career advancement is very much dependent on research productivity and that this is manifest, particularly in the promotions process. All survey responses from staff indicated that they would seek promotion on the basis of research, either exclusively or primarily if in combination with teaching and service. Thus, according to the focus group participants, the general attitude among academics – particularly successful academics – is that

> *Research is the most important thing and teaching is a thing that they have to do. Research is what counts.* (Female academic)

The academics most negatively affected by the prioritisation of research over teaching are those with heavy teaching loads and/or few "research resources" (including for example a research team of PhD students), such as junior academics and those with high teaching loads (quantitative data shows that women primarily, but not exclusively, fall into both these categories). This is because teaching and related administrative and pastoral care activities compete directly with research activities for time, and teaching holds less weight than research in the promotions process. This is particularly disappointing when the academic is not recognised for the teaching load with a high number of contact hours and associated pastoral duties:

> *When I went for promotion, someone from the committee said [that I've] "got an enormous amount of teaching" and that I'm "too eager to take on teaching" … they'd just say "you haven't published very much, isn't that terrible, and you didn't get any grants" … I've been penalised for having this enormous load of teaching that's being varied all the time.* [Female Academic]

[28] Some more recently recruited members of staff said that despite the issues at UNSW, they felt that UNSW is *"better"* than their previous place of employment.

5.5.5. Domestic circumstances and carer responsibilities:

Primary carer responsibilities

All female survey respondents have partners and children, although the children range in age from very young (under one year) to teenage and upwards (with many still dependants). Over half of the male respondents have partners and children, and the remainder are single or have partners and no children. Carer responsibilities are carried by the women in most cases. All the women academics are primary carers (or were, when their children were young). One male academic respondent reported equally sharing caring responsibilities and none of the other male academic respondents are/were primary carers. Similarly, half the academic women and one male academic reported having additional caring responsibilities (such as aged parents or sick relatives).

All focus group participants acknowledged the impact that having a family had on career progression. Interestingly, the male participants went into more detail on their experiences and thoughts on the negative affects primary care responsibilities might have on one's career, noting in detail the kind of support provided by their spouses. For example:

> *To be honest, I just can't work out how people with families do it. I just manage to do my job provided I spend 10 or 12 hours a day here. But if I did have a family I don't know how I'd get around a job. I might well be on half time.* [Male academic]

> *I have a family with a very supportive wife. Travelling and working long hours…if it hadn't been for that…well, I think it's a very important factor to my success.* [Male academic]

For the female academics the effect of family responsibility did not draw as much comment other than stating that it resulted in disengagement from academic work, a statement supported by survey results. The lack of explicit comment in the focus group may be due to the fact that all the women are mothers and integrating the demands of family life and academic life at UNSW is an experience they take for granted.

Family, mobility and sabbatical leave

It was stated in the women's focus group that primary care responsibilities and spouse's careers did impede their mobility. This in turn affected their ability to take Special Studies Program (SSP) leave (i.e. sabbatical leave). SSP leave is pivotal for the development of academic staff members research.

> *(sabbatical leave), for me has been what has kept my research career going. Every three or four years, I get a chance to rejuvenate and do*

research. If it wasn't for that, I would have faded away by now I think. [Male academic].

When the children of male academics were young (usually at the pivotal early stages of their academic careers), they were able to relocate for SSP with the support of their spouses/ partners. The majority of the spouses/ partners did not have career obligations and were able to look after their children. Indeed, one male academic stated that it enabled him to have time with and travel with his family. Of the female academics, few were able to take SSP because of their family responsibilities particularly when their children were young. In addition the spouses/ partners of the women tended to be older and in more established in their careers and were not available to travel as the SSP system requires. Until 2004, only one of the current physics women academic staff had taken SSP. The recent option of teaching release is much more compatible to the personal situation and responsibilities of the physics women. When this option was made available two long term physics women academic staff members took leave for six months in 2004 and 2005.

Family and Time

The impact of breaks in a science career were universally acknowledged to be detrimental.

If you have to take time off in science, for whatever reason…you can't seem to get back into it. [Male academic]

The clearest impact families had on career was the time taken to raise children. The staff survey showed that most women had primary care responsibilities and all but one of the women took breaks from *full time work* in physics. The length of time for these breaks ranges from 3 months to 8 years with the average length of time over 5.5 years. Some women worked part time in physics during this period, usually in a teaching role. In comparison, all the male respondents had no primary carer responsibilities and one staff member shared primary carer responsibility. None of the male respondents had breaks from full time work in physics. However, two male focus group participants presented a constructive equivalent: they had changed fields of research within physics and their words shed some light on the impact that breaks from work have on one's career progression irrespective of one's gender:

It was like having been out of the game for about four years. Suddenly all the invitations to give invited talks disappear because you're new to the game and you're having to pay your own way to go to conferences…you start to think. 'Oh gee, I'm a junior researcher here; no-one knows who I am. [Male academic].

Consequences

Some academic women believe that they are unfairly judged by some (sometimes newer) members of staff to be mediocre or of lower ability because they have not been promoted at the same rate or to the same levels as their male colleagues of similar age. It was felt this erroneous perception is due to a lack of understanding

of the impact of a non-traditional career path and a lack of appreciation of the restricted opportunities that some of the women had experienced during their careers.

6. Emerging Themes

The findings of the empirical research indicate that there are several explanations for why the average performance as indicated by academic progression of the academic women in the School of Physics, University of New South Wales is not equal to that of the academic men. Several issues have arisen from the research, related to the success of all academics in the School, and highlighting in particular the situation of women academics, junior academics and academics with heavy teaching loads.

6.1. Teaching versus Research

Over 95% of School of Physics teaching academics are considered research active according to Department of Education Science and Technology (DEST) standards and derive great personal and professional reward from their research. Similarly, the academics participating in this project contribute significantly to teaching. However, the relationship between teaching (service) and research is often perceived to be a problematic one in the University.

Academic women and men who carried high teaching loads expressed concern over how academic work is valued, and what is considered "valuable" academic work. It was felt that teaching was much less valued than research in the University and in the Faculty, particularly in the promotions process. Although there are some awards for teaching, these were perceived to be merely cosmetic because staff are not confident they are seriously considered in the promotion process. New University promotion guidelines may allay some of these concerns in the future, if their implementation can be demonstrated to produce the desired more equitable outcomes (http://www.hr.unsw.edu.au/academic.htm). However, recent attempts by University management to encourage the publication of work on teaching innovation are seen as recognition of research-style work, not the "plain hard work of teaching" (Physics academic woman). Indeed it is felt that as a result of the University's previous promotion policies, the responsibility of teaching has become a burden that prohibits research work and thus career opportunities.

In terms of the School's own systems, although these are established with the aim of fairly redistributing workloads amongst staff, this study has found that they have evolved into systems that reinforce and perpetuate inequitable teaching workloads and responsibilities. The distribution of workloads via the current workload unit (WLU) scheme needs to be addressed. Some levels B and C academics (women and men) observed that some measures of research productivity, such as external grants and publication numbers, can be misleading indicators and need to be revised. Furthermore, the WLU scheme can be detrimental to academics who for various reasons, have low research output (according to WLU measures). Whilst the WLU scheme gives allowances for research productivity, it does so at the expense of academics with prohibitive teaching loads. They cannot write up research because of their teaching load, therefore they do not get WLU allowance reductions; therefore they have to teach more, which feeds back into the cycle. This self perpetuating *"downward spiral"* [woman academic] is exacerbated by the weighting of lectures, tutorials and laboratories in such a way as to increase contact hours of lower level, teaching intensive academics (see section 4.5 and 4.6). Male and female staff with

higher teaching loads and contact hours (e.g. level B and C academics), find it very difficult to progress their research.

6.2. Workload

The fact that women academics, comprising 21% of the academic staff, average more contact hours per workload unit than academic men and carry 70% of the service teaching – the "bread and butter" of the School – is a stark indication of the workloads they carry (these figures are based on timetabled hours and beg consideration of unquantified administrative and pastoral work). In general the physics women have large physics service course teaching loads and small physics major course teaching loads. In contrast, the senior academic men have higher proportions of physics major courses to teach.

This imbalanced representation has several consequences that impact on equity and gender issues. Firstly, physics major students can complete a degree without being taught by an academic woman, thus perpetuating the idea that women play peripheral or service roles in academic physics and denying all students female academic role models. Secondly, academic women do not get the opportunity to teach students with a primary interest in physics, nor to experience the related satisfaction of witnessing student's scholarly development. Third, an established teaching relationship often informs a student's choice of supervisor, thus women are by default not considered and miss out on potentially mutually beneficial research supervisory relationships. Finally, high service teaching loads are time consuming and exhausting, with high student enrolments, and thus impact on research productivity and increase the probability of student complaints against that academic staff member. The strong feeling amongst level B and C physics women and men with high teaching loads, is that systems by which academic work is recognised must be reformed and that the distribution of teaching work amongst staff must be equitable and representative.

6.3. Increasing Teaching and Administrative Workloads

Similarly to academic staff in the School of Public Health and Community Medicine (EADU &SPHCM, 2004), academic men and women in the School of Physics commented on the pressure of increasing workloads and the reduction in administrative and financial resources. For some staff, the increase in administrative and teaching workloads has meant restricting time spent with students, whilst for others research time has been sacrificed. Academic women were more likely to fall into the latter category, resulting in further disruption to and degradation of their research productivity and promotional opportunities suffered. In both cases time pressure has impacted negatively.

6.4. Gender as an Issue in the Workplace

Of the academic staff who participated in the focus groups and surveys, more academic women were conscious of gender as a feature of their experience of academic work than academic men. Furthermore, the dissatisfaction of the women academic staff with their teaching and research conditions, their prospects for promotion, and their treatment by either the students or the staff contrasted greatly with the academic men's satisfaction with the same.

Overall, women academics felt that their experience of academic work was not the "norm", in comparison with their male colleagues, and that this was related both directly and indirectly to their gender. There are both objective and subjective ways in which this occurs.

Women's (gendered) social roles both inside and outside of work impact on their access to opportunity in the academic work place. As mothers and/or primary carers as well as academics, women must divide their energies between these competing priorities. The objective factors of (a lack of) time and mobility have recurring impacts on women's academic work and career progress, particularly in light of the failure to usefully accommodate the alternative career paths women may take in light of their social responsibilities.

Although the women academics did not directly state that external care responsibilities competed with work for time, it is apparent in their survey responses regarding time use that they spend more time on domestic duties than their male colleagues, and that this competes with time spent on academic work. In addition, survey responses indicate that for academic men and women in particular, the early stages of career establishment often overlapped with childbearing and raising families. The impact on career progression for women is significant in contrast to men. Access to opportunities that require mobility and time (such as post-doctoral research, participation in conferences, special study program or sabbatical leave (which previously required academics to travel), etc., is severely limited when one is primary carer. To illustrate this point: male focus group participants felt that the first five years of their academic careers were crucial for establishing a research field, publications record, grant record and international reputation. They also felt that they would not have been able to achieve their current standing had they had primary care responsibilities.

There are also subjective ways in which gender affects women's academic work and career. Women felt that the types of academic work that they chose, and the way in which they engaged with their work was different from their male colleagues. For example they felt that they often did more of the invisible (unquantifiable, untimetabled) or under-appreciated (lower status) work such as pastoral care, and service teaching, laboratory and tutorial classes which were time-consuming, but did not bring them recognition or material benefit. However, they also felt that this work had to be done and was a responsibility of academic staff as teachers. They did this work because they chose to (which may be attributed to a gendered difference in attitudes to teaching responsibility), because the work was assigned to them (some of the women thought that this was a result of others perceiving them as "teachers" and "tutors"); or because nobody else was doing it and it needed to be done.

The women also felt that they had to work harder or prove more in order to be respected in the same way their male colleagues. Interestingly, this pertained to the School and University, but not in the international arena of their field of expertise, in which they felt they were generally valued equivalently. Women academics noted that they were not always treated with the respect and regard that they felt they deserved, and often questioned whether they would be treated the same way if they were men. They felt that they had to work harder to gain respect that was often automatically given to their male colleagues, for example, by students (although other examples were drawn from interactions with industry representatives, academic and non

academic university staff as well). It is for this reason that the women participants stated they were wary of collaborative work with male academics (in particular senior male academics) because they were assumed by others to be "assistant" or "junior" rather than co- or primary contributors.

Many of the women participants stated that they avoided voicing any disagreement or complaint about School-related issues because they felt that, as women, their concerns would be dismissed, nothing would be done, and/or that they would be negatively sanctioned as a result. The individual academic women assumed they alone were hesitant and were surprised to find that the others in the focus group felt the same way. Some women academics also felt that when complaints made against them (e.g. from students), they did not get the opportunity to hear or address the complaints. These issues highlight the importance of following transparent and objective processes for addressing complaints and disagreement so as to maintain objectivity and to encourage open communication within the School and to obtain feedback and resolution so that the same problems do not arise in future.

The academic women also felt that they had little input into the operation of the School. This is in part due to the fact that generally only associate professors or professors can hold administrative and managerial positions, and that membership in the most influential committees which may be automatic for professorial staff is by election for the less senior (mainly female) staff. This is an indirect result of gender because access to opportunities that enhance promotion chances are influenced by gender, as discussed briefly above.

6.5. Organisational Change and Gender Equity

6.5.1. School Organisation

As academics in physics both women and men understand what to expect of their work conditions and career opportunities. However, the chance to fulfil these expectations can be undermined by existing organisational culture and process, political policies and work conditions. Unfortunately, the ubiquitous and often uninformed explanation for "poor performance", in the rhetoric of corporate management discourse, is a lack in individual ability or application. With reference to the performance of women in the work place, it is also convenient even as recently 2005 to fall back on biological determinism to explain why women do not perform at the same level as men (*c.f.* Harvard president's 14 Jan. 2005 speech at the 2005 NBER Conference, (Summers, 2005)). Perhaps what the Maximising Potential in Physics project shows best is that the performance of the women in the School of Physics is indeed influenced by their gender, not due to genetic predisposition, but as a result of the differences in social and cultural conditions under which academic men and women work. As women, the organisational environment had default roles for them to play which are created and maintained by organisational culture and processes and personal interactions that are difficult to change. Academic staff own gendered perceptions of their roles also contribute to this situation.

This situation is exacerbated when forms of academic work, such as teaching, teaching innovation and administrative work is perceived not to be sufficiently recognised by the promotions process (arguably the only process in which the full range of academic work can be formally recognised). The frustrations arising from the

contradiction between University management assertions of the importance of teaching and the lack of recognition for the "plain hard work of teaching" is considerable.

Even the intrinsic rewards of teaching are diminished in some cases, with most of the women in the School of Physics teaching students in service courses (i.e. a course providing targeted basic physics instruction to students majoring in other areas of science or engineering) and thus not having the opportunity to follow the students' intellectual development throughout their degree. The reward for teaching a student with a sincere passion for physics is quite different to teaching a student from another discipline studying a compulsory basic service course. Physics is sometimes (often?) perceived by people who are not physics aficionados to be a difficult and dry subject. The service course students may be less receptive to the subject matter because of negative perceptions of the difficulty of physics, and therefore effectively teaching physics service courses requires special skills and dedication. These service students may also need extra help and encouragement. Additionally, it may be more difficult for an academic staff member teaching a service course to get a positive anonymous student feedback assessment via class surveys.[29] Furthermore, the stress and pressure of high teaching and administrative loads can impact on the quality of teaching and the number of student complaints.

6.5.2. Faculty and University Organisation

The Probert Report (Probert, 2002) identified that the working lives of most academic staff are particularly influenced by the leadership in their particular School or Faculty. However, beneficial policies and practices can be used to improve the situation across the University. As a result of the UNSW Gender Initiative, including the research and recommendations developed in the Probert Report, a variety of innovative University policies were initiated in 2003 to improve gender equity in academic employment. These initiatives include Women's Promotion Workshops for women applying for promotion to level D (identified as the level at which University and Physics women's career progress generally stalls), UNSW Staff PhD Completion Scholarships of up $10,000 each; Special Studies Leave rules have also been changed to allow this leave to be used for PhD completion; Career Advancement Fund of $10,000 for women academics returning from maternity leave to help re-establish their research careers; Vice-Chancellor's Childcare Support Fund for Women Researchers to a maximum of $1,200 per application to assist with additional childcare costs; and an annual program of Equity Initiative Grants of up to $10,000 each to enable staff to investigate or initiate innovative research or programs related to gender equity.[30]

The University's innovative policies and programs were developed to address the needs of the average UNSW woman. However many of these policies are not relevant for the current cohort of Physics women as all of them have PhDs and most of the children of Physics women (who are all mothers of between one and four children) are old enough not to need child care anymore. Clear gender differences

[29] The anonymous student feedback is currently formalised into the Course and Teaching Evaluation and Improvement (CATEI) process at UNSW. (http://www.unsw.edu.au/learning/pve/catei.html).

[30] contact http://www.hr.unsw.edu.au/services/empequity.html for further details on these excellent initiatives.

have emerged in the survey and focus groups data about the impact of family responsibilities on time management, career path, career choices and academic progression. Many of the organisational factors observed at the School level are reflected at Faculty and University level. A traditional career path is still the most efficient, effective and recognised path to promotion within the University.

Ultimately though, career progression is just one goal of equity in the workplace and should not be the only way in which equity is achieved or measured. University employees should be able to derive fulfilment and recognition at all academic levels. Indeed it is necessary that this occurs because not all academics want professorships, not all academics *can* be professors, and most importantly, the dedication and hard work that academic staff invest in their work deserve recognition and reward.

The collegial form of University and School organisation arguably provided this recognition in previous decades: there was uniformity in experience and more consensus on priorities and interests for the predominantly white, male academics. However now, as tertiary education and the professions become accessible to people previously excluded from academe – including women – the academic labour market is changing demographically, and will continue to do so. The diversity of experiences, interests and needs require that universities ensure incorporate the diversity of needs into organisational processes. This places new importance on procedures of communication and decision making which will, ideally, impact on other functions such as resource allocation, workload distribution and recognition of contribution and achievement.

This does not simply mean that representation of women must improve. It requires their active inclusion and participation in the life and processes of the School and University, and the creation of the conditions under which this can flourish. The presence of women on a decision making committee will not ensure that equity is achieved. They, like all members, must feel confident that their insights will be heard and considered with the same consideration and respect given to others, particularly if they speak as representatives for other members of the School.

Unfortunately new corporate management systems are a long way from providing this kind of environment. By shifting control over funding allocation from Schools to central management, devolving operational costs from University management to Schools, and implementing strategies that increase academic workload and competition for resources, corporate management reforms may alienate academic staff from their work, from each other and from the University. For example, academic staff must think of their work more often in terms of the short term value it brings to their promotion chances or job security, and less in terms of the long term and qualitative value it brings to their discipline, School and students. The increased competition for scarce resources undermines trust between colleagues and within Schools that are already struggling under the inadequacy of the collegial structure to integrate a diverse workforce. Academic staff view with uncertainty and increasing apprehension, the minimal control that they have over their working conditions and job security.

In such an environment, academics use the resources they have to meet the increased demands of work, or shield themselves somewhat from the tighter budgets and higher workloads. As this study has shown, academic staff have differential

access to resources such as funding, workload credits, postgraduate students, research teams, technical support, professional networks etc. Those who do not have these advantages must use their basic resources – time, labour and skill – to make themselves valuable to the School. Often this group encompasses level B and C academics, academics entering a new research field, academics that specialise in education and academics with heavy teaching loads. Academic women often fall into this category, but by no means exclusively.

Currently, one of the major reasons the School is productive is because teaching and research is unevenly distributed amongst academics, with some academics doing predominantly teaching and others predominantly research. This has been enabled somewhat by the gendered differentiation of academic roles within the School due to women's and men's contrasting career trajectories (traditional versus non-traditional). The development of other mechanisms (resource allocation, networking, decision making), individual work/career strategies and unconscious attitudes have also contributed to the current situation. The fair and equal distribution of resources (funding, technical and administrative support etc.) and responsibilities (teaching, pastoral care etc.) can go some way to supporting academic staff individually and the School as a whole. Ultimately however, academic career progression, the productivity of the University, and its national and international profile, requires a decision to actively and equitably support all members of the University: a decision that should be supported at all levels of University management.

7. Recommendations

Many of the following recommendations relate to fostering the research activities of staff. Of course not all staff agree with all recommendations. It is clear however that some staff have been unable to sustain their research because of their high level of teaching, administration and (unrecognised) pastoral activities.

It is also reiterated that some women were appointed as teaching academics, but all women have a PhD in physics and all expressed their strong desire to participate fully in research as well as teaching activities. The difficulty in establishing of a research profile for most Physics women relates to their non-standard career path, where breaks for child rearing, lack of opportunities to do postdoctoral fellowships and take sabbatical/ study leave have impacted through out their careers.

Postdoctoral fellowships enable a researcher to build up research networks, establish a publication record apply for grants, and develop a research leadership profile. Most Physics women have not done postdoctoral fellowships, and those women have not been promoted at either the rates or to the levels of their male colleagues. This is not because these women are less able or less talented, but because they have had less opportunity to succeed. As many of the women did not have the opportunity to do post doctoral fellowships, their research profile was less established, they therefore had less initial and subsequent success attracting research funds and therefore were given a greater teaching load than their well funded research active colleagues. This situation can and has become self perpetuating.

7.1. Recommendations relevant to the School of Physics

Establishment of a School of Physics Equity Committee

It is recommended that a School of Physics Equity Committee be established to ensure implementation of initiatives, to monitor their effectiveness and subsequently to refine initiatives if necessary. This committee was established in 2004 at the beginning of the Project. The School of Physics is the only School in the Faculty of Science with an Equity Committee.

Development of School of Physics recruitment policy

Currently women are adequately represented in percentage terms relative to feeder group. The age profile of the School of Physics indicates new staff will need to be recruited in the next decade if current research and teaching activities of the School are to be maintained. While affirmative action is not recommended, a documented recruitment policy mindful of equity issues could increase the diversity and ensure proportionate gender representation in the School.

Development of School of Physics mentoring strategies within the Career Development Scheme

A mentoring scheme (possibly incorporated into the career development program) should be implemented to assist (a) new academic staff in the early years of their academic career, (b) academic staff wishing to revitalise their research. The aim of this program would be to provide staff support in setting up and balancing research, teaching, and service commitments. Some School of Physics men have developed successful strategies that allow them to effectively balance their teaching, research and service. Successful strategies such as taking SSP or teaching release regularly, defining set consultation hours, and making firm "appointments" to do research have been identified by this project and are recommended to all staff.

Review of Workload Allocations Scheme - More equitable distribution of teaching duties.

Workload allocation must aim to fairly distribute work by accounting for all forms of academic work The introduction of the more equitable revised workload allocation scheme in 2004 gave every staff member the same number of Work Load Units (WLUs). In previous years there was a sliding scale of WLU allocation, with the professorial staff allocated the least number of WLUs. Despite the implementation of the new scheme, the disproportionate allocation of low WLU value tutorials and laboratory classes to the level B and C academics did not allow the hoped for benefits of more equitable distribution of contact teaching hours to eventuate.

Note that >95% of School of Physics academic staff were officially deemed "research active staff" in 2005 using the criteria used to inform the allocation of research resources. The high percentage of "more" research active academic staff in the School of Physics are to some extent indirectly supported by staff who are "less" research active and therefore have a greater number of contact hours.. These staff are less research active, not necessarily through choice, but rather through circumstance or lack of opportunity. *The current WLU Scheme does not provide a mechanism to improve a research profile or to become research active.* Physics women (who all have a Physics PhD and have all applied for research funding with varying success over the period 2001-04), expressed a strong desire to enhance their research activities.

A key reason why physics women have such high contact hours relative to the most of the physics men is because they are more likely to be assigned low WLU value tutorials, duty tutoring and laboratory supervision to fulfil their teaching workload allocations. *Staff should be allocated an **equal proportion** of lectures laboratories and tutorials.* This would facilitate a more equitable distribution of formal contact hours as well as teaching activities. A teaching allocation that includes higher WLU value lecturing duties reduces contact hours and provides fewer fragmented, more usable blocks of times to devote to research.

Review of Workload Allocations Scheme - Recognition of new teaching practices.

The workload allocations scheme should be regularly reviewed to reflect new teaching practices, especially those which do not involve face-to-face lecturing, such as "exploratorials"[31] and development of internet based courses. This will allow staff to be appropriately recompensed for the time spent in teaching activities, and also encourage staff to continue to initiate and develop innovative teaching practices.

Review of Workload Allocations Scheme – Internal research grant funding.

For the purposes of workload allocation, no concession is given for successful internal grant funding. These schemes are competitive and peer reviewed. The funded research also takes time to complete. This level of funding allows relatively economical research projects which also generate peer reviewed publications to be initiated and supported. These publications generate research income for the University. Internal research grant funding can provide opportunities for a staff member to reactivate their research: Preliminary studies can be completed, publications can be generated which can increase the likelihood of subsequent successful external funding. Internal research funding should be included in the workload allocation scheme.

Access to various types of leave should be equitable.

Staff who have not had the benefit of SSP, internal/teaching release and other leave etc, should be encouraged to take these opportunities to "revitalise" their research. Staff who have not had the benefit of SSP, teaching release and other leave entitlements should be given *priority* over staff who have made frequent use of these programs in the past. Staff should be better informed of their entitlements (e.g. link on School of Physics Equity web site). *A formal process for application and approval for SSP etc, should be developed within the School to ensure equity*.

Reduce the cost of buying out teaching

In 2005 the cost of buying out one WLU is $135, which is prohibitive in most cases. While it is most desirable that the academic staff lecture to students, the possibility of buying out excessive lower WLU value/ high contact hour laboratory and tutorial duties should be an option *only under approved circumstances*. This recommendation is emphatically not to provide a means by which well funded staff can buy out their teaching. Rather it is to provide an opportunity for teaching relief for staff with large teaching loads and who also some discretionary funding, the possibility of cutting back their contact hours and redirecting some of their time to research activities subject to the approval of the Head of School.

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[31] "Exploratorials" are innovative two hour tutorial sessions which have been developed by School of Physics staff to "integrate observations, experiments, calculations and theory. They aim to offer the insight of a lecture, the student-led analysis of a tutorial and the hands-on measurement of a lab, and will be supported with a range of media."

For further details see http://www.phys.unsw.edu.au/exploratorials/about.html

Recognise Women in Physics

The School of Physics has displayed framed portraits of high achieving (almost exclusively male) physicists on the walls of the corridors in the Old Main Building for decades. In 2002 an anonymous person believed to be a female physics student attached printed sheets of the biographies[32] of high achieving but little recognised women physicists between these framed portraits (see Figure 46). It is likely that the person(s) responsible did this to redress the balance because she/ he perceived that the women's contributions were not (fairly) recognised. The profile of women and recognition of women in physics needs to be improved. Replacement of the loose sheets with properly framed biographies of some high achieving women physicists is not window dressing. It is important to equitably recognise achievements in Physics by both men and women. It sends out a message to all our students that women also contribute to physics. Women make up ~25% of our enrolments. If the percentage is to increase students need to see that contribution from women are real and valued, and there is a place for women in physics. Our survey of both male and female senior physics students indicated that the academic women in the School are seen as peripheral.

Equity in School committee membership.

In general academic women are not represented in committees in equal proportion to academic men, particularly in the key decision making committees at School level. This may be due to the smaller pool of academic women, the ex officio (i.e. professorial) membership in many committees and the requirement to cover different research fields in those committees, etc. It may not be desirable for full gender equity to be implemented on every committee as the female staff may find their non-teaching times dominated with committee responsibilities. However from an equity standpoint, it is desirable that female staff be represented on *key decision making committees* in preference to the more administrative type committees. In particular, it is recommended that there should be an Equity Committee representative on the Committee that allocates undergraduate teaching duties.

Equity in allocation of technical support.

The research of all academic staff is indirectly supported to some extent by the School. (e.g. computing and IT support which is essential for all Physics research). Some academic staff have the additional benefit of technical support within their research laboratories which has to some degree been funded from the School budget. It is not clear on what basis this support has been allocated but not all staff benefit. This is an undesirable situation in terms of equity. Any allocation of technical support for the research of academic staff members paid from the School budget should be on the basis of a transparent process.

[32] The biographies remained on the walls for a period of over two years, a tacit acknowledgement by staff and students that the contribution of these women physicists is significant and worth recognition.

7.2. Recommendations relevant to the Faculty or University

Recognition of service and pastoral activities

It is important to recognise the time and effort some staff devote to ***service*** roles within the promotion process. Those involved in pastoral activities have less time to do research. The research efforts of staff who minimally participate in pastoral/ service activities are indirectly supported by those who do.

UNSW Career Advancement Fund - Equity Initiative research start up fund.

The Probert Report (Probert, 2002) found that UNSW women tended to be younger that UNSW men and fewer women had PhDs. UNSW developed some excellent equity initiatives to assist academic women's staff development using these data. UNSW's admirable programs to assist the academic women include help to complete PhD theses, conference child care provisions, maternity leave provisions and post maternity leave start-up research grants of $10K (UNSW Career Advancement Fund), etc. Unfortunately these programs do not assist most women currently in the School of Physics. All women already have PhDs. All women have children but due to the ages of the children, currently only one woman is directly benefiting from the maternity/ childcare related initiatives. This may change if physics women are recruited in future.

A scheme which would provide funding to revitalise research programs would be beneficial to physics women and help aid their career development. The University currently provides women returning from maternity leave with $10K to restart their research. A similar program to assist eligible (male and female) staff who because of teaching and administrative duties or other issues beyond their control, have also experienced a hiatus in their research. Such a program would be would be particularly valuable to most of the women in the School of Physics, and no doubt would be of benefit to other academic staff in similar situations in other Schools across the University. This money could be used to hire a research assistant, buy out some teaching, do preliminary measurements for a new area of research, etc. In return for this funding it is recommended that the recipient should be required to submit an external funding grant application within 18 months of receiving the funding.

Carer Assistance Fund

Also, it is clear that carer responsibilities may also impact on the ability of some staff to attend conferences and/or take SSP (sabbatical leave). Access to the Vice-Chancellor's Child Care Assistance Fund and assistance for academic staff on study leave schemes could be extended to cover carer as well as child care responsibilities.

Equity in committee membership at Faculty and University levels.

In general academic women are not represented in committees in equal proportion to academic men, particularly in the key decision making committees.

From an equity standpoint, it is desirable that female staff be represented on *key decision making committees.*

Promotion at UNSW

It is a strongly held perception amongst Physics academic staff that successful promotions particularly to senior levels depend strongly on research achievements rather than teaching or service. Demonstrated and genuine recognition of teaching and service in the promotion process would encourage more staff to apply, and would result in more successful applications.

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8. Postscript

8.1. Establishment of a School of Physics Equity Committee

To the credit of the past and present Heads of the School of Physics, this committee was established in 2004 and has been invited on occasion to provide ex-officio representation on other committees. The School of Physics is the first and currently the only School in the Faculty of Science with an Equity Committee.

8.2. Promotion of female academic staff

During 2005, all three level B women were promoted to level C (see Figure 44 and 45). Two Physics women who have been long term UNSW employees (>10 years) were promoted from level B to level C. In addition a level B woman applied for a new Physics academic position and was appointed at level C. To date none of the women who have been employed at UNSW in excess of 10 years have been promoted beyond level C in contrast with their male colleagues. In 2006, a more recently appointed level C academic woman (0.2 FTE) was promoted to level D.

Figure 44: Percentage of School of Physics academic staff by gender and level (2004)

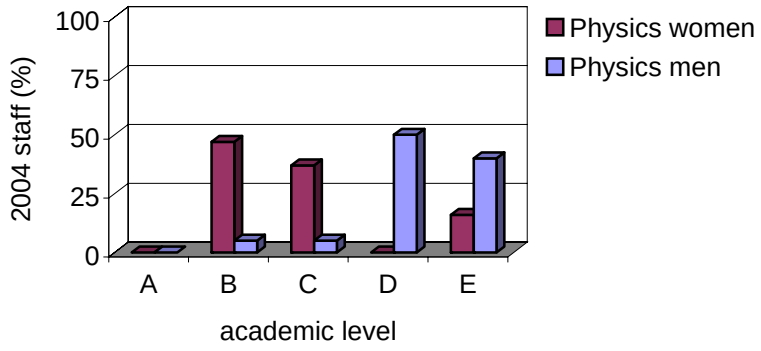
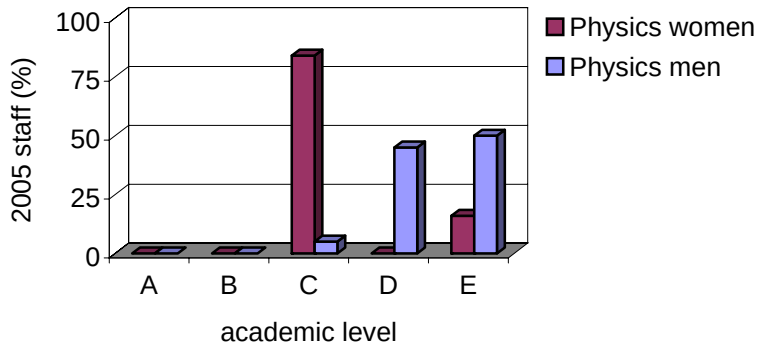


Figure 45: Percentage of School of Physics academic staff by gender and level (2005)



8.3. Sabbatical leave (SSP) and teaching release for female academic staff

Prior to 2004, only one of the current physics women academic staff had taken a session of SSP. This level C woman took a further session of SSP in the second session of 2004. The recent option of teaching release is preferable for most of the physics women whose responsibilities have not allowed them to take SSP in the past although they are eligible. Since this option was made available, one long term level C physics woman has taken teaching release in the second session of 2004. Other eligible women have been encouraged to negotiate their options for the future: A level B woman who has been employed at UNSW for >15 years has never been able to take SSP in the past, negotiated a fractional teaching release in the second session of 2005 and a full session of teaching release in the first session of 2006. A more recently employed woman took SSP in the second session of 2006. The level E physics woman is a research only academic.

8.4. Establishment of the Dean's Gender Equity Advisory Committee (DGEAC) in Faculty of Science

As a result of UNSW Equity Initiative Grant funded investigations of equity issues within the Faculty of Science[33], a Gender Equity Advisory Committee has been formed in the Faculty of Science. This is the first such Faculty equity committee at UNSW. The purpose of the Committee is to identify and co-ordinate gender equity initiatives within Science, and monitor and advise the Dean on improving the gender equity profile amongst academic staff and students within Science. The Committee is comprised of a representative of all Schools in the Faculty, nominated by their Head of School, together with "ex officio" representation from the Equity and Diversity Unit (up until the end of 2006 when this Unit was disbanded), the Science Human Resources consultant and the Faculty Standing Committee

8.5. Extension of this Physics Equity Project to a Faculty of Science Equity Project.

Significant gender related issues have been identified from the data collected for this School of Physics Equity project. As a result the Faculty of Science DGEAC applied for 2006 funding to extend the Physics project to an investigation across the Faculty of Science. The results from this Physics project will be compared and contrasted with a those from the School of Biological, Earth and Environmental Sciences (BEES) which has ~10% women academic staff, and the School of Psychology which at 40%, has the highest representation of women academic staff. These Schools are of a similar size to Physics in 2004[34] but represent opposite ends of the academic gender profile spectrum in the Faculty. The Equity Initiative Grant Application, the Ethics approval application, the methodology and surveys developed for this Physics Equity Project have formed the basis of the Faculty Equity Project. Comparisons across the three Schools will be used to develop specific and general recommendations for strategies to promote the academic advancement of women in

[33] During 2004/5 EIG projects were funded in the Schools of Physics (this project), Mathematics, Materials Science and Engineering, Psychology and Biological, Earth and Environmental Sciences

[34] The School of Physics was restructured in mid 2006.

these Schools, and across the Faculty and University. The Faculty project willreport in 2008.

8.6. Acknowledgement of the contribution of Women in Physics.

Surveys of senior physics students revealed that physics women were generally seen as peripheral or of lower status than their male colleagues. This was largely due to the fact that the physics women tend to teach service courses and are therefore not as visible to the physics major students.

Figure 46 shows the corridor outside the School of Physics office in 2004. On the walls are pictures of high achieving physicists (often Nobel Prize winners) who have contributed to important physics research over the past ~100 years. The vast majority of the pictures are of men. This is of course due to historical reasons as women (and minorities) did not have the same educational or work opportunities as men. In some cases women did make significant contributions in the sciences but they were not always fairly acknowledged. Probably the best known case is that of physical chemist Rosalind Franklin (Maddox, 2002), (Franklin, R.: CWP) who contributed to the understanding of the structure of DNA. Lisse Meitner (Sime, 1996), (Meitner, L. CWP) and Jocelyn Bell Burnell (Burnell, J. B. CWP) are examples of physicists whose contributions to Nobel prize winning work were not acknowledged by the Royal Swedish Academy of Sciences selection committee for the Nobel Prize in Physics.

In the words of Chien-Shiung Wu[35] when describing women physicists: *"Never before have so few contributed so much under such trying circumstances"* (McGrayne, 1998)

Figure 46: School of Physics ground floor corridor – 2004

In early 2003 the printed sheets of biographies of women physicists were anonymously interspersed between the existing framed pictures of the eminent physicists. This occurred presumably because the responsible person or persons[36] felt

[35] Chien-Shiung Wu (1912 - 1997) demonstrated experimentally for the first time that parity is not conserved in nuclear beta decay. She was the first female president of the American Physical Society.

[36] Believed to be (female) student(s).

that the work of these women, or women physicists in general had not been acknowledged sufficiently. The printed women's biographies were not removed either overtly or covertly, despite ample opportunity to do so. This indicates that no staff or students objected to the work of these women being acknowledged along with the work of the men. The fact that the original framed pictures were (predominantly) of men relates to historical context rather than a current conscious decision to minimise the contributions of women physicists.

It is important to ensure that physics women are properly acknowledged. Approximately 25% of current physics students at UNSW are women and it is essential to equitably recognise achievements in Physics by both men and women. This demonstrates to students that the contributions of women are valued, and there is a place for women in physics.

Following interim recommendations made as a result of this study, the current Head of School, Prof Richard Newbury approved the funding for an initial group of women physicists to be "promoted" into framed pictures in the corridor. Nominations for these women were sought from staff and Lise Meitner, Jocelyn Bell Burnell and of course Marie Curie[37] were selected. Refurbishments in the School of Physics including the repainting of the corridors have resulted in the removal of the framed and interspersed printed biographies. A new and updated selection of framed biographies to be installed in 2008.

[37] Marie Curie was awarded two Nobel Prizes. She was the first woman to be awarded a Nobel Prize (in Physics in 1903), and was subsequently awarded the Nobel Prize in Chemistry (in 1911).

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Appendix 1

School of Physics Workload Allocation Scheme

The School of Physics operates a transparent system of allocating teaching and administration workloads to academic staff. Prior to 2004, teaching workload allocations were fewer for level D and E academic staff than for level C and B staff. Due to the preponderance of academic staff in the senior levels (for example in 2003, ~75% of academic staff in the School of Physics were either associate professors or professors), the prior scheme had to be abandoned to ensure there were enough academic staff available to teach the courses offered. A revised algorithm for the allocation of workloads was instituted in 2004 after consultation with the Undergraduate Teaching Committee and Academic Staff Committee. The main elements of the revised model are that all staff, regardless of academic rank, will start with the same basic workload. Reductions of up to but not exceeding 200 Work-Load Units (WLU) can be made on the basis of (external) research income, publications and research student (PhD and MSc) supervision. Teaching load reductions for various duties (including administrative duties, year and laboratory co-ordination, etc.) have been included in this scheme. As part of the process of instituting a revised algorithm, the opportunity to review and modify as appropriate at the end of 2004 was included.

The scheme was devised by looking at the median research activity of School of Physics academic staff in the years preceding 2004. It was found that the median annual research income per person was ~$50,000 and the median number of publications per person per year was 5. On this basis it was decided that if $100,000 of funding is made equivalent to 50 WLU and a journal paper is credited 5 WLU, the "average" research active School of Physics academic staff member will obtain a 50 WLU teaching load reduction. These figures are reasonably consistent with a calculation based on the purely financial considerations of the funding the School receives for the research activity.

The Australian Federal Government provides research support funding to Universities through the Department of Education, Science and Training (DEST). These funding programs include amongst others, the Institutional Grant Scheme (IGS) and the Research Training Scheme (RTS). IGS/RTG funding is assessed by a combination of research income, higher degree research student enrolments and research publications. A proportion of these funds are allocated to the Faculties and Schools within the University to support research and research training (for more details about this funding see http://www.dest.gov.au/highered/a_to_z.htm).

The 2004 algorithm

The School calculates the academic's teaching load using WLU's (Work Load Units). Marking loads are worked out on a separate scheme of marking load units (MLU's). At the start of the year, academics are given an annual WLU teaching load

and MLU marking load. These loads will change from year to year, depending on the number of staff, number of courses taught, etc. The load is the same for all staff members, although calculated on a pro-rata basis for part time staff or if staff members are away for a session. New staff members are normally given a reduced load for their first year. There may be WLU carried over from one year to the next. In 2004 each full time (FTE) member of staff was allocated a teaching load of 555 WLU and 135 MLU. In addition, the maximum teaching hours per week for any staff member is set at 14 hours/week.

WLU's are calculated at the following rates

Table 13: Allowances for teaching

Teaching duties	*Number of WLUs per contact hour*
Lecture	3
Lecture (new course)	5
Tutorial (first time)	1.5
Tutorial (repeat)	1
Evening Lectures	3.5
Lab Director in Charge	1
Duty Tutor*	1

**The duty tutor is available at set times to provide individual assistance to students.*

These WLU allocations are independent of the number of students enrolled in the course. General Education courses are calculated at the same rate as Physics courses.

Table 14: Allowances for supervision (research project students)

Supervision duties (research project students)	*Number of WLUs*
Post graduate* student	50 for first student 25 for second and subsequent students
Honours student	21 per student per session
3rd Year Physics Participation project student	8 per student
1st Year Physics laboratory project student	20 per group

**This allowance only applies for the first 8 sessions of a student's enrolment*

Primary supervisors receive the entire allowance for postgraduate physics students; the co-supervisors do not receive an allowance, unless a special arrangement is made to share the allowance. No credit is given for co-supervision of a postgraduate or honours student in another School, regardless of the effort involved. Those staff members involved in cross disciplinary research with other UNSW colleagues are therefore disadvantaged.

Table 15: Allowances for administration

Administrative duties	*Number of WLUs*
Head of School	As required
First Year Director	As required
First Year Lab Director	112
Undergraduate Director	112
Postgraduate Director	84
Second Year Lab Director	56
Colloquia Organiser	28
Careers & Marketing Coordinator	84
Computing Coordinator	14
Medical Physics Coordinator	28
Outreach Coordinator	28
Library Liaison Coordinator	28
Developing new experiment	20

The teaching load reduction is calculated on attributable annual external research income averaged over the past three years, plus the average annual number of refereed journal publications for the past three years (independent of the number of authors) written by the staff member or their enrolled student. The reduction was set at the rate of 50 WLU/$100K and 5 WLU/paper. “Attributable research income” is defined as the income for which UNSW receives (RTS)/ (IGS) funding divided by the number of UNSW Chief Investigators. In most cases, this is equal to the total dollar value of the grant divided by the total number of Chief Investigators. In the 2004 scheme, the number of publications was not divided by the number of authors. The rationale behind this was to give deliberate extra weighting to publications rather than income (i.e. output rather than input).

This was further modified in 2005, when staff were asked to estimate their percentage contribution to each publication. The comparison of the value of a publication across areas of physics research is not straightforward and inequities remain. For example in some areas of physics a publication of two or three papers a year is an excellent output where in other area, six or more is the norm.

Prior to 2004, the allowance for *postgraduate research student supervision* was 14 WLU for each student up to a maximum of 56 WLU. In 2004, the allowance was increased to 50 WLU for the first student, with second and subsequent students attracting an allowance of 25 WLU each. The WLU allowance is valid for the first 8 sessions of a student’s enrolment. The total reduction (research income plus publications plus research student supervision) is capped at 200 WLU.

Table 16: Allowances for research

Research	*Number of WLUs*
Publications	5 x number of publications (averaged over previous 3 years)
External Research Funding	50 WLU/$100K external research income (averaged over previous 3 years)

Marking load Allocation

Marking Load Units (MLU) for being an examiner, an assessor or for marking exams and theses are allocated at the following rates:

Table 17: Marking load allocations

Marking duties	*Number of MLUs*
Examiner	4 per hour of exam
Assessor	2 per hour of exam
Marker	1 per 3 hour exam for Year 1 papers. 1 per student for Years 2, 3, 4 exams
Honours Thesis	12 per thesis (supervisor and assessor)
General Education course coordinator	1 per 10 students

Modifications to the 2004 algorithm to be applied in 2005

Some changes to the allocation of credit given to administrative duties are listed below.

Table 18: Modified administrative allowances for 2005

Administrative duties	*Number of WLUs*
Head of School	200
First Year Director	168
First Year Lab Director	112
Undergraduate Director	112
Postgraduate Director	112
Second Year Lab Director	56
Colloquia Organiser	28
Careers & Marketing Coordinator	84
Medical Physics Coordinator	10 per 4th year student
Computing Coordinator	28
Outreach Coordinator	28
Library Liaison Coordinator	20

Following the first application of the revised workload allocation scheme in 2004, some modifications were proposed. These revisions were in response to perceived inequities or anomalies. In particular the method of allocating credit for publications was modified, so that it more fairly reflects the contribution staff members make to each of their papers. A new and simple self-assessment scheme for crediting staff members for their research publications has been developed. When staff members submit their yearly list of publications for determining their WLU credit, they will be asked to provide a self-assessed determination of their contribution to each publication which, for simplicity, will involve selecting one of five intervals between 0-100%.

"Self-assessment" of research publication contribution is also practiced when applying for academic promotion at UNSW. Ethical behaviour is required when assessing publications for either academic promotion or for the WLU scheme. This process allows an author to truly quantify their contribution, rather than for example, a scheme that assumes each co-author contributes equally to a publication.

Appendix 2

Staff Survey

UNSW School of Physics
Academic Staff Survey

Thank you for taking part in the Physics Equity Project. The information gathered from this short survey will aid in developing a general picture of academic life in the School. The information is strictly confidential and will be collected and collated by Ms. Aileen Woo of the Physics Equity Project Team. It will be used solely for the purpose of this project and presented only in aggregate form. The data will be locked in a secure storage place. Individuals will not be identifiable from the research.
Please place the completed survey in the box labelled "Physics Equity Project", which can be found in the Administration Office next to Ms. Patricia Furst's desk. Alternatively, please send by email to Ms. Woo (a.woo@unsw.edu.au).
Should you have any questions or concerns about the survey or the use of your response, please do not hesitate to email Ms. Woo at the above email address.
Additional comments are very welcome – please attach to or write them on the survey.

---

1. Please indicate your Academic level:

- ❑ level B
- ❑ level C
- ❑ level D
- ❑ level E

2. What is your gender?

- ❑ Female
- ❑ Male

3. What is your age?

- ❑ 25-34
- ❑ 35-44
- ❑ 45-54
- ❑ 55 and above

4. Please indicate your domestic situation by ticking the appropriate boxes below:

- ❑ Single with children *OR* ❑ Partner with children
  - Please indicate how many children_____
  - Please indicate the age(s) of the children:_____
- ❑ Single with no children
- ❑ Partner without children

5. If you have children, who is the primary care giver?

_____

_____

6. Please indicate any other primary care-giving responsibilities you might have:

- ❑ Aged parents
- ❑ Aged relatives
- ❑ Partner with illness or disability
- ❑ Other relative with illness or disability
- ❑ None
- ❑ Other (Please state_____)

7. In what year was your PhD conferred?_____

8a. A 'traditional' academic career path is usually described in terms of the following progression:

High school → BSc → PhD → Postdoctoral/ Research fellowships
→
→ Academic appointment → Tenure

Does this scenario describe your career?

❑ Yes ❑ No

8b. If no, how has your career been different (e.g. study/work in a different profession, time taken to bear/raise children, etc.) ?

_____

_____

_____

_____

9a. Have you had any career breaks or periods when you have not worked full time as a physicist since your PhD was conferred?

❑ Yes ❑ No

9b. If yes, for how long? _____

9c. Did you work part time during that period?

- ❑ Yes
- ❑ No

Comment (optional)

_____

_____

_____

10a. What year did you start work at UNSW? _____

10b. At what level were you appointed? _____

11a. How many times have you applied for promotion at UNSW? _____

11b. How many times were you successful? _____

11c. On what basis have you, or would you seek promotion?

- ❑ Research
- ❑ Teaching
- ❑ Service
- ❑ Other _____

_____

_____

_____

12. Please indicate on the pie chart below the proportion of time you spend on research, teaching, administration, etc and family responsibilities in an *average working week*. Please include a rough estimate in hours next to each activity.

13. How much do you agree with the following statement:

"The Physics Work Load Unit (WLU) teaching scheme fairly distributes teaching and administrative duties amongst academic staff."

❑Strongly Agree ❑Agree ❑Neither Disagree or Agree ❑Disagree ❑Strongly Disagree

14. Do you think gender issues are important in the School of Physics?

❑ Very Important ❑ Important ❑ Slightly Important ❑ Not Important

15. Are there any other issues that you believe are of importance to the Academic Staff at the School?

Appendix 3

Useful Web based resources

The ***Australian Institute of Physics*** (AIP) has a ***Woman in Physics (WiP) Group***
http://www.aip.org.au/content/women
One the major activities of the WiP group is the ***Australian Institute of Physics International Women in Physics Lecture Series***. The WiP Lecture series celebrates the contribution of women to advances in physics. Under this scheme, a woman who has made a significant contribution in a field of physics travels to each state branch of the AIP (QLD, NSW, ACT, Vic, Tas, SA and WA) to give a series of lectures. In particular a public lecture of interest to a non-specialist audience is organized in each state. This public lecture helps to lift the profile of women in physics, showcases excellent physics research and increases awareness of physics careers among students and their families.
http://www.aip.org.au/content/wiplecturer

Where are the Women in Australian Science
This site provides information about women and the roles they played in the history of Australian science (including physics), technology and medicine.
http://www.austehc.unimelb.edu.au/wisa/

UNSW Gender Equity Project
In 2002 the University committed to improving the representation of women amongst academic staff. Information about the program is available at the Staff Equity website.
http://www.hr.unsw.edu.au/services/empequity.html

Copies of reports into the Gender equity in academic employment of UNSW and the Faculty of the Built Environment are available at this site.

- ***Gender equity in academic employment at the University South Wales***. Probert, B., Ewer, P. and Leong, K. (2002). Centre for Applied Social Research, RMIT University. June. 2002
- ***Faculty of the Built Environment Report Gender Equity Project Report*** 2003. Rachel Gray and Jude Stoddart, Equity and Diversity Unit, University of New South Wales October 2003.
- Se also ***Maximising Potential in Physics****: Investigation of the Academic Profile of the School of Physics at the University of New South Wales.* Marion Stevens-Kalceff, Susan Hagon, Maria Cunningham and Aileen Woo. (2007) School of Physics, University of New South Wales. Australia **ISBN** 978 0 7334 2590 5

The potential of women's programmes to generate institutional change
A. Devos, J. McLean and P. O'Hara: HERDSA 2003 conference proceedings.
The role of women-only professional development programmes is investigated.
http://surveys.canterbury.ac.nz/herdsa03/pdfsref/Y1041.pdf

The Athena Project (The Royal Society)

The Athena Project is a UK-wide initiative which developed out of the Committee of Vice Chancellors and Principals Commission on University Career Opportunities. The aims are to remove discrimination against women in Higher Education and to increase significantly the numbers of women in top posts by 2007. In 1999 the Steering Committee issued a call for development grants to encourage strategies to promote good practice and other incentives to improve the access, participation and promotion of women in Science, Engineering and Technology (SET) in Higher Education.

Athena Reports are available on
www.athenaproject.org.uk.
See in particular the
(report 22) "Athena Good Practice Guide"
(report 26) "ASSET 2003: The Athena Survey of Science Engineering and Technology in Higher Education"
http://www.athenaproject.org.uk/reports.htm

The ***Institute of Physics*** (UK) has a ***Woman in Physics (WP) Group*** which includes a Women in Research and Academia Subgroup. The WP Group encourages professional development, organises an annual meeting with discussions of topical interest, regularly produces a newsletter.
http://www.iop.org/activity/groups/professional/wip/index.html

See also *Equity for Women in Physics* by Marcia Barbosa in IoP's Physics World, July 2003. See also links to related articles
http://physicsweb.org/articles/world/16/7/2

Women in Science (EU)

Women are under-represented in science and in decision-making bodies concerned with scientific issues. The European Commission recognizes this is both a waste of human resources and a serious obstacle for the development of the sciences and for European society as a whole. Information on strategies and programs to improve the participation of women is available.
http://www.cordis.lu/improving/women/home.htm

Contributions of 20th Century Women to Physics

An archive of data on 83 twentieth century women who have made original and important contributions to physics is presented. http://cwp.library.ucla.edu/

American Institute of Physics (AIP)

- *Women in Physics and Astronomy, 2005.*

Rachel Ivie, Kim Nies Ray AIP Publication Number R-430.02 February, 2005

- *Women Physicists Speak: The 2001 International Study of Women in Physics*

Rachel Ivie, Roman Czujko, Katie Stowe.

- *Women in Physics, 2000.*

R. Ivie, K. Stowe, AIP Publication Number. R-430 (2000).
These reports are available online at
http://www.aip.org/statistics/trends/gendertrends.html
What Works for Women in Undergraduate Physics? Barbara L. Whitten, Suzanne R. Foster, and Margaret L. Duncombe, Physics Today September 2003.
http://www.aip.org/pt/vol-56/iss-9/p46.html

The American Physical Society (APS)

The Committee on the Status of Women in Physics (CSWP) offers programs and publications to encouragement the career development of women in physics.
http://www.aps.org/programs/women/index.cfm
The Gazette newsletter is the official newsletter of the CSWP and an excellent source of information exchange.
http://www.aps.org/programs/women/reports/gazette/index.cfm
Due to concern at the relatively small percentage of female physics students and staff, the American Physical Society designed its “Climate for Women Site Visit Program.” This program has been developed to help physics departments improve the "chilly climate" that women in physics sometimes experience.
http://www.aps.org/programs/women/sitevisits/

IUPAP Working Group on Women in Physics

International Union of Pure and Applied Physics (IUPAP) International Conference on Women in Physics was held in Paris, France, from March, 2002. The Conference surveyed and investigated under-representation of women and developed strategies to increase participation in physics.
http://www.if.ufrgs.br/~barbosa/conference.html

***A Study on the Status of Women Faculty in Science at MIT* (1999)**

This ground breaking report resulted from the establishment in 1995 of a Committee by the Dean of Science to analyse the status of women faculty.
http://web.mit.edu/fnl/women/women.html
and 2002 update
http://web.mit.edu/faculty/reports/sos.pdf

The Gender Equity Report, Pennsylvania State University, Dec 2001

http://www.upenn.edu/almanac/v48/n14/GenderEquity.html

Faculty and Families Project (2001)

Robert Drago, Ann C. Crouter, Mark Wardell, Billie S. Willits. Pennsylvania State University The project investigated the difficulties faculty face in combining their academic and family commitments. This site also has links to other reports into family issues including child and elder care
http://lsir.la.psu.edu/workfam/facultyfamilies.htm

NSF ADVANCE at the University of Washington Center for Intuitional Change
The goal of the ADVANCE program is to increase the participation of women in the science, engineering, and mathematics workforce through the increased representation and advancement of women in academic careers. Recruitment and retention issues are addressed.
http://www.engr.washington.edu/advance/

Report of the ***Task Force on the Status of Women Faculty in the Natural Sciences and Engineering at Princeton***, Virginia Zakian et al. May 2003
http://www.princeton.edu/pr/reports/sciencetf/sciencetf-9-19-03.pdf

Committee on the Status of Women Faculty at Caltech *Anneila I. Sargent,* Dec., 2001.
http://diversity.caltech.edu/statements_reports.html

NSF ADVANCE Assessing the Academic Work Environment for Women Scientists and Engineers University of Michigan Report (2002)
http://www.umich.edu/~advproj/climatereport.pdf

Achieving Gender Equity in Science Classrooms
Compiled by Women Science Students and Science Faculty and Staff at New England Consortium for Undergraduate Science Education (NECUSE) Colleges
http://www.brown.edu/Student_Services/WiSE/gender.html

Appendix 4

Presentations

1 **UNSW School of Physics briefings and presentations**

Various throughout 2004, early 2005

2 **Australian Institute of Physics Congress**, Canberra ACT

30 Jan - 4 Feb 2005

*"Achieving Maximum Potential in Physics***"**

3 **UNSW BEES Women in Science Workshop,**

20 April 2005

"Maximising Potential in Physics; Investigation of the academic profile of the School of Physics, UNSW"

4 **UNSW Sociology Postgraduate Symposium**,

4 June 2005

"Obstacles to Equity: Old Meritocratic Systems and New Corporate Management"

5 **UNSW Faculty of Science Seminar**

23 June 2005

"Maximising Potential in the School of Physics"

6 **Gender Equity Colloquium**: presentation to UNSW

22 Nov 2005

"Achieving Maximum Potential in the School of Physics."

7 **WEXDEV International Conference**, Adelaide SA

11-13 April 2006

"*Physics Women: Career progression in a non-traditional field*"

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