

# Women in the Science Research Workforce: Identifying and Sustaining the Diversity Advantage



**Sharon Bell and Lyn Yates**

with assistance from Robyn May and Huong Nguyen

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# WOMEN IN THE SCIENCE RESEARCH WORKFORCE: IDENTIFYING AND SUSTAINING THE DIVERSITY ADVANTAGE

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**Professor Sharon Bell and Professor Lyn Yates  
with assistance from Dr Robyn May and Dr Huong Nguyen**

The research described in this report was supported by an Australian Research Council Linkage Grant (LP110200480, 2011-2014) with Industry Partners the *Bio21 Cluster/Biomedical Research Victoria*, the *Royal Australian Chemical Institute* and *Science and Technology Australia*. The host institution was the *University of Melbourne*.

The research project CIs were Professor Sharon Bell and Professor Lyn Yates. Dr Robyn May and Dr Huong Nguyen supported them at different stages of the project's development. The project has also benefitted from the statistical advice and deep interest of Dr Daniel Edwards of the Australian Council for Educational Research.

This report is designed to be accessible to the sector and policymakers. It is a revised version of the preliminary report supplied to participants in the *Women in the Scientific Research Workforce Workshop* on 29 October 2014 at the University of Melbourne. This version of the report incorporates feedback from participants and reinforces key themes arising from the workshop.

The researchers wish to acknowledge the lively and collaborative input of the participants at the workshop and the keen interest and active participation of our Linkage partners throughout the project, in particular Jan Tennent, Roger Stapleford and Dr Elizabeth Johnson. We also gratefully acknowledge Charles Darwin University's support of the project.

One of the delights of the project was to see both project research assistants, Robyn May and Huong Nguyen, receive their doctorates. We hope the academy will offer them and their peers better prospects than those described for female scientists in this report.

## Biomedical Research Victoria

Victorian biomedical researchers have contributed to improving the lives of millions of people and their work is an important driver of economic development in the State.

Biomedical Research Victoria\* represents a remarkable research community of universities, academic hospitals, medical research institutes, CSIRO and other research organisations. Seeking to develop shared vision, long-term plans and better links between government, industry and the health and biomedical communities, Biomedical Research Victoria enables Members to identify and respond to matters that are best addressed, or have a better chance of being resolved, by collective action.

Biomedical Research Victoria's goals are to enable Victoria's health and biomedical research sector to flourish and compete successfully alongside global life sciences centres and to better use existing resources for the creation of knowledge, new treatments and new commercial opportunities for the benefit of Victorians and people all over the world.

\* formerly the Bio21 Cluster



## Royal Australian Chemistry Institute Inc.

The RACI is the voice of chemistry in Australia and advocates the importance of chemistry to the public, educational establishments, industry and government. The organisation exists to actively support the professional needs, development and interests of all its members.

Founded in 1917 and granted a Royal Charter in 1932, the RACI is the professional body for the chemical sciences in Australia. It acts both as the qualifying body in Australia for professional chemists, and as a learned society promoting the science and practice of chemistry.

The RACI has over 4,500 members with an extensive nationwide network. It represents and caters for the professional needs of chemists in all walks of life, providing targeted activities and services that encompass the profession of chemistry in Australia.



## Science & Technology Australia

Science & Technology Australia\* is the peak group for the nation's 68,000 scientists and those working in technology.

Formed in 1985, STA represents a vast array of professional interests and disciplines across Australia, with members including the Australian Neuroscience Society, Australian Society for Biophysics, the Royal Australian Chemical Institute, the Australian Council of Deans of Science and the Women in Science Enquiry Network.

STA contributes to discussions at the highest levels of government and policymaking in Australia. STA's mission is to bring together scientists, governments, industry and the broader community to advance the role, reputation and impact of science and technology in Australia.

\* previously the Federation of Scientific and Technological Societies

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# WOMEN IN THE SCIENCE RESEARCH WORKFORCE: EXECUTIVE SUMMARY

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This research project was designed to contribute to understanding of a ‘wicked problem’ that appears to repeat itself in successive generations of women in science – the well-documented, entrenched patterns of disadvantage associated with women’s participation in the science research workforce. Despite the fact that outstanding women are increasingly achieving at the highest levels, obtaining advanced scientific qualifications and taking key roles in the fields of science and technology, women’s participation in the science research workforce continues to be characterised by low levels of retention and success beyond the postdoctoral career stage.

The focus of the research was on the disciplinary fields of biology and chemistry, as these two disciplines have experienced significant female participation up to the doctoral level for several decades, and postgraduate female biology and chemistry graduates, particularly chemistry graduates, enter a wide range of occupations in industry and government as well as in the science research workforce. This project is distinctive in that it is cross-sectoral in two important fields of science, and draws on data from both men and women across all career stages.

The research strongly suggests that new employment conditions and new career pathways are needed to reframe patterns of participation and opportunities for success for a wider range of entrants to the scientific research workforce. This is particularly the case in universities and research institutes, as evidenced by the differences between the fields of biology and chemistry, but to achieve this a better understanding of what opportunities exist, for whom, and in what professional contexts is necessary.

## What Opportunities Exist?

The research tells us that significant generational differences are emerging with regards to changing patterns of employment by sector. Most postgraduate students in the fields of biology and chemistry aspire to academic and research roles within universities and research institutes. However, structural change in higher education and research in Australia, characterised by extremely competitive research funding and an increasingly pervasive casualised/fixed-term and insecure employment environment, mean that the majority will ultimately seek work in other sectors.

There is currently a significant disjunction between postgraduate aspirations and the reality of employment opportunities that differentially impacts on women, as education and training has historically been the primary industry of employment for women in this sector. If the rate of growth in the postgraduate-qualified population continues and employment practices in universities and research institutes do not change, this disjunction will increase. This disjunction is particularly marked for women in the biological sciences, where fewer transition to roles outside universities and research institutes that use their scientific knowledge and skills.

Whilst opportunities exist in a wide range of occupations in the public and private sectors, and such roles are increasingly seen as realistic alternatives to academia, these roles may require additional specialist (non-scientific) qualifications and experience. Moreover, they are not currently part of the professional identity formation of PhD students or the socially constructed concept of the ‘scientific workforce’ in Australia, even though scientific knowledge and skills are essential and utilised at high levels. There are also systemic barriers to mobility between the academy, the public sector and industry, including very different, ‘non-transferable’ measures of attainment.



## For Whom?

Opportunities exist for those who, in addition to being meticulous, hard-working and having excellent track records have, and have been supported and mentored (Ibarra 2010, 82-85) to have the confidence and optimism as well as the intellectual and technical ability to succeed in what some describe as a tournament but we think of as a marathon. This includes those whose life circumstances enable them to commit to cultures of long hours, full-time continuous employment when available, and the political skills and resilience to negotiate a highly competitive and insecure employment/funding environment over a career lifetime. Importantly, an intensive period of research productivity in the postdoctoral career stage, coinciding with a critical period of family formation for many women, is key to establishing a career as an independent researcher. These attributes may be characterised as those, following Acker (1992), of the 'ideal' research worker – a scientist whose life circumstances enable them to engage in the continuous accumulation of academic and social capital (Morley 2013).

Women, especially those who have children, are less likely to be employed full-time than men. Amongst our respondents, three times as many women as men had taken significant periods of leave during their careers, and a significant proportion of women believe that this has affected their career progression. Given that networks, connections and knowing the right people are seen as equally important as being good at your work, those whose circumstances do not provide the opportunity or time to develop supportive and influential networks are unlikely to succeed.

There are also income gaps between men and women who are employed full-time, especially pronounced in the higher income categories. Men reach higher income categories at a younger age and a small but stable proportion of women remain in the lower income categories for all ages, whereas for men this gap diminishes steadily.

## In What Professional Contexts?

Postgraduates in the fields of biological sciences and chemistry are part of an exceptionally highly qualified, small but rapidly growing population in Australia. The high proportion of doctoral graduates as compared to masters' graduates sets the biology and chemistry populations apart from graduates in other fields and undoubtedly impacts upon patterns of employment.

Project survey respondents identified improved job security as the single factor that most increases job satisfaction – less than half the respondents to the project survey were employed in full-time continuing positions, with men constituting the majority in this employment category. Women outnumbered men in the employment categories of full-time fixed-term contracts and in the part-time and casual categories. This is partly a reflection of the career stages of respondents, but it also reflects generational structural change, particularly in the academy (Norton & Cherastidtham 2014: 32).

Patterns of women and men's participation are differentiated by industry, with women predominantly employed in the education and health sectors, and men in scientific and technical industries and manufacturing. Women are employed in a wider range of roles than men, indicative of adaptive strategies to fit life circumstances, especially in the mid-career phase. The professional contexts of the biological and biomedical sciences are very different to those of the chemistry-related industries. The differences include gender profile, employment status, research funding, career aspirations, job satisfaction and private sector employment, indicating that 'whole of science' strategies need to be nuanced to ensure the most effective approach to change.



## Recommendations

A research project such as this is expected to generate a set of succinct recommendations. To this end, key findings of the research, and background contextual issues, were considered by participants in a workshop in October 2014. Discussion was organised around the following themes:

- Career paths and destinations
- Organisational cultures
- Employment practices
- Scientific skills and knowledge.

The workshop made it very clear that in presenting recommendations we face the challenge that previous studies and reports have generated comprehensive lists of recommendations but achieved little. In this context, a critical conclusion of the workshop and this research is that:

The patterns of women's participation and success in the science research workforce are well documented. Consistent and enduring patterns of vertical and horizontal segregation of women have been consistently described over the past twenty years. The persistence of tacit, rather than explicit gendered organisational cultures and systems that in small but cumulative ways disadvantage many women, whilst simultaneously advantaging many men, are also well known. It is time to focus on developing clear actions and strategies to achieve organisational and sectoral change. There is a new imperative to do this as the deterioration of research funding and employment conditions in universities and other public research institutions, and the disjunction between these conditions and the investment required to meet extremely high entry-level standards, presents a significant threat to the attractiveness and sustainability of the science research workforce.

In short, what is needed is a move away from the 'heroic' science paradigm to a new scientific workforce and career paradigm that eliminates the barriers for women, and improves opportunities for a greater diversity of participants, addressing:

- the postdoctoral 'tipping point'
- the impact of career breaks
- the ubiquity of short-term contracts and project-based support
- an unforgiving – and in some disciplines alienating – competitive culture, and
- disincentives to sectoral mobility and transitions.

In this context it is recommended that it is essential to review and change:

### Career Paths and Destinations

- 1 Create mechanisms that enable women to thrive and excel, not just 'survive', in science and technology careers, including supporting flexible, non-traditional career paths and periods of significant leave, with attention to programs that support teams of researchers, the retention of scientific and professional 'currency', and professional re-entry.
- 2 Acknowledge the rapidly changing nature of the academy and correct the increasing disjunction in the aspirations of higher-degree research students through provision of improved career knowledge and professional opportunities.
- 3 Dismantle the barriers to 'career branching' and mobility between the academy and industry in keeping with changing employment patterns and the need for sectoral mobility.

## Organisational Cultures

- 4 Recognise that a scientific research career is a marathon, not a sprint, and those who have the ability to succeed may not fit the stereotype of the 'ideal research worker' who can accumulate academic and social capital uninterrupted.

## Employment Practices

- 5 Change funding regimes and employment practices to improve the security of employment in the higher education and research sectors. Longer fixed-term contracts, five years rather than three years, would make a significant difference to career prospects and planning and help to accommodate the pressures that accumulate with family formation.

## Scientific Skills and Knowledge

- 6 Adopt a more inclusive understanding of the 'scientific research workforce' to include emerging roles in cognate fields that demand high levels of scientific knowledge and skills, and cultivate awareness of relevant career options and pathways in the private sector and industry.

This project confirms the need for implementation of a multifaceted strategy, as recommended by the US National Science Foundation (NSF 2009) and FASTS (Bell et al 2009) reports, to broaden participation in the science and technology workforce (refer Appendix 1). The research also confirms the need for a detailed longitudinal study of the scientific research workforce to increase understanding of workforce dynamics and the stark, emergent patterns of generational change.

# SECTION 1: BACKGROUND TO THE PROJECT

Over two decades ago (1993) the Minister Assisting the Prime Minister for Science and the Minister for Science and Small Business established the Women in Science, Engineering and Technology Advisory Group (WISSET). The Advisory Group was tasked to advise on strategies to improve women's participation in SET careers and education. In a discussion paper from the Advisory Group, it was argued that:

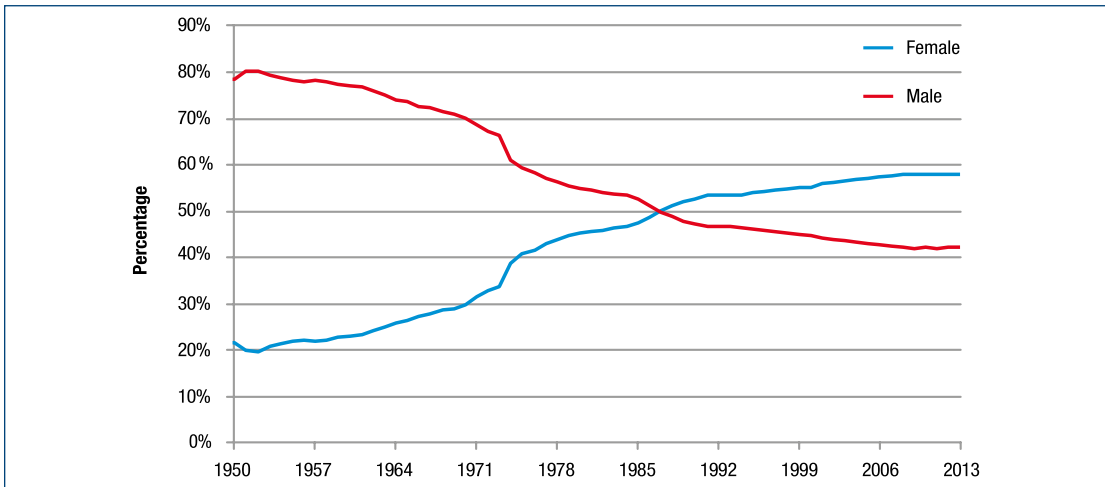
Women remain seriously under-represented in some specific disciplines of science, engineering and technology (SET), and furthermore, are not well-represented at the most senior levels in all disciplines. This problem is poorly understood since statistics actually show a significant improvement in women's participation overall in SET-based education, training and employment over the last decade...

Women are 51% of the nation's population. Using their talents to the full at all levels of scientific and technological education, training and employment is an economic necessity, and an investment in Australia's future national development. The Advisory Group believes that continued under-representation and under-participation of women in SET-based education, training and employment is not only a cause for social concern on equity grounds, it is also likely to inhibit Australia's capacity to develop internationally competitive research and industries. (1995, 5-6)

The Advisory Group asked 'what it is about the environments of science, engineering and technology, and society's perception of them, that they do not attract and keep girls and women' (WISSET 1995: 14). The Advisory Group proposed three strategies. First, a short-term strategy to put in place the conceptual and structural foundations. Second, a medium-term strategy aimed at providing leverage to existing programs 'with the specific aim of preventing the loss of existing investments in SET education and training'. Third, a long-term strategy to address those areas requiring further research and analysis (1995: 6). The fourteen recommendations generated from this report included: family-friendly policies and workplaces; higher education participation in non-traditional disciplines; re-entry schemes; attraction, selection, retention and success initiatives; identification of barriers to the achievement of excellence; and public awareness campaigns.

Twenty years later, consistent with a global pattern of feminisation of the academy (Morley 2013: 3), in Australia women now outnumber men in many universities; over 50% of the domestic student population in Australia is female, graphically illustrated in the Grattan Institute Report *Mapping Australian Higher Education 2014-2015* (Norton & Cherastidham 2014) (Figure 1.1):

**Figure 1.1: Proportion of higher education enrolments by gender, Australia, 1950–2013**



Sources: DEEWR (2000); Department of Education (2014h)

It is important to note, however, that Figure 1.1 presents discontinuous data, as the Dawkins reforms of the late 1980s brought the previous Colleges of Advanced Education, and the non-university training colleges of teacher education, hospital nursing programs, schools of art and conservatoria into the university sector. These previously independent institutions were characterised by large proportions of female students and staff (Castleman et al 1995) concentrated in certain disciplines – most notably education, nursing and the creative arts.

Nevertheless, the changed pattern of participation of women in tertiary education in Australia over the past two decades is so pronounced that the original ‘*A Fair Chance for All*’ (DEET 1990) equity targets to:

- increase the proportion of women in engineering courses to 15% by 1995
- increase the number of women in other non-traditional areas to at least 40% by 1995, and
- increase the number of women in postgraduate study, particularly in research, relative to the proportion of female undergraduates in each field by 1995

have been rendered invisible in our current policy environment, even though not all have been met, especially those that relate to engineering and non-traditional areas.

Despite the fact that outstanding women are increasingly seen achieving at the highest levels and taking key roles in the fields of science and technology, recent international studies (NAS 2007; OECD 2006) provide evidence of persistent patterns of horizontal segregation by discipline and vertical segregation by level of seniority and measures of esteem of women in the science research workforce. Research suggests that these patterns exist in Australia (Larkins 2012; Bell et al 2009; Bell & Bentley 2006). Moreover, whilst our knowledge of women in the science research workforce outside the academy has been consistently advancing, our knowledge of women in the science research workforce inside the academy has remained poor. In Australia much of what we know about women in science is predominantly a reflection of patterns of participation and success within universities and research institutes reinforced by a narrow social construction of what we understand to constitute the science research workforce, which fails to capture the experiences of those who leave the academy and work in the government and private sectors. Nonetheless the evidence generated by this project indicates that many who leave teaching and/or research roles continue to use their scientific knowledge and skills at high levels.

## What we know

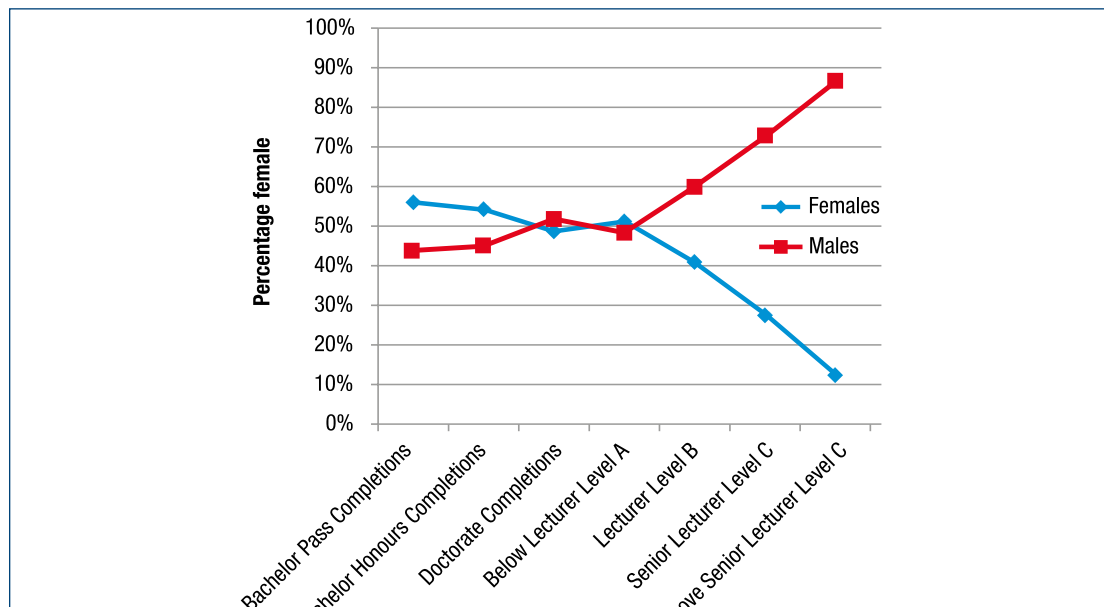
The literature suggests that patterns of representation of women in science and technology can be separated into two broad categories (Carrington & Pratt 2003). First, horizontal segregation of women in the technology disciplines based on perceptions regarding women’s innate ability in science and mathematics, societal attitudes towards gender stereotypes and gender equality, and job security and employability of graduates (Watt 2007; Whitehouse 2003; Collins et al 2000; Jones & Young 1995). Second, in science disciplines that are characterised by high female undergraduate and postgraduate participation, vertical segregation generated by the organisational culture of the workplace through practices that disadvantage women such as workload, cultures of long hours, promotions policies and practice, lack of female role models and sponsorship, lack of accommodation of carer responsibilities, and sex discrimination (Strachan et al 2013; Hatchell & Aveling 2008; Mills 2008; APESMA 2007; Stephens-Kalceff et al 2007; Morley 2006; Probert 2005).

Data on participation in higher education graphically illustrates established patterns of **low levels of participation in engineering and information technology and low rates of retention and success in and beyond the postdoctoral phase for all other broad fields of science.**

The FASTS *Women in Science in Australia* (2009) report found that women were represented at more than the 1990 equity target of 40% in only seven of the 29 ‘narrow fields’ of SET education: agriculture, forestry studies, environmental studies, chemical sciences, earth sciences, biological sciences and other natural and physical sciences (Bell et al 2009). This is one contributing factor to levels of female representation amongst academic staff consistently declining with seniority. In 2007

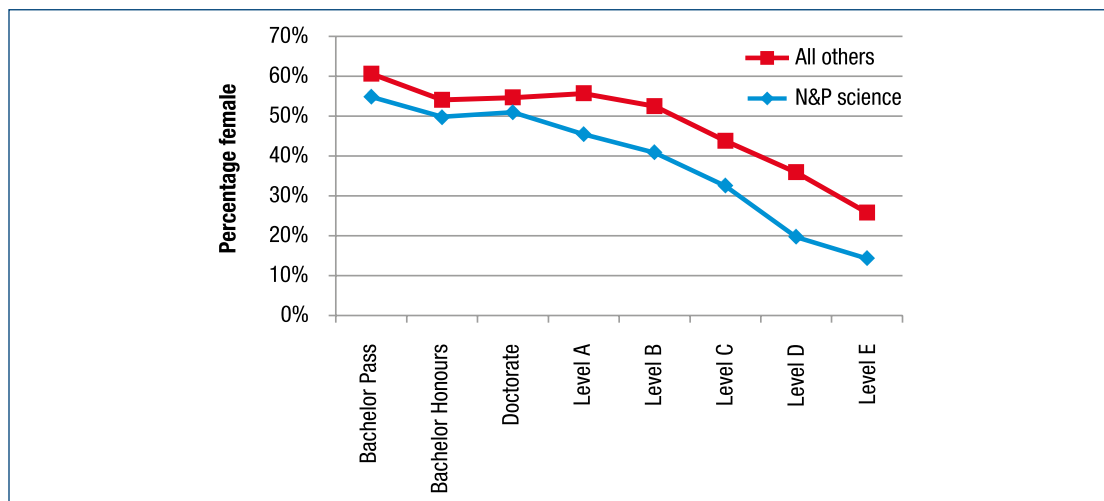
women constituted more than 50% of natural and physical sciences bachelor degree completions but less than 15% of level D & E academic staff (DEEWR 2008 & 2009). The most frequently cited legacy of the FASTS report is the ‘scissors graph’ (Figure 1.2; note: this is repeated cross-sectional not longitudinal data) (2009: 18).

**Figure 1.2: Academic profiles by gender, natural and physical sciences, 2007**



By 2011, in the natural and physical sciences, women made up 56% of completing students at the bachelor level, 50% of honours completions and 51% of doctorate completions (Figure 1.3).

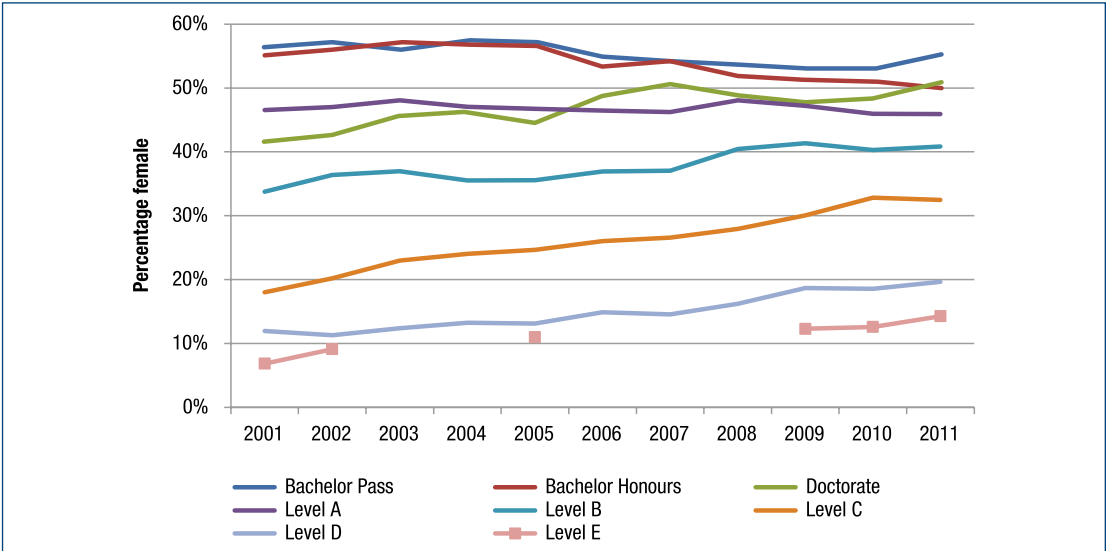
**Figure 1.3: Female representation by student completions and academic level, 2011**



Source: ACER DIISRTE Higher Education Statistics Collection, customised data, 2011

Between 2001 and 2011, the proportion of women at the bachelor level remained relatively constant, at the honours level a slight decline in representation is discernible, while at the doctorate level representation increased (Figure 1.4). There continues to be a marked difference in the proportions of female and male staff members in senior academic positions.

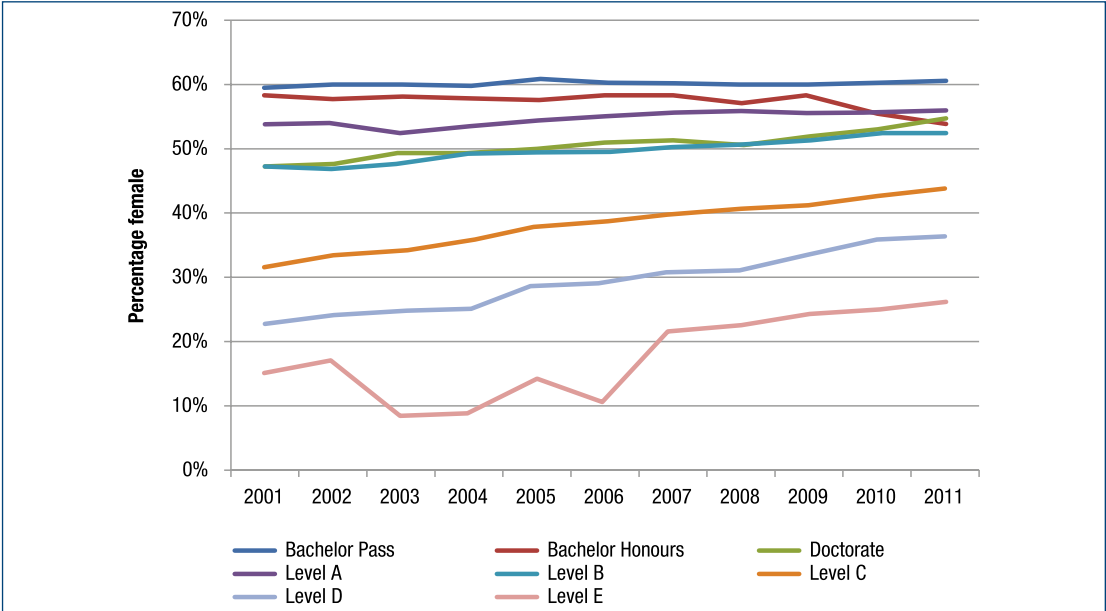
**Figure 1.4: Female representation by student completions and academic level, sciences, 2001–2011**



Source: ACER DIISRT Higher Education Statistics Collection, customised data, 2001–2011

Figure 1.4 shows that over 2001–2011 there were increases in the proportions of female staff at higher levels of employment in the sciences, especially at levels C (rising from 18% to 32.5%) and D (12% to 20%), but the rate of change is little more than 1% per annum. At Level E the rate of change is less than 1% per annum and from a low base (from 7% in 2001 to 14% in 2011). There were more marked increases in other fields over this time, as Figure 1.5 shows.

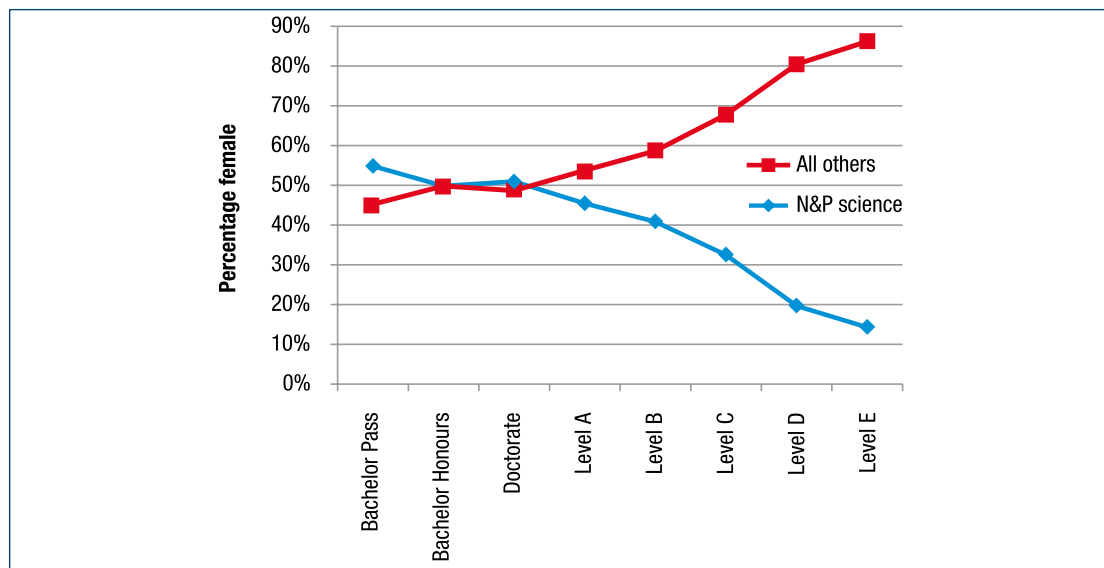
**Figure 1.5: Female representation by student completions and academic level, non-sciences, 2001–2011**



Source: DIISRT Higher Education Statistics Collection, customised data, 2001–2011

Reproducing the 'scissors graph' based on 2011 data indicates gradual change at the most senior academic levels, but in an increasingly competitive employment environment; what is notable is the entry of a larger proportion of men to the level A positions historically dominated by women, pushing back the 'tipping point' to the doctoral phase for women. (Note: this is cross-sectional not longitudinal data.)

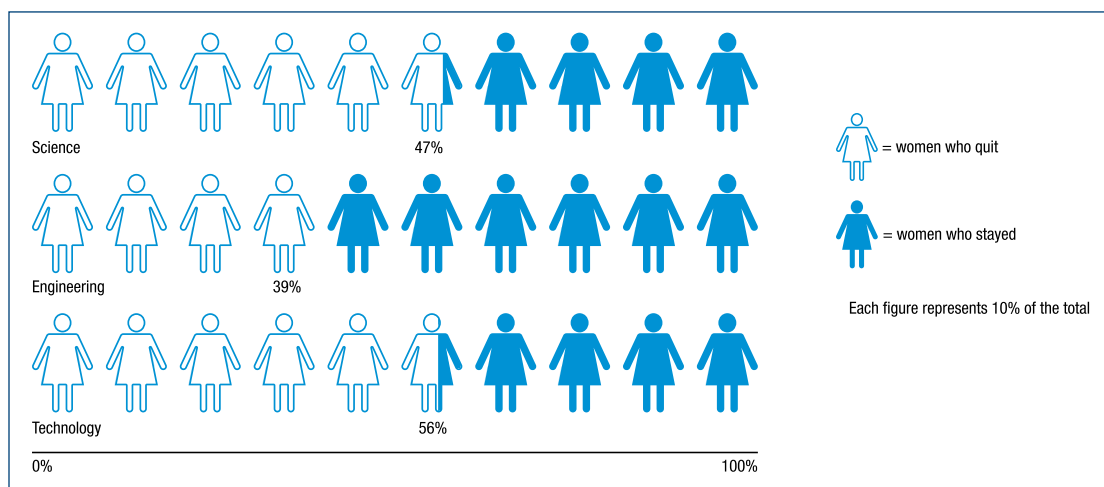
**Figure 1.6: Gender representation by student completions and academic level, natural and physical sciences, 2011**



Source: ACER DIISRTE Higher Education Statistics Collection, customised data, 2011

The overall sustained pattern of gender inequality in universities in Australia is consistent with the international evidence base (NSF 2009; NAS 2007; OECD 2006). It is also increasingly recognised that the attrition of women from the scientific professions impacts negatively on productivity and, through the consequent failure to achieve diversity, limits innovation (Bell et al 2009; Hewlett et al 2008; NAS 2007). Our American colleagues refer to this as the 'hidden brain drain' (Hewlett et al 2008), graphically illustrated by the representation of 'women who quit' (2008: 50) (Figure 1.7):

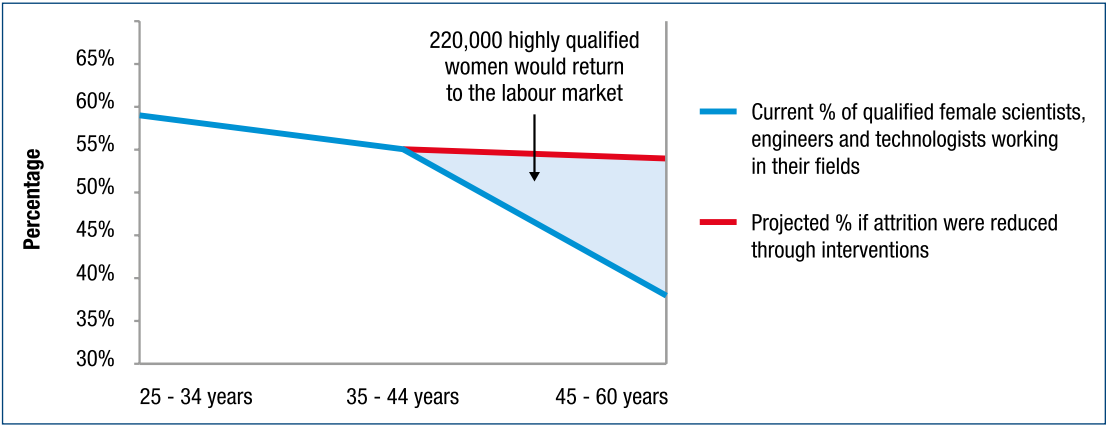
**Figure 1.7: Female 'Quit Rates' Across SET**





The HBR Athena Factor report notes that ‘women in SET fall away rapidly after age 35, whereas men gain ground’, and that ‘in SET companies, the falling away of women (and the ascendancy of men) is particularly steep and sharp’ (Hewlett et al 2008: 56) (Figure 1.8):

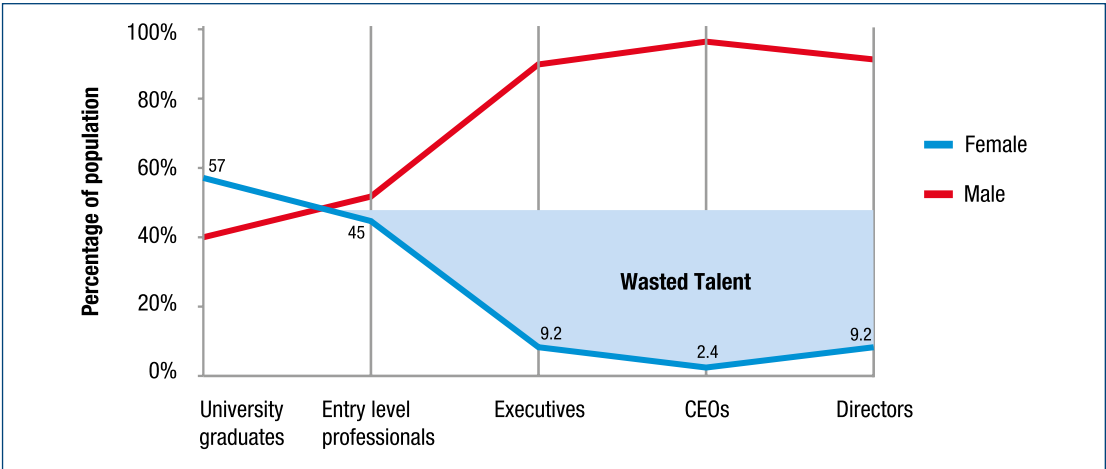
Figure 1.8: Intervening at the fight-or-flight moment



Although the FASTS report (Bell et al 2009) was cautious not to equate lack of seniority with ‘quitting’, it was acknowledged that pressure exists at the postdoctoral career phase along with a need for clear mapping of scientific career paths.

In 2008 Equal Opportunity for Women in the Workplace Agency (EOWA) generated a local version of ‘the stupid curve’, a term coined by Deloitte’s Mike Cook, to illustrate a similar pattern of wastage of talent at the senior levels of Australian companies (Figure 1.9). Whilst male and female graduates enter the workforce in about equal numbers, men have a nine times greater chance of reaching executive level than women (CEW, 2009: 2).

Figure 1.9: The Stupid Curve



Source: EOWA Analysis 2012 ASX500 + Mo Kinsey Women Matter Asia 2012

This *Women in the Science Research Workforce* project aimed to interrogate the factors behind the apparent ‘falling away’ of women and the concomitant ‘ascendancy’ of men and produce a coherent set of resources and approaches to solving a ‘wicked’ problem (Rittel & Webber, 1973) that appears to repeat itself in successive generations of women in science (Bailyn, 1999, 4). Professor Lotte Bailyn, MIT, eloquently articulated the nature of the challenge in 1999 with diagnostic insight that continues to resonate:

The key conclusion that one gets from the report is that gender discrimination in the 1990s is subtle but pervasive, and stems largely from unconscious ways of thinking that have been socialized into all of us, men and women alike. This makes the situation better than in previous decades where blatant inequalities and sexual assault and intimidation were endured but not spoken of. We can all be thankful for that. But the consequences of these more subtle forms of discrimination are equally real and equally demoralizing.

The women who worked on these issues over the past five years are all gifted scientists, themselves convinced that gender had nothing to do with their careers: if they succeeded it was on the basis of their competence, and recognition would certainly follow, if they did not it was based on something they lacked and rewards were not warranted. During their earlier years, this belief was continuously reinforced, but then something seemed to change. It was only when they came together, and with persistence and ingenuity, that they saw that as their careers advanced something else came in to play, which for them meant an accumulation of slight disadvantages, with just the opposite for their male colleagues... This is hard work. Our first instinct is to deny that a problem exists (if it existed it would surely have been solved by now), or to blame it on the pipeline, or the circumstances and choices of individual women. None of these, however, explains the inequities surfaced by the Committee.

**(Chair, Committee on Women Faculty in the School of Science, MIT, 1999: 3)**

## SECTION 2: PROJECT SCOPE AND AIMS

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This *Women in the Science Research Workforce* project builds on existing research on women in science in Australia to extend understanding of gendered career paths and critical career transitions in science within and outside the academy in two strategically significant fields – biological and biomedical research and chemistry-related industries. The project comprised four main components:

- i analysis of existing large datasets (ABS Census of Population and Housing 2011; National Research Student Survey 2010; DIISRTE Higher Education Statistics Collection 2011) to obtain new information, especially age and gender correlations to ascertain patterns of change and mobility over time;
- ii a survey, involving a detailed questionnaire distributed through industry partners, to map and track the nature of scientific career paths of women and men in biological and biomedical research and chemistry-related industries. Following the comparable US Study *The Athena Factor* (2008) and the National Research Council report *Gender Differences at Critical Transitions in the Careers of Science, Engineering and Mathematics Faculty* (2010), the research focuses on non-traditional career paths and patterns of mobility and transferability of knowledge and skills between the academy, the public sector and industry;
- iii focus groups with women and men working in various career phases and employment locations to probe further into the decision-making processes and experiences flagged in the survey; and
- iv development of a *Women in Science Research Workforce Diversity Advantage Toolkit* for developing and sustaining diversity, designed to be transferable across professional and industry boundaries, and empirical and conceptual foundations for the business case for linking diversity and innovation.

In 2012 the project commissioned the Australian Council for Educational Research (ACER) to analyse pertinent data from three large datasets: the ABS Census of Population and Housing (2011), the National Research Student Survey (NRSS 2010), and the DIISRTE Higher Education Staff and Student Data Collection for 2011.

An online survey of present and past female and male participants in the biological and biomedical and chemistry-related research workforces was piloted by the project research team and then conducted from November 2012 to the end of February 2013, distributed via the project's industry partners and participant referrals. Analysis was performed using SPSS software, and included regression analysis of key elements of the survey data.

Eleven follow-up focus groups were held in Brisbane, Sydney, Canberra and Melbourne, involving 38 female and male survey respondents who had indicated they would like to participate. Focus group respondents were clustered to obtain richer detail on issues flagged in the survey responses and large data analysis, prior to work on the Toolkit. With the consent of participants discussions were recorded, transcribed and entered into NVivo for thematic analysis.

Preliminary results were shared and discussed at a workshop at the University of Melbourne on 29 October 2014. The 35 workshop participants were drawn from project partner institutions. Participants in the project focus groups were also invited to attend.

The Women in the Science Research Workforce Gender Diversity Toolkit [womeninscienceresearch.org.au](http://womeninscienceresearch.org.au) is designed to address key audiences: those in leadership positions at executive level, at team level/lab head level, and individual female scientists. It is also designed to provide access to resources for professional associations and funding agencies.

## Why Biology and Chemistry?

The disciplinary focus for this study was prompted by the National Research Council (NRC) report *Gender Differences at Critical Transitions in the Careers of Science, Engineering and Mathematics Faculty* (2010), which clearly identifies biology and chemistry as two critical target disciplines for such a study (2010: 28). In the US these fields of science have the largest representation of women with doctoral qualifications, but the percentage of PhDs awarded to women (1999-2003) was found to be almost double the percentage of applications for tenure track positions in the research-intensive (RI) universities surveyed (2010: 47–48).

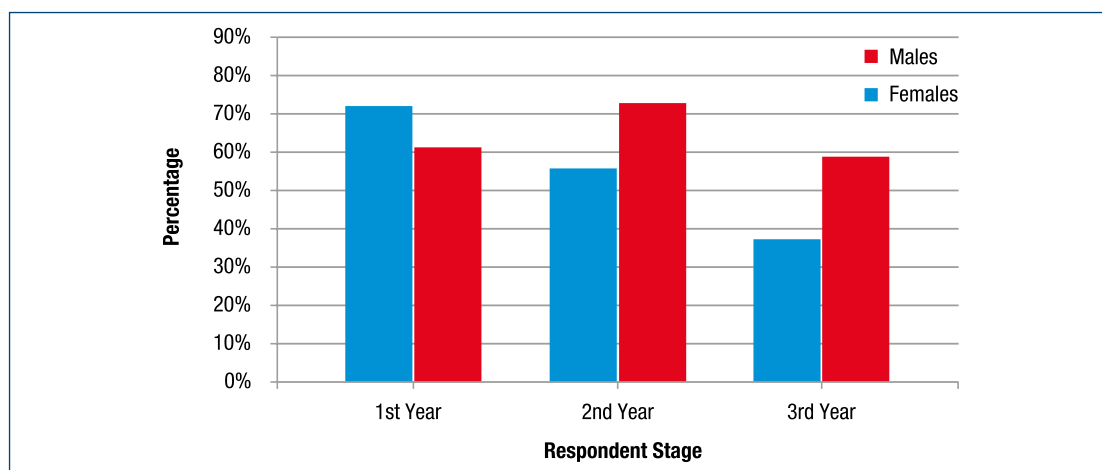
Not only have biology and chemistry experienced significant female participation up to the doctoral level for several decades, but also the NRC study concluded that female biology and chemistry doctorates take up a wide range of occupations in industry and government and as teachers outside RI institutions (2010:48). Moreover, these disciplines are in a dynamic state of interaction and change, especially given the increasing demand for computational competence. This change offers challenges but also significant potential in terms of configuration of the future workforce. As the NRC report authors observed:

Many of the “whys” of the findings included here are buried in factors that the committee was unable to explore. We do not know, for example, what happens to the significant percentage of female PhDs in science and engineering who do not apply for regular faculty positions at RI institutions, or what happens to women faculty members who are hired and subsequently leave the university. (2010: 3)

It is important to note that the NRC study did not capture the experiences of PhDs who have never applied for academic positions, female faculty members who have left the academy at various points in their academic careers, or non-tenure-track, part-time scientists (2010: 13). In fact, the study acknowledges the ‘significant limitation of the focus only on full-time tenure-track and tenured faculty’ (2010:168). This significant limitation, and the consequent potentially misleading findings from an influential source, were strong motivations behind this research project. This is particularly relevant in the Australian context, where not only has the gap between available university positions relative to number of PhD graduates been increasing, but also significantly more of those university opportunities are now casual or fixed-term rather than ‘tenure track’ (May, 2011). There has also been significant growth in medical research institutes outside universities, where a lot of researchers are congregated and where there is even less job security.

The research imperative in these fields was also informed by studies undertaken in the UK, particularly by the Royal Society of Chemistry (RSC) and the UK Resource Centre for Women in Science Engineering and Technology (UKRC). The RSC became interested in ‘the leaky pipeline’ when analysis of Higher Education Statistics (HESA) data showed that ‘female attrition’ in chemistry is significantly higher than in other science disciplines (Newsome, 2008: 10). In their 2008 report *The chemistry PhD: the impact on women’s retention*, researchers found that the decision by women not to pursue a research career is the result of challenging and frustrating doctoral experiences together with concerns regarding postdoctoral employment conditions, the fiercely competitive research environment and the challenges of balancing family and career aspirations, together with the lack of female role models in their field who seem to have achieved such a balance. The report concludes that ‘the chemistry PhD program and academic careers are based on masculine ways of thinking and doing, which leaves women neither supported as PhD students nor enthused to remain in research in the longer term’ (2008: 7). Their findings about young male and female scientists’ career intentions are illustrated in Figure 2.1:

**Figure 2.1: Proportion of respondents intending to pursue research on completing doctoral study in Chemistry by gender and stage (UK)**



Source: Royal Society of Chemistry, 2008, 11.

## Key Research Questions

Like much of the international research, existing Australian research on the patterns of participation and attrition of women in science is characterised by a predominantly single-disciplinary or institutional focus due to high levels of professional interest and sponsorship (de Vries & Todd 2012; Sheil 2010; Mills et al 2008; Stevens-Kalceff et al 2007); a focus on specific cohorts such as recent PhDs (Dever et al 2008) or new female professors (Diezmann & Grieshaber 2009); and, as indicated previously, a focus on the academy (Bell et al 2009). Thus research to date has failed to fully capture the range of occupations that female scientists assume and the issues that arise at differing stages of women's career trajectories.

Female scientists working in industry have been largely ignored and their professional circumstances and capacity to contribute are less well understood than those of women in universities and research institutes. We also know very little about mobility between the academy, public sector and industry. This is an omission readily acknowledged in international research on women in science (NRS 2010; Hewlett et al 2008; NAS 2007). The absence of reliable data tracking the mobility of the science workforce between the academy, the public sector and industry means it is much harder to evaluate whether there is net attrition or simply a wide range of graduate and postgraduate outcomes at different career stages. The Women in the Science Research Workforce project was designed to address some of these knowledge gaps. What is distinctive about this project is its focus across sectors in two important fields of science, and that it draws on data from both men and women across all career stages.

The premise of this project is that if we do not address academic and professional career structures overall equity participation in higher education might increase but professional success will remain limited, potential for the 'attrition' of women will remain high, and diversity and concomitant innovation will not be achieved.

New employment conditions and new career paradigms have the potential to reframe patterns of participation and opportunities for success for a wider range of entrants to the scientific research workforce. This raises questions regarding the social construction of science and occupations that are reflective of 'branches' of science but are not included in the dominant paradigms of STEM and data relevant to the STEM workforce (Metcalf, 2010).

**The critical questions are:**

What opportunities exist? For whom? In what professional contexts?

There is a pressing need, which this research addresses, for a more nuanced understanding of critical decision-making processes, including:

- the demand for flexible and less linear career options;
- the push-pull factors of organisational cultures;
- the diversity of career destinations and evidence as to whether skills and knowledge gained in professional education and training are utilised; and
- career mobility between the academy, the public sector and industry.

# SECTION 3: THE BIOLOGY AND CHEMISTRY POSTGRADUATE POPULATION – THE NATIONAL CONTEXT

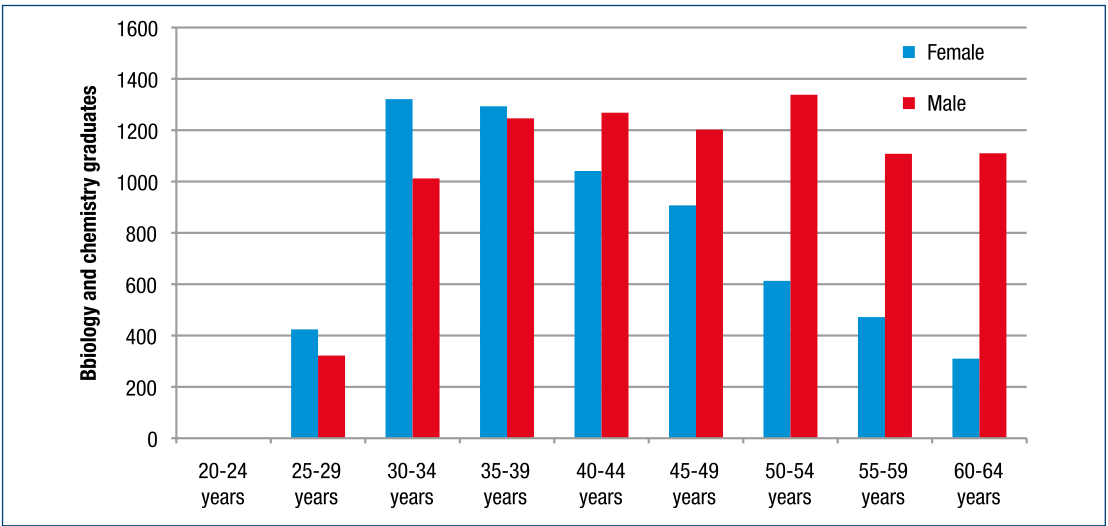
Data from the 2011 ABS Census of Population and Housing and the 2006 census was analysed to establish the career patterns of the target population over time in basic demographics, employment and income. The data reveals that the population of people with postgraduate qualifications in either biology or chemistry in Australia is growing significantly and is predominantly qualified at the doctoral level. In 2006 this postgraduate population was 17,599, but grew to 22,315 in 2011 – an increase of 27%. Nearly half (48%, 10,622 people) of this postgraduate population were female. Two-thirds (67%, 14,987 people) held a PhD qualification (compared to only 19% in the general population of postgraduates). Of this sub-group of those qualified at the doctoral level, women comprised 43%, compared to 37% in 2006. The high proportion of doctoral graduates as compared to masters' graduates sets the chemistry and biology population apart from graduates in other fields and undoubtedly impacts upon graduate expectations and patterns of employment.

Eighty-six per cent of women and 83% of men with a postgraduate qualification in biology or chemistry live in capital cities. Together, Sydney and Melbourne are home to 50% of women and 45% of men with postgraduate qualifications in these fields. This geographical concentration probably increases competition for employment opportunities.

Of all Australian residents aged 20 to 64 in 2011, 65% were born in Australia, but only 44% of all postgraduates. In the populations of biology and chemistry postgraduates, 44% and 40% respectively were Australian-born; older graduates were more likely to be born in Australia. The fact that younger graduates are more often from overseas explains the age distribution differences between 2006 and 2011: it is possible that a relatively large number of young international students or skilled migrants has contributed to the growth in the biology and chemistry postgraduate population, which is mainly concentrated in the younger age brackets.

Census data reveals that most women qualified in biological sciences or chemical sciences are under 40 years of age. In contrast, most men with these qualifications are over 40 years of age. Women are more highly concentrated amongst those with qualifications in the biological sciences and men are highly concentrated amongst those with qualifications in the chemical sciences (Figure 3.1).

**Figure 3.1: Doctoral degree holders in biology or chemistry, by age and gender, 2011**





The census data indicates that the overwhelming majority of women with doctorates do not have children until after age 30. The proportion of female doctoral graduates with one or more children exceeds 50% from the 35-39 age category onwards, whereas this occurs five years earlier for masters' graduates. This fact is likely to be related to the varying ages at which women in these categories enter the labour force, which is in turn linked to the length of time taken to gain qualifications.

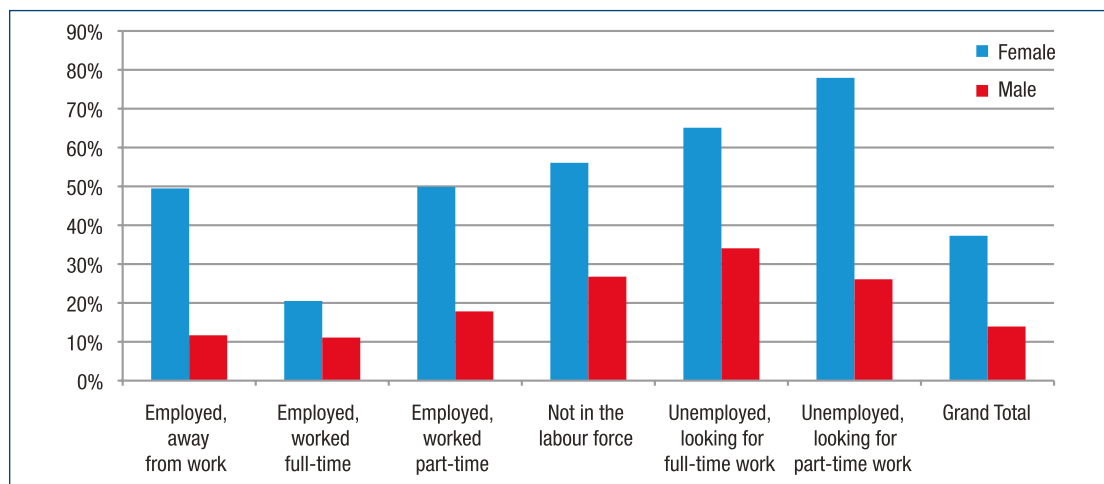
## Employment

In 2011 the participation rate in the workforce was 76% for female and 77% for male biology or chemistry postgraduates, lower than for the postgraduate population as a whole (82% and 86% respectively). In both populations, the overwhelming majority of men work full-time. While most women also work full-time, women are more likely to work part-time or self-identify as not being part of the labour force. In both populations the proportion of women out of the professional workforce peaked in the 30-39 age groups, which for many is the critical postdoctoral career stage. This peak is less pronounced for the broader population of postgraduate degree holders.

Most Australian women without children were in paid employment in 2011. Interestingly, the employment status of women with children varied little by number of children. Women who had children, whether one or more were more likely than women without children to work part-time or be outside the labour force. The 2006 and 2011 census data show little change in the labour force distribution patterns of women by number of children. Women with one child were slightly less likely to work full-time in 2011 and more likely to work part-time than in 2006. Women who had three or more children in 2011 were slightly less likely to be outside the labour force than five years previously.

To provide a richer picture of the household arrangements of our population and patterns of 'private work', Figure 3.2 displays the proportion of biology and chemistry postgraduates who spent 15 hours or more doing household duties, by labour force status, in 2011. Large gender differences existed between male and female contributions across all labour force categories.

**Figure 3.2: Proportion of biology and chemistry postgraduate degree holders spending 15 hours or more per week doing household duties, by labour force status and gender, 2011**



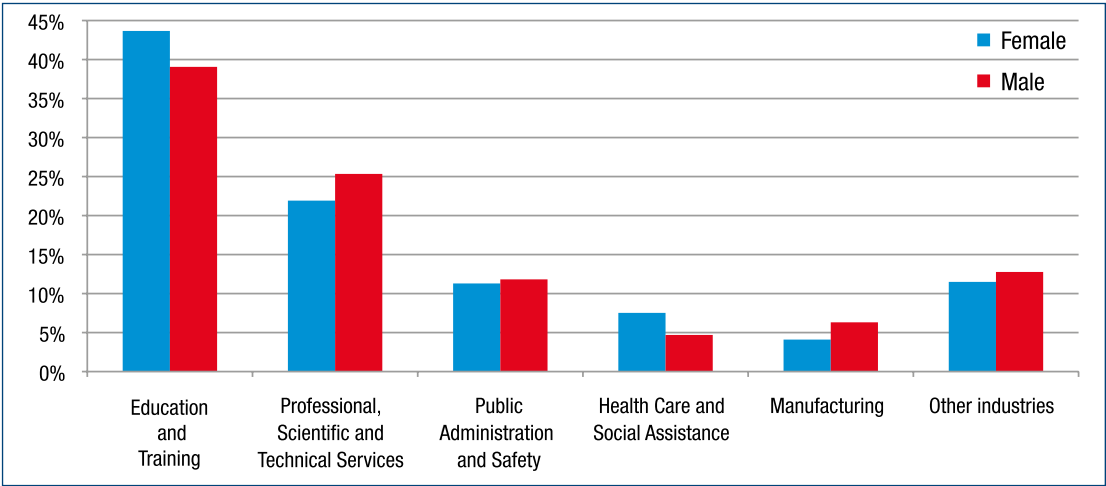
There was little gender difference in the distribution of employed persons in the overall population of biology and chemistry postgraduates between the public and the private sector; of all such persons in employment in 2011, 47% of women and men were in private employment. However, the patterns for chemistry and biology graduates differed. Of all biology postgraduates in employment 43% worked in the private sector, whereas most chemistry graduates (56%) worked in this sector.

Biology and chemistry graduates in employment differed in employment status across the public and private sectors. In the public sector, 27% of women but only 10% of men worked part-time in 2011. In the private sector, 33% of women and 18% of men worked part-time.

The census allows us to look at fields of employment in two distinct ways: by industry and by occupation. Industry of employment is coded using the Australian and New Zealand Standard Industrial Classification (ANZSIC), 2006. Occupation is coded using the Australian and New Zealand Standard Classification of Occupations (ANZSCO), First Edition, Revision 1. In the census, occupation code is based on the occupation title and tasks of the main job held during the week prior to census night.

Figure 3.3 below displays the major industry groups in which the population of biology and chemistry postgraduate degree holders were employed, by gender, in 2011. A large proportion of doctoral graduates were employed in the education and training industry (44%), followed by the professional, scientific and technical services industry (ANZSIC Divisions P and M). Women were more likely to go into education and health care and social services, and less likely to go into the professional, scientific and technical services, or manufacturing industries. Interestingly, detailed analysis of occupations (ANZSCO 2 digit) indicates that women were employed in a more diverse range of occupations than men. Graduates in the 50–59 age group were more likely to be employed in the education sector than those in the 30–39 age group – possibly an indication both of diminished opportunities in higher education and of a changing generational pattern of employment.

**Figure 3.3: Industries of employment of biology and chemistry doctoral degree holders by gender, 2011**



The census data on employment provides confirmation of several issues critical to this analysis. Firstly, participation rates for biology and chemistry postgraduates were lower than for the postgraduate population as a whole. This is likely to be due to a combination of the over-representation of women in these fields and the increasingly large, and growing, PhD-qualified population. Secondly, almost half the population of postgraduate qualified men and women were employed in the private sector, even though the National Research Student Survey (2010) showed that this was seen as the ideal career path for only about one third of postgraduates in these fields. The private sector offers employment opportunities not currently available in the academy, and women in particular are found to be in a more diverse range of occupations than their male counterparts. **This points to a disjunction between postgraduate aspirations and the reality of employment opportunities, and if the rate of growth in this population continues and employment practices in universities and research institutes do not change, this disjunction will increase.**

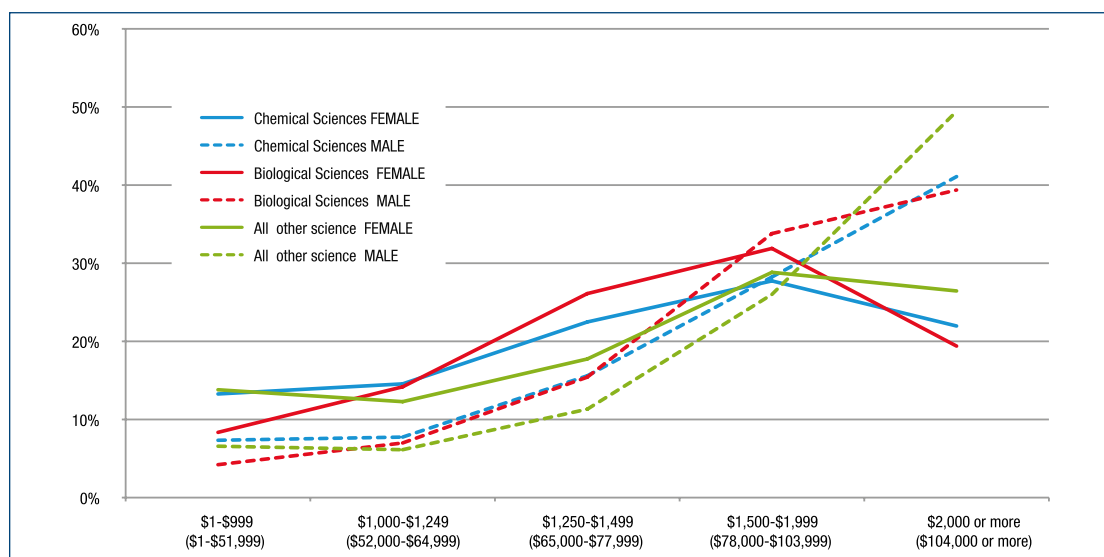
## Income

While the census provides some information on the income of individuals, the degree of detail in this data is restricted, since it is categorical. In order to make comparisons as accurately as possible, all data used in this section is based on persons in full-time employment.

The average income of science postgraduates is similar to that of postgraduates in other fields, but the income range is high amongst science graduates, as opposed to that for health, management and commerce, and engineering graduates, who are overwhelmingly in higher income brackets.

Figure 3.4 below provides an initial view of gender differences in income amongst the specific fields of chemistry, biology and other sciences in 2011. Gender differences occurred similarly across the science fields. **Female postgraduates were mostly in the lower and middle income groups; substantially fewer were in the highest income category used here.**

**Figure 3.4: Weekly (and annual) income distribution of chemistry, biology and other science postgraduate degree holders employed full-time, by gender, 2011**



Although some of the patterns in Figure 3.4 may reflect age distributional differences between men and women in the census cohort of those with chemistry and biology postgraduate qualifications, there are also indications of a persistent gendered differential. Differences in income between men and women are most pronounced in the higher age brackets across graduates from all fields of science.

**The census data indicates that men reach higher income categories at a younger age and that a small but stable proportion of women remain in the lower income categories for all ages, whereas for males this group diminishes steadily.** This latter effect is especially pronounced amongst chemistry postgraduates.

## Key Findings from the Census Data

This rich data source revealed that more than 20,000 Australians had a biology or chemistry postgraduate qualification in 2011 and that this number has grown markedly since 2006. Women are in the majority in this population in the younger age categories, while men dominate the older age categories. The postgraduate population is getting younger, as numbers in the lower age groups are much larger than in the higher age groups. A large proportion of this young population was born outside Australia.

Most science postgraduates work in the education and training or professional, science and technical services industries, but women are more likely to work in the 'caring' professions of education, health and social services. Women in this population are less likely to be employed full-time than men; in the public sector, women are three times more likely to be working part-time, and in the private sector almost twice as likely to be working part-time than men. Women who have had children are much less likely to be employed full-time, but the number of children a woman has does not influence labour force status. Although the capacity to work full-time is a contingent rather than causal relationship, this pattern of participation has the potential to impede women's competitiveness in achieving senior roles or achieving a place in the highest income brackets. It should be emphasised that there are income gaps between postgraduate men and women employed full-time, and these are especially pronounced in the higher income categories.

This contextual data provides a valuable comparative framework within which to consider data generated by the project survey. **Significant generational differences emerged, particularly with regards to changing patterns of employment by sector, with diminishing opportunities for continuing employment in higher education. This differentially impacts on women, as historically the ANZSIC Division 'education and training' has been the primary industry of employment for women in this postgraduate population, particularly those qualified in the biological sciences.**

Consistent with the international literature, there is evidence that women at the critical postdoctoral career stage engage in what Case and Richley (2013) describe as 'organic branching' associated with family formation, as women occupy a more diverse range of occupations than their male counterparts. In addition, women's ability to work full-time is differentially reduced compared to men due to child-bearing, childcare and assuming responsibility for other household duties.

## The Next Generation

In 2010 ACER, in conjunction with the Centre for the Study of Higher Education, conducted the National Research Student Survey (NRSS), surveying higher degree research (HDR) students in 38 of the (then) 39 Australian universities. We used the NRSS to explore the 'pipeline' of the core population of interest in this study. Whilst the project was primarily directed at the career outcomes of postgraduate women and men in the biological and biomedical sciences and chemistry-related industries, the analysis of NRSS data provided some insight into the career aspirations of those in this population undertaking the advanced qualifications required for employment in the research sector.

Responses from almost 12,000 students enrolled in PhD or Masters by Research degrees were collected (a 25.5% response rate). Of this sample, 695 respondents were women undertaking study in the chemical or biological sciences. This group is the focus of the analysis in this section. The responses of these women were compared with a range of benchmark groups. The focus of the analysis here was on the career intentions of this group of students, although the data available through the NRSS does also allow exploration of university experience, engagement and involvement in training for university teaching. (The full project report on the NRSS can be found at [http://www.cshe.unimelb.edu.au/people/bexley\\_docs/RAW\\_Combined.pdf](http://www.cshe.unimelb.edu.au/people/bexley_docs/RAW_Combined.pdf)).

Of the 695 female respondents, 137 were studying chemical sciences and 558 biological sciences. More than half were aged between 23 and 27, the vast majority were from an English-speaking background (although one quarter were not Australian citizens), and more than half were based in New South Wales or Victoria. They were similar to the whole population of research students (male/female and across all fields) on most demographic characteristics, but women in chemical or biological sciences were in general younger on average, and less likely to come from a home where English was not the first language.

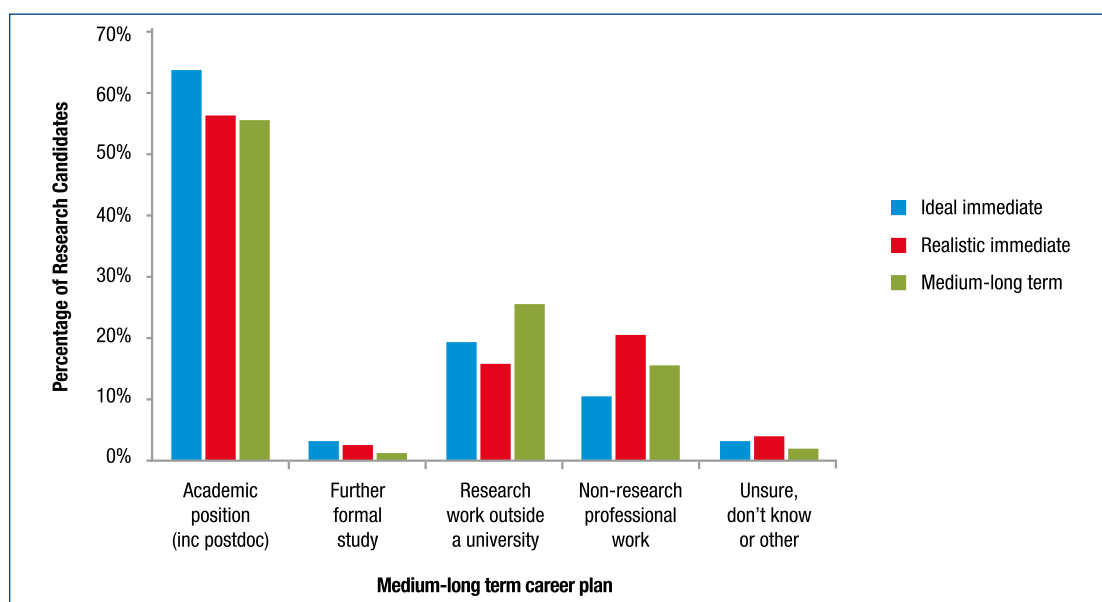
When compared with all candidates who were part of the NRSS, the 695 women were more likely to be enrolled in a PhD, more likely to be enrolled full-time, less likely to be international students and more likely to be in the later stages of their candidature.

HDR students were asked about their career intentions based on three considerations: (1) what they would ideally like to do in the year after completing their degree; (2) what they realistically expect they would do in the year following completion, and (3) what career they planned to pursue in the medium to long term (five to seven years after completion of their research degree).

Responses from the 695 female NRSS respondents studying chemical (137) or biological sciences (558) showed that while expecting or hoping to begin their post-HDR career in a university, a large minority saw themselves moving away from the university sector. While 64% ideally wanted to go directly into an academic position (including a postdoc), only 56% saw this as a realistic option. Just over half (55%) intended to pursue such a career in the medium to long term (see Figure 3.5). These findings are similar to those for participants studying in other fields.

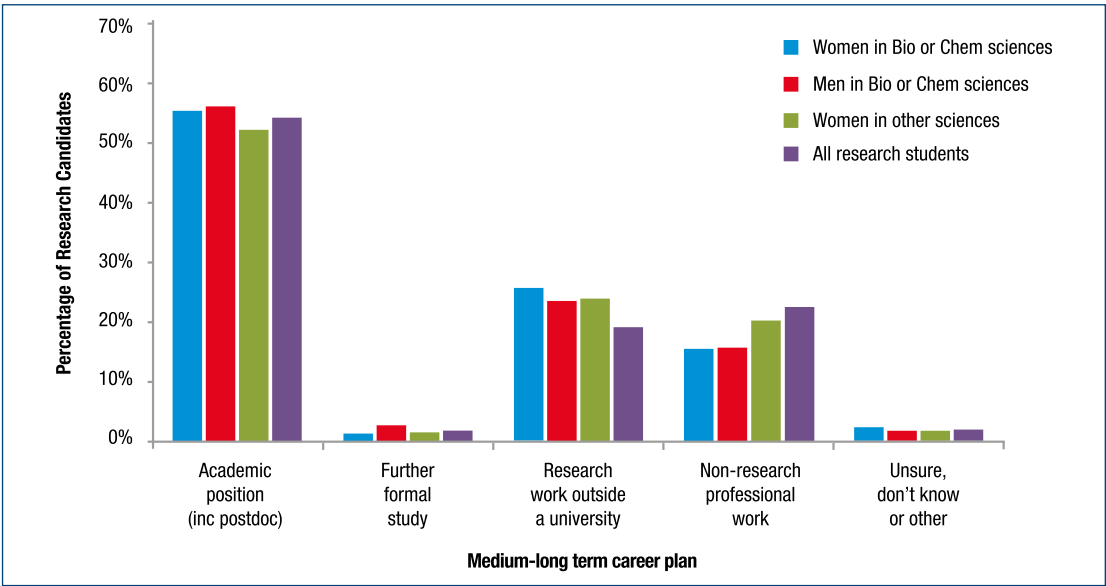
However, in the medium to long term overall, few participants planned to work in non-research professional employment (15.5%). Again, these findings were similar to results for the whole HDR candidate population regardless of gender or field. It should be noted, however, that views change significantly with stage of candidacy (see Figure 3.8 below).

**Figure 3.5: Career intentions of female biological or chemical science HDR students (%)**



The proportion of women in this population who intend to pursue an academic career over the medium to long term (55.2%) is only slightly lower than men in the same field (56.2%) and slightly higher than women in other sciences (52.1 %). (Figure 3.6) Our population is close to the figure for the entire cohort of HDR students in this respect, with 54.5 per cent overall responding that an academic career is their goal over the medium to long term. Female HDR students in biological or chemical sciences are slightly more likely to intend to pursue a career in research outside a university. As noted above, more than a quarter (25.6 per cent) of this group indicated this ambition. By comparison, the other groups examined here are slightly less interest in this avenue, with 23.6 per cent among both the men in these fields and 23.9 per cent among women in other sciences indicating interest in these occupations. However, the proportion of female HDR students in biological or chemical sciences intending to do non-research professional work was much lower. On average, 22.5% of all research students planned to do non-research professional work in the medium to long term, but only 15.5% of female HDR students in biological and 15.7% in chemical sciences.

Figure 3.6: Medium- to long-term career intentions of HDR students (%)



The NRSS revealed some stark differences in female Chemical Science and Biological Science HDR students' medium- to long-term career intentions. Female HDR students specialised in biological science were more interested in pursuing an academic career and less likely to envisage non-research professional work than those in chemical sciences. In terms of research work outside a university, the differences between women in biological and chemical sciences were only minor, as illustrated in Figure 3.7.

Figure 3.7: Medium- to long-term career intentions of women in chemical or biological sciences (%)

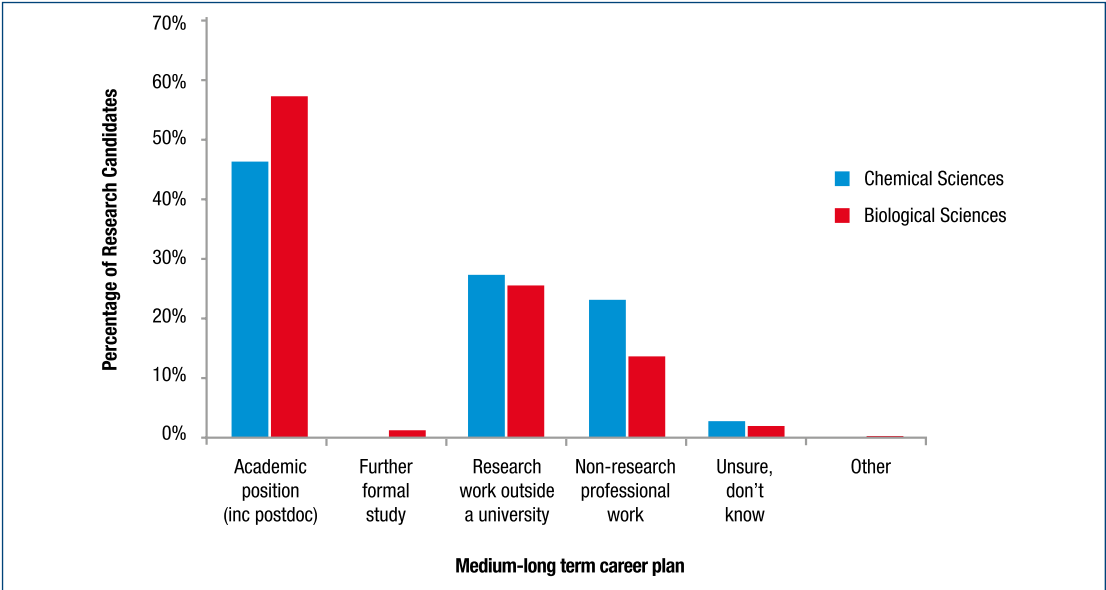
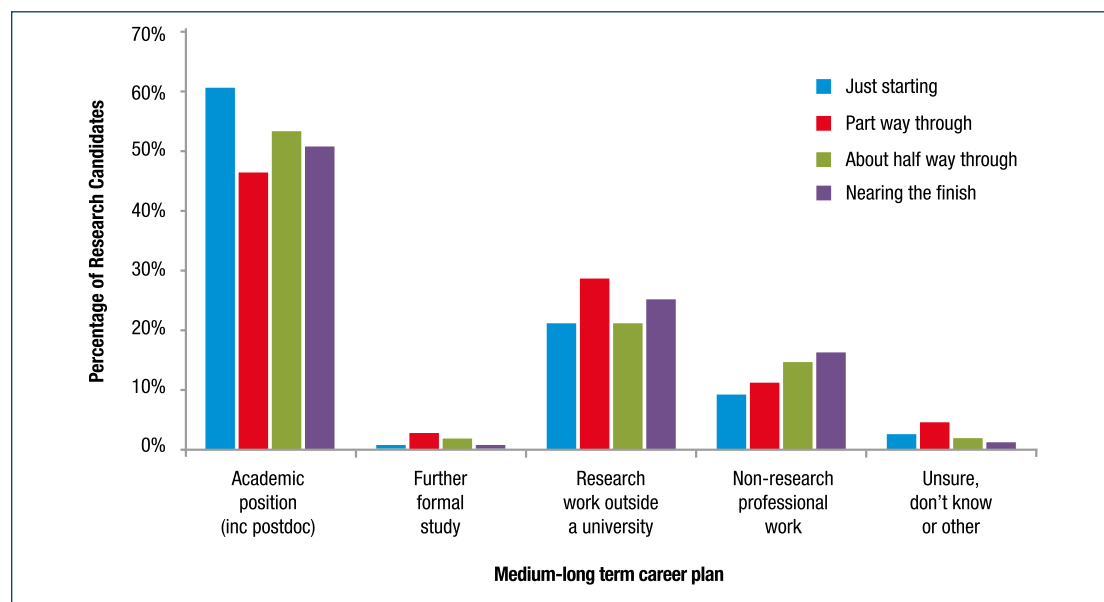


Figure 3.8 depicts the differences in the medium- to long-term career intentions of women in biological and chemical sciences when the period of their candidature is taken into account. Only questions with more than 100 responses are included, eliminating the small numbers of students

who were about to submit or had submitted their thesis. Figure 3.8 shows that **the proportion of new HDR entrants with long-term ambitions for academic careers was higher than among students further into their degrees**. Consistent with the data from the RSC cited above, it also shows a consistent rise in respondents indicating their plans to enter a non-research professional occupation as the end of their research degree approaches. Whether this indicates a refocusing of career goals based on pragmatic decisions (essentially a more pessimistic or realistic assessment of job opportunities), a change in interest as candidates traverse the HDR, or poor HDR experiences is unknown.

**Figure 3.8: Medium-long term career intentions of women in chemical or biological sciences (%)**



## Key Findings from the NRSS

This brief analysis provides insight into the career aspirations of students undertaking postgraduate research degrees in the biological or chemical sciences. Its value to the wider project lies in illuminating the views and expectations of the next generation of women who plan to join the scientific research workforce.

The data here indicates that despite rapidly changing employment patterns in higher education and research most research students hope to work in traditional research fields, but those expectations do not match the available opportunities. Only about one quarter of the women in these fields intend to pursue a research career outside universities in the medium to long term. Interestingly, among this group of students, far fewer have this career in mind as their immediate occupation following completion of their research degree – research work outside a university only becomes an ambition when thinking further ahead than graduation. It is unknown why this is the case: perhaps students anticipate non-academic work will accommodate family formation more easily, or that a start inside academia is required to break into this sector. It should also be noted that Australian universities have historically had more structured family leave provisions and flexible work arrangements than research institutes. While those aiming for a non-university-based research career are in the minority compared with those with ambitions of an academic career when viewed within the target population, they are actually overrepresented when compared to other relevant reference groups – specifically men in the same fields, women in other science fields, and the cohort of all HDR students. This anomaly in our target population deserves further investigation.



Another interesting finding from this analysis is that **as these students progress through their research degree, more of them intend to pursue a professional career outside research.** While only about 19% of finishing students indicated that they intended to follow this career in the medium to long term, the fact that this figure rises consistently suggests that some students become more disillusioned with their career prospects in research as they progress through their degrees. As noted above this pattern is consistent with the UK RSC (2008) data.

These findings also show that in biological or chemical research **there are far too few positions available for the postgraduate students who aspire to continue in research careers in universities and research institutes and there are potential implications for the career ambitions and career knowledge that are formed during doctoral study.** This reinforces the need to improve understanding of patterns of mobility between sectors and knowledge of alternative career paths, a key objective of the project survey.

## SECTION 4: THE PROJECT SURVEY

I just hope this survey gets to some of those people that have already been squeezed out of their science career. I can give plenty of anecdotes of highly qualified, capable scientists that wish to be doing research but can't get jobs. I will try and forward this survey to a few friends including one working in the deli at Coles. She has a PhD in cell biology. I wish I did medicine. At least those researchers can fall back on their 6-figure day jobs. Pure scientists are pretty screwed in terms of fallback career options. Try planning to have a family or taking a loan for a house in this environment!

### Survey Respondent

In the last quarter of 2012 the Careers in the Scientific Research Workforce Survey (CSRWS), was broadly promoted with the following announcement through the project's industry partner newsletters:

### Careers in the Scientific Research Workforce survey – coming soon!

You will be invited to participate in an important survey examining careers, career mobility and patterns of retention and attrition in the Scientific Research Workforce. Led by researchers at the University of Melbourne, and with The Bio21 Cluster, Royal Australian Chemical Institute (RACI) and Science and Technology Australia (STA) as industry partners, the survey will seek to gather new data about the workforce, and inform workforce planning and policy making.

There has been a lot of discussion recently in the popular media about careers in science and about the sustainability of the scientific research workforce. Australia's scientific research workforce, and the sustainability of that workforce, is critical to the nation's future. However we know little about career mobility within and between government, industry and academia, and in particular whether skills are transferred between these sectors. Further, not enough is known about why highly trained scientific researchers leave the workforce, in particular why this is sometimes the case with women. Are the experiences of men and women different, and are the experiences of early career researchers different from those already in the field?

We are asking all those currently in, or formerly associated with, the scientific research workforce, whether you work in industry, government, in a university or a small research laboratory, to have your say and contribute to filling the gaps in knowledge about your profession.

Your participation in this survey is voluntary and is anonymous. Results will be collected by the researchers and results reported in aggregate form only.

Between mid-November 2012 and the end of February 2013, the industry partners distributed a link to the online CSRWS questionnaire to their members and related organisations. The link was also distributed amongst staff at CSIRO. Recipients were asked to forward the link to colleagues qualified in the biological sciences and chemical sciences but no longer working in the field: 'Whilst we are interested in the experiences of those currently working in the scientific research field, we are also interested in the experiences of those who are qualified but no longer working in the field. If you have colleagues who fit this description, would you please forward the survey to them.'

The use of a 'snowball selection' method, a non-random technique that provides access to difficult-to-reach or 'hidden' populations (Atkinson & Flint, 2001), could have resulted in bias either towards those who remain engaged with science or towards those who feel disenfranchised and may be motivated to complete such a questionnaire, even though they no longer work in the field. However, as described above, census data was analysed to describe the population of qualified individuals in the relevant fields of biological sciences and chemical sciences and to test the representativeness of the survey data. This generated confidence in the range of respondents reached by the survey

and its findings, but care must be taken in generalising across the full population of this particular workforce and those who have left the science research workforce. In the case of the latter, the reach of the CSRWS was biased towards individuals with continuing inter-relationships – those who have maintained connections with members of the community of research scientists, and perhaps retain a heightened interest in and engagement with their scientific field, or had a negative experience that they were motivated to share.

The CSRWS questionnaire consisted of 72 multiple-choice questions about respondents' demographics, qualifications, conditions of work (including hours of work), contract of employment, career profile, career decisions, job and career satisfaction, career impediments and work/life balance issues. It gave opportunities for comment and to opt-in to follow-up focus groups.

The CSRWS received 1298 usable responses. We were keen to capture responses from male and female scientists to enable comparison, and this goal was achieved: 52% of respondents were female and 48% male. Consistent with the census data for postgraduates in the fields of biology and chemistry, most female respondents were under 40 years of age and most male respondents over 40. Mirroring the census data, women were found to be highly concentrated amongst those qualified and working in biological sciences, and men were highly concentrated amongst those qualified and working in chemical sciences.

The CSRWS respondents differed by gender. Male respondents were older on average, less likely to be working in research roles and more likely to be employed on fixed-term contracts than female respondents. These differences need to be taken into account in reading responses on career satisfaction and like issues and are flagged at relevant points in the following analysis.

The survey provided a great deal of detailed data that was analysed using SPSS software. In this section of the report, analysis of the overall survey population is presented and compared against census data. In Section 5, the data from respondents qualified in biological sciences (n=519) and chemical sciences (n=445) is analysed separately. Data relevant to the population as a whole and data on the key themes of employment, organisational cultures, career paths and destinations, and scientific skills and knowledge are discussed. Key findings are proposed in the context of recent and relevant literature.

## Respondent Demographics

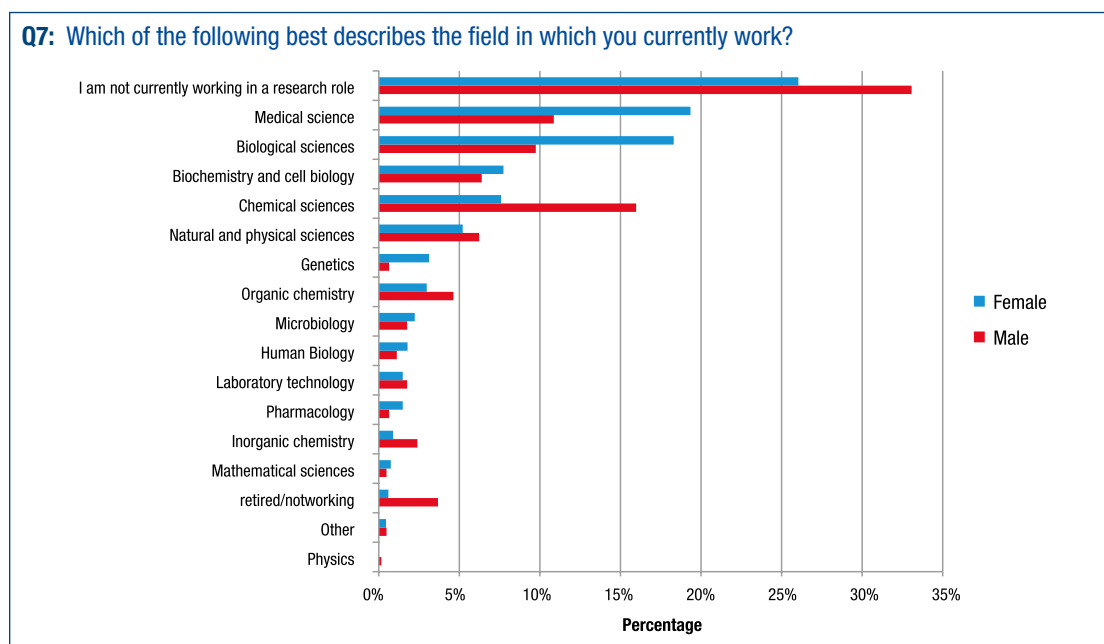
I am about to retire. I feel that the opportunities and conditions for scientists are worse now than when I started, although the opportunities for women have improved a lot.

**Survey Respondent**

Just under a third (29%, n=298) of CSRWS respondents were working at a university and a further 27% (n=280) were working in a research institute. Eighteen per cent (n=181) were working in the private sector/industry, 9% in government, 8% in a hospital and 7% at CSIRO (72 respondents). Most respondents (72%) were working in organisations of more than 100 employees but close to a third (28%, n=289) were working in organisations of fewer than 100 employees, and 12% (n=121) in organisations of fewer than 20 employees, reflecting the diversity of the sector and underlining the range of strategies that might be needed to improve gender equity and diversity.

As indicated above, most female respondents were working in biological sciences whilst most men were working in chemical sciences. Twenty-nine per cent (n=382) of respondents (33% of men and 26% of women) were not working in a research role at the time of the survey – an important target group to inform understanding of career decisions and career mobility. Thirty-six respondents indicated they were retired/not working, and most of these respondents were male.

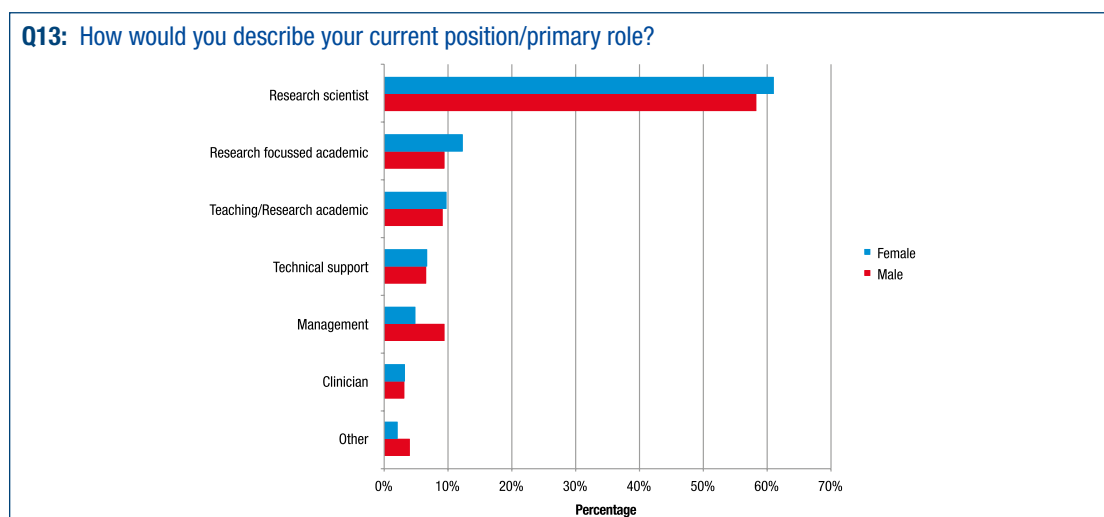
**Figure 4.1: Gender profile by field of work**



Seventy-four per cent of respondents' had their highest academic qualification in the biological or chemical sciences; others reported highest qualifications in cognate fields such as medical studies (10%), natural and physical sciences (6%), engineering and related technologies (5%) and mathematical sciences (1%). Field and gender distributions were very similar: 52% of female respondents were qualified in biological sciences, and 48% of men in chemical sciences. Nearly twice as many women as men were qualified in medical studies (13% vs 7%); the remaining respondents self-identified as working in the biological and biomedical sciences or chemistry-related industries. We were keen to include these responses as the focus of the research was to capture the nature of the scientific workforces in biological sciences and chemistry-related industries rather than rigidly defined disciplinary fields.

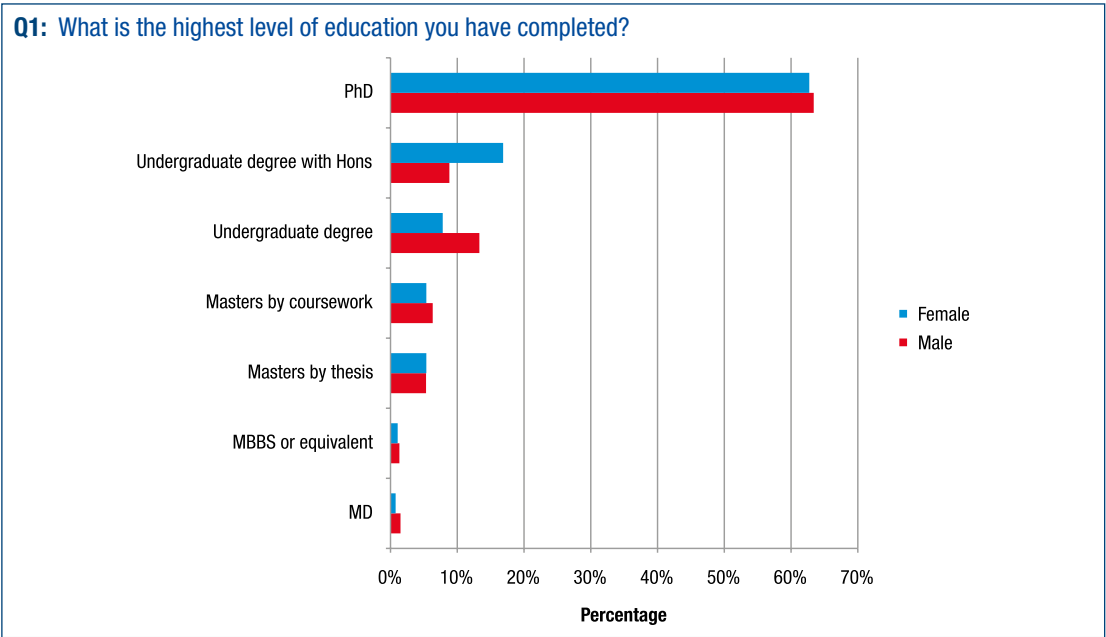
Consistent with the target population, 60% of respondents described their current role as 'research scientist' (Figure 4.2). A further 20.5% were either research-focused or teaching/research academics.

**Figure 4.2: Gender profile by current position/primary role**



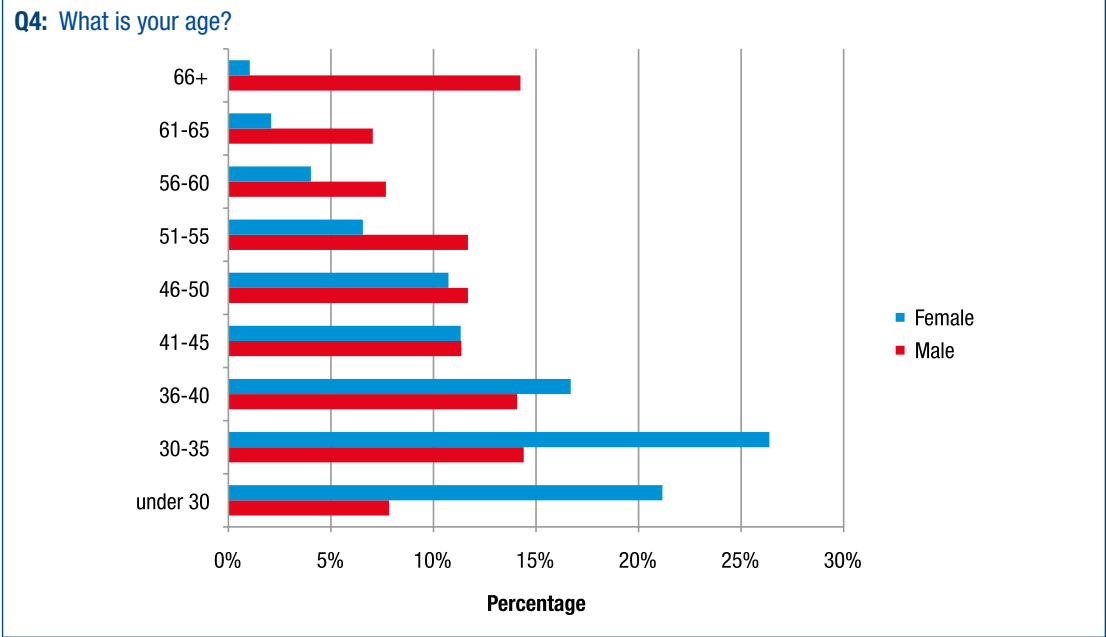
Consistent with the 2011 census, the highest qualification of most survey respondents was a PhD (63%) and a further 5% had a Masters by Research degree (Figure 4.3). There was no significant difference in degree type proportions between men and women within the postgraduate-qualified group.

**Figure 4.3: Gender profile by highest qualification**



As Figure 4.4 indicates, there was a distinct difference in gender profile by age and career stage, with women constituting 64% of respondents in the under-40 age group and men 64% of the over-40 age group. This is consistent with the 2011 census data.

**Figure 4.4: Gender profile by age of respondents**



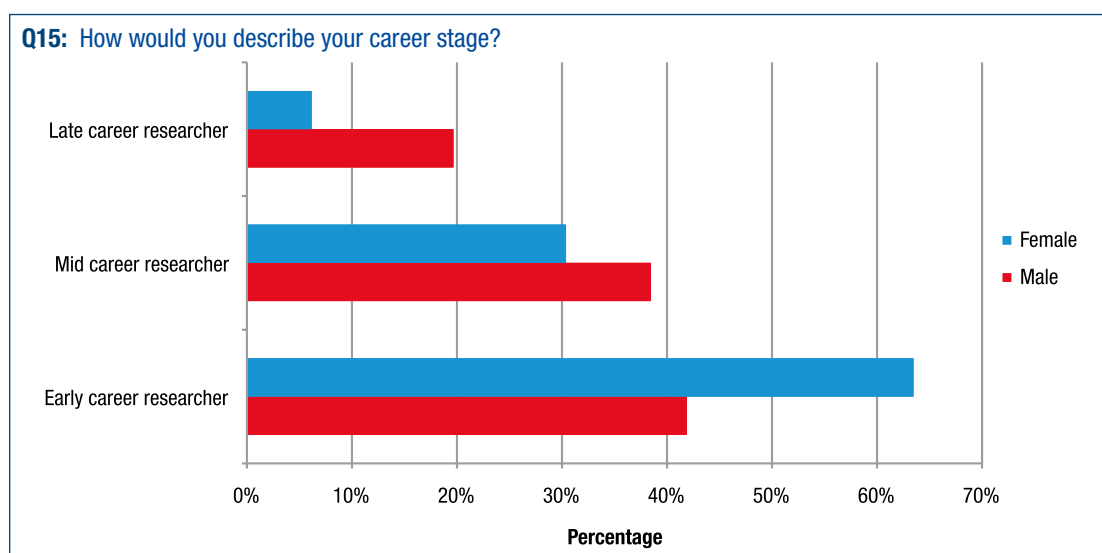
## Career Stage and Employment

It is a difficult time to be a scientist – and while there were lots of questions about job satisfaction and career progression and prospects, to be honest I, and many of my peers, are just so grateful to have a job in science that career advancement really comes so secondary to that.

### Survey Respondent

Consistent with the age profile of respondents, 49% of respondents described their career stage as early career, with women making up 70% of this group; 35% described their career stage as mid-career, with women making up 48% of this group; and 16% of respondents described their career stage as late career, with women making up only 23% of this group of respondents (Figure 4.5). Career stage is very closely associated with age, with only small proportions in the early and mid-career researcher categories falling outside the expected age ranges. Three quarters of early-career researchers were under 35 years of age, although 12% are 36–40 years of age. Those who described themselves as mid-career researchers were typically aged 36–50 (75% fall into this age category), and late career researchers were overwhelmingly in the 50+ age group category.

**Figure 4.5: Gender profile by career stage**

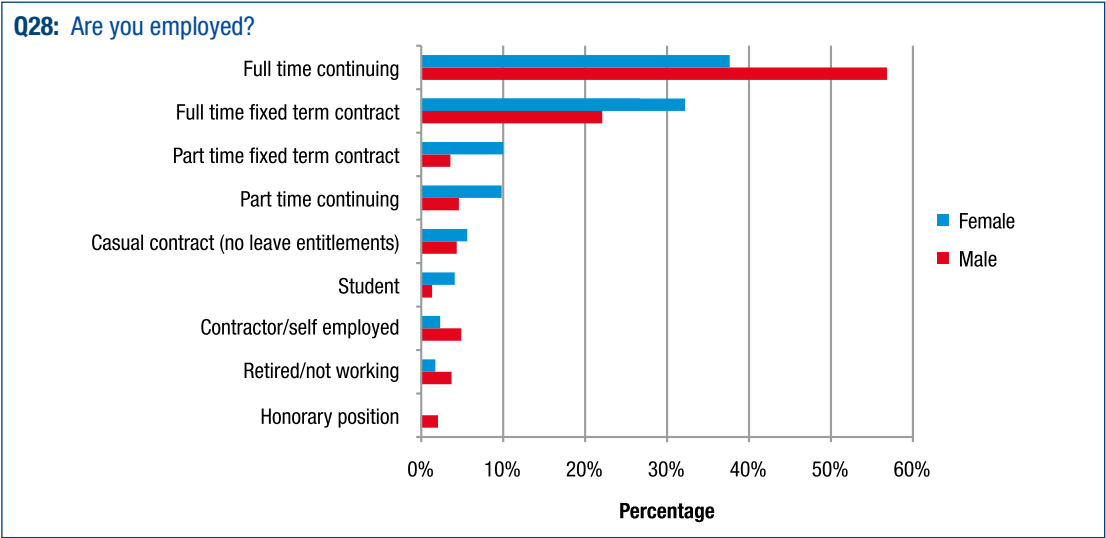


This reflects the demographics of the biological and chemical sciences: they are characterised by a growing number of young, female entrants (particularly the biological sciences), as evidenced in the 2006 and 2011 census data.

Only 55% of respondents indicated that their career path had been a traditional linear one (undergraduate study followed by postgraduate study, doctorate and postdoctoral research) but this may have been skewed by the large percentage of self-described early career female research respondents whose career trajectory had not had time to evolve. More men ( $n=127$ ) than women ( $n=111$ ) classified their career path as a 'non-traditional' career path that included work in other sectors.

**Less than half the respondents who identified as currently in the research workforce ( $n=499/1095$ ) were employed in full-time continuing positions, with men making up the majority of this employment category (57%)** (Figure 4.6). Women outnumbered men in the second-largest employment category, full-time, fixed-term contracts, and in the part-time and casual categories.

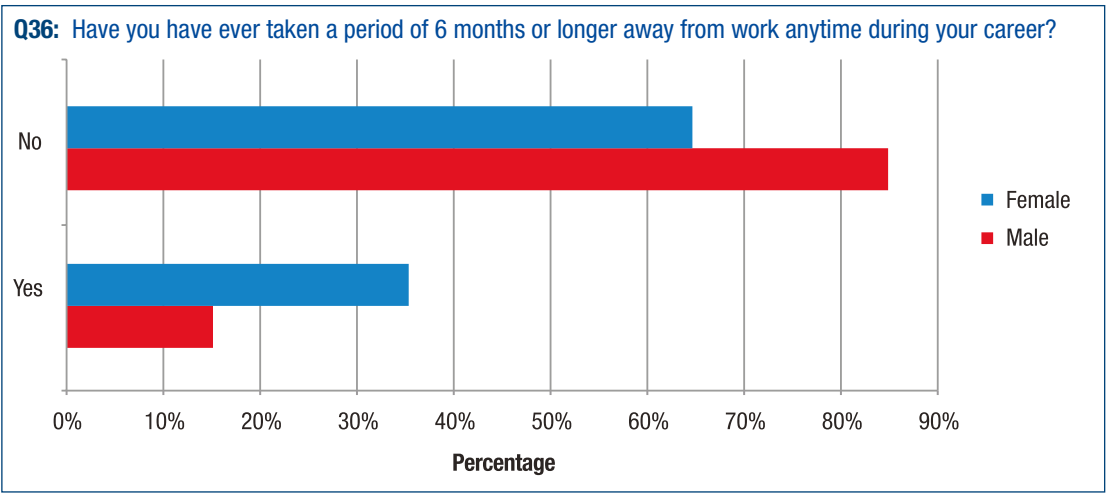
Figure 4.6: Gender profile by employment type



There are critical differences between employment patterns in the biological sciences and chemical sciences. The percentage of respondents directly employed in chemistry-related fields was substantially higher (69% compared to 34.5% in the biological sciences), suggesting that there are risks associated with generalised ‘whole of science’ conclusions. Consistent with the above, and noting differences between the biological sciences and chemistry-related industries, a higher proportion of men than women (56%) were direct employees; women were more likely than men to be employed on someone else’s research grant (29%), and a smaller percentage had their own grant (16%).

Almost three times as many women (n=209) as men (n=73) indicated that they had taken leave from the research workforce for six months or longer (Figure 4.7).

Figure 4.7: Leave from the research workforce by gender



Time away from the workforce is a major factor warranting further analysis in terms of Bailyn’s ‘accumulated disadvantage’; such periods of leave were reported by 52% of late-career women, compared to 12% of late-career men; 37% of mid-career women, compared to 10% of mid-career men; and 24% of early-career women compared to 12% of early-career men. Thus, a significant

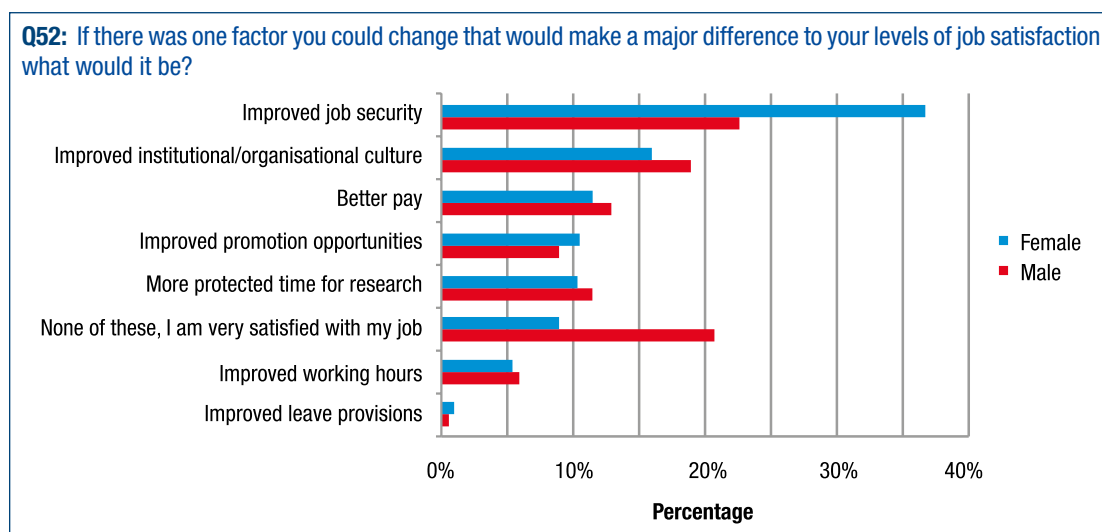


proportion of women in the science research workforce, at least 36% of the survey population (and that is likely to be an underestimate due to the higher proportion of early career female researchers in the respondent population) have had to develop career strategies to accommodate long periods of leave. Interestingly, only 19% of survey respondents indicated they had taken paid parental leave, even though such leave was available to most respondents; 12% (15% of women) had taken unpaid parental leave. Very few (10 men and 30 women) indicated they had received return-to-work assistance after parental leave. Moreover, when asked whether time out for family reasons had hindered their career progress, 34% of women strongly agreed compared to 7% of men.

The survey data (Q24) confirms that on a rating scale (very important, somewhat important, neutral, not important) the overwhelming majority (> 80%) of the survey population was motivated to pursue a career in science primarily by 'intellectually stimulating work' and the scientists' 'genuine passion for field of study', with no significant differences between men and women. Financial rewards (36%) and status of profession (37%) were only 'somewhat important' or 'neutral' to respondents' decision to pursue a career in science. This is consistent with the large salary and career survey of scientists Nature undertook in 2010 (Russo, 2010, 1104–1107). The least important factors in scientists' decisions to pursue a career in science were family influence (36%); 'inspired by a university lecturer' (32% rated this as neutral and 24% as not important); and inspired by a school teacher (34% neutral and 32% not important).

In this context, it is not surprising that a large minority (over 30%) of respondents identified improved job security – meaning the security to pursue your passion – as the single factor that would improve their job satisfaction (Figure 4.8). Almost twice as many women (n=200) thought this was significantly more important than the men (n=109) who also chose this factor. This is even more strongly apparent for current researchers (not shown in Figure 4.8): 40% said job security was the one factor that would improve their job satisfaction. This included 30% of male and 48% of female current researchers, reflecting the much higher proportion of women in fixed-term positions. Twice as many men (n= 97) as women (n=49) indicated that they were very satisfied with their current job, and indicated that none of the listed factors that might improve their job satisfaction were relevant for them.

**Figure 4.8: The most critical factor for job satisfaction by gender**



The second most important factor in improving job satisfaction for survey respondents was improved institutional/organisational culture; this was important for women and men. The well-documented importance of organisational culture (Bailyn 2003; OECD 2006; Hewlett et al 2008) was also reflected in responses to other survey questions, but the importance of this may be partially masked by the overriding issue of employment security.

# Organisational Cultures

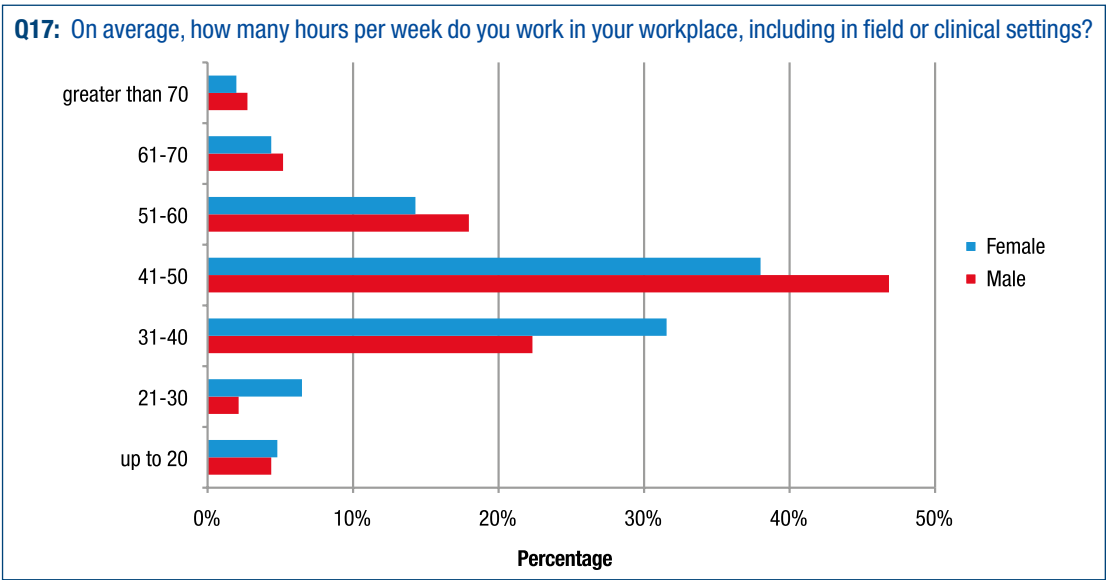
I am sick and tired of short-term contracts based entirely on limited industry/ARC funding, and the expectations that you will put in 'whatever hours it takes' to get things done.

Survey Respondent

The survey data confirms that the demands of the science research workforce are akin to those of 'greedy' organisations, a term coined by Coser (1967) to describe institutions based on the concept of a 'vocation' such as the church and the armed forces. Coser (1974) noted that certain institutions make 'total claims on their members' and 'attempt to reduce the claims of competing roles and status positions' (1974: 6). This concept has regained currency more recently in the gendered workplace (Currie et al 2000) and work-family balance literature (Bartram 2007).

The data confirms the well-documented fact that scientific research roles demand high levels of commitment from those working full-time and part-time. Figure 4.9, which includes all CSRWS respondents in research roles, indicates that over 60% (n=494) of the survey population currently in the science research workforce estimate that they work, including in field or clinical settings, over 40 hours per week, with 22% (n=172) working over 50 hours per week and 6% (n=50) over 60 hours per week. With the exception of those working part-time and those working 31–40 hours per week, men on average work longer hours than women. Women dominate (n=137) the 31–40 category, that is, the 'normal' work week, but it should be noted that less than a third of respondents (215/783) nominated this category.

Figure 4.9: Estimated work hours per week by gender



High levels of competition and paucity of funding are important drivers for hours spent at work. Research institutes and universities are highly competitive environments and individual researchers are usually responsible for their own professional survival, meaning the next grant is vital. Even if employed on someone else's grant, it is in the researcher's interest to work as hard as possible to ensure the next grant is successful. If continuous external funding is not achieved, it is difficult to maintain a research position. Many research institutes don't provide bridging funding, and those that do may only provide short-term support for selected cases they deem worthwhile – another context in which gender can come into play.

Individuals highly committed to science populate these 'greedy' organisations. When asked 'what do you value most in your current role?' (Q25), passion for field of study, intellectual stimulation and autonomy and control were the most highly valued factors for most respondents (all >60%), closely followed by the opportunity to contribute to new knowledge. These responses suggest that the high levels of commitment and motivation of research scientists are important contributors to cultures of long hours and may in part be driven by the scientists themselves. It should also be noted that workplace flexibility was highly valued and reported by many respondents, to a certain degree mitigating the impact of the 'crazy hours'.

In the decision to pursue a career in science, job security was very important for 21% of respondents and somewhat important for 35% of respondents, with only 12% indicating that this was not a primary factor. However, job security was identified as 'highly valued' by 40% of women and 29% of men and 'valued' by 36% of men and 34% of women, suggesting that job security becomes more important once employment has been secured or that the disadvantages of non-secure employment become more evident.

In response to the question 'What factors do you rank as being most important for having a successful career in science research?' (Q54), 97% of respondents ranked the accumulation of social and political capital (networks, connections and knowing the right people) as highly as academic capital (good track record and being good at their work). Projecting a positive image at work and working long hours were also highly ranked factors for success.

Given the patterns of attrition of women from the science workforce, we were keen to explore whether respondents perceived gender to be an issue in their workplace. In describing 'attitudes in my workplace to people of my gender' (Q51) most respondents were neutral, but women gave a wider variety of responses than men: 20% of women reported a positive attitude (helpful or very helpful), 55% were neutral, but 25% (n=134) responded that gender was a problem or major problem. For the majority of men, 'attitudes towards people of my gender' were positive or neutral (96%), with fewer than 4% indicating that this was a problem (n=12) or a major problem (n=4). **These responses raise the question of whether, as suggested by the UK RSC, some organisations retain a normative organisational culture in which 'masculine ways of thinking and doing' remain dominant and the majority of men experience organisational 'fit', in contrast to the dissonance experienced by a substantial proportion of women.**

Given some of the factors relating to cumulative female disadvantage identified in previous studies, it is interesting that men and women differed only slightly in their perception of the importance of some factors in career advancement, such as geographic mobility; level of support from supervisors/managers in applying for promotion; opportunities for professional development; access to research funding; and access to equipment and resources. However, as Marion Stevens-Kalceff and colleagues at the University of New South Wales (Stevens-Kalceff et al 2007) showed, such factors are most likely to be identified through micro-organisational studies that document the fine detail of male and female experiences in specific organizational contexts.

## Career Paths and Destinations

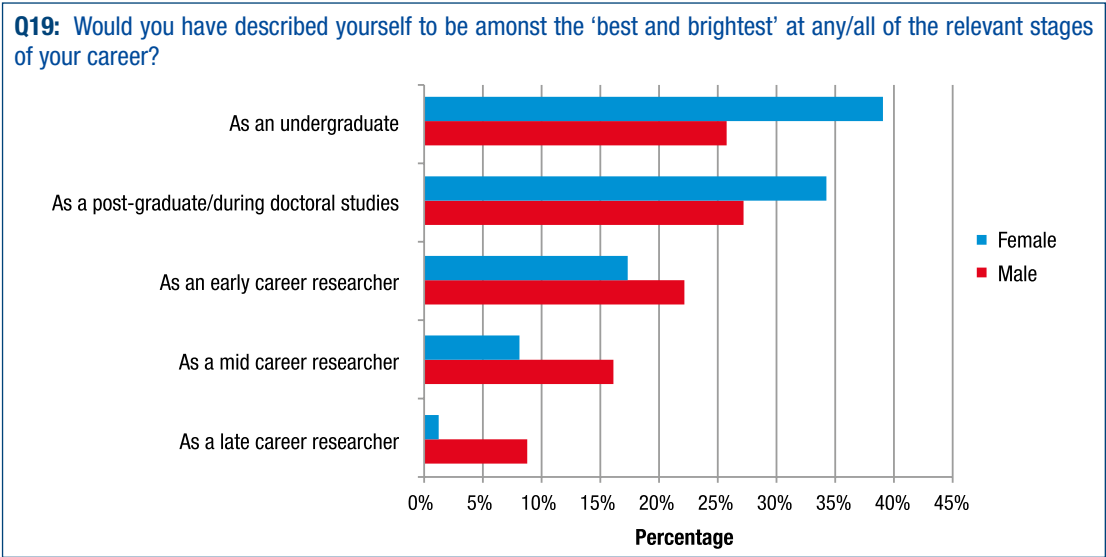
The further up the ladder you move, the more demoralising a career in science seems to become, with continual fights for funding, pressure from employers to do research with 'public appeal' and an overload of administrative responsibility.

**Survey Respondent**

One of the assumptions that initially drove this research project was that the targeted research workforce population, those with postgraduate qualifications (generally doctorates) in biological sciences or chemical sciences, would be amongst the 'best and the brightest' in our target

community. Survey responses to the question of identification with this category present a stark pattern (Figure 4.10) that is undoubtedly important to understanding women’s career trajectories in the scientific research workforce and patterns of generational change.

**Figure 4.10: Self-assessment by gender and career stage**



This was a question that not all survey respondents answered and those who did answer (n=845, 455 female and 390 male) were able to choose more than one career stage. This generated 1422 total responses (727 from women and 695 from men). While female respondents tended to describe themselves as ‘best and brightest’ as an undergraduate applicability of this descriptor clearly declines with career stage for women. We conducted regression analysis to identify the factors significantly and independently associated with this self-perception. (Note that the question did not require a response, therefore we cannot be sure if those who did not complete this item considered they had never been amongst the best and brightest or thought the question irrelevant.) The 11 independent variables we evaluated are listed below, with dummy variables shown in parentheses:

- ‘Gender’ (M/F)
- ‘Age’ (U30/30-35, 36-40, 41-45, 46-50, 51-55, 56-60, 61-65, 66+)
- ‘PhD qualified’ (yes/no)
- ‘Studying’ (yes/no)
- ‘Research Role’ (in a research role/not in a research role)
- ‘Contract’ (Employment type is fixed-term contract/employment is continuing)
- ‘Casual/self’ (employment type casual or self-employed/employment is continuing)
- ‘Direct employee’ (employment is direct/employment is on a grant)
- ‘Self-employed’ (respondent is self-employed/respondent is direct employed)
- ‘Combination of other employment types’ (respondent is self-employed or casual or fixed-term/direct employed)
- ‘Career break’ (has taken a career break of longer than 6 months/has not taken a career break of longer than 6 months)

Controlling for gender, discipline, age, qualification and employment characteristics, the regression confirmed the earlier finding that **women were more likely than men to have considered themselves as among the best and brightest at undergraduate level** (the coefficient is not especially large, but it is statistically significant). Notably, the older cohorts of survey respondents were less likely to have considered themselves among the best and brightest at the undergraduate level.

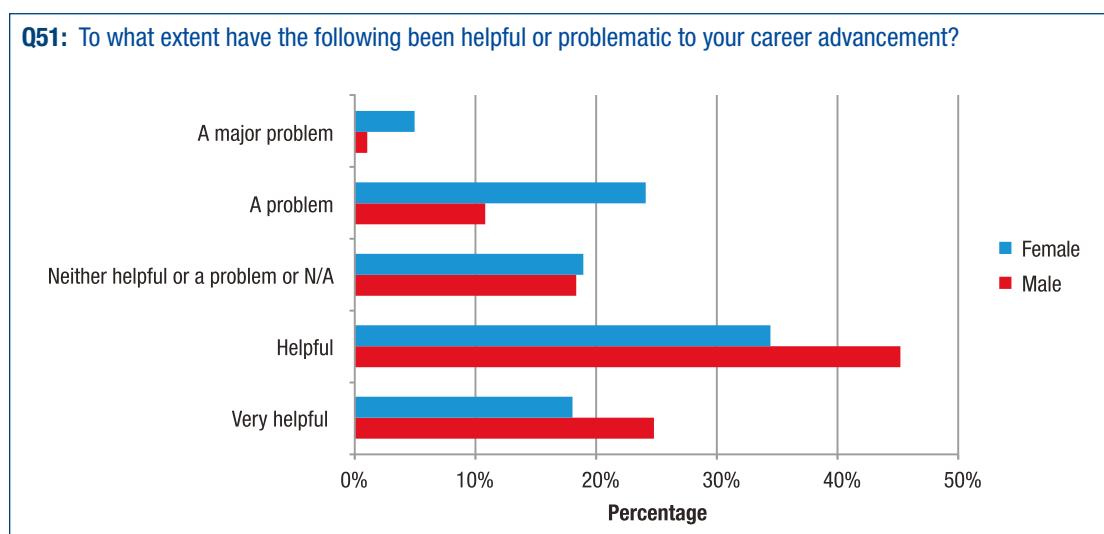
At the postgraduate level, those currently studying and those with a PhD qualification were significantly more likely to say they were among the best and brightest, but this did not differ by gender.

At the early career stage, respondents in the younger age cohorts (i.e., those likely to be at this stage at the time of the survey) were significantly less likely than others to indicate they were among the best and brightest. Again, gender was not significant. At mid-career, the older the respondent, the more likely they were to say they were among the best and brightest. Those employed in research roles were also more likely to offer this response in relation to mid-career. Again, gender was not significant. Late-career researchers who were self-employed or in research roles were significantly more likely to indicate they were among the best and brightest at this stage. Gender was not significant.

The data indicates some interesting dynamics, with more women than men having confidence in their abilities at the undergraduate level, but at all later career stages age and employment in a research role being more significant factors than gender. The regression analysis suggests that in the later career phases both male and female respondents were reflecting their experience of the 'funnel' of scientific employment. In the early-career phase they are aware of sharp competition with many other very bright people. At mid- and late-career stages, those who sustain employment recognise their relative success. But given that more men than women in the survey sample were in the late career stage, this can also be interpreted as those who are successful seeing their own success as a result of their own innate qualities, and the lack of success of others (e.g., women) as a result of lack of these qualities rather than the conditions in which they compete. This dynamic is reinforced with the emerging disjunction in career opportunities for younger generations discussed earlier, and documented in the NRSS (2010) data. It also reflects the influence of circumstance that impacts on understanding of meritocratic and structural factors in gender inequality documented by Cech and Blair-Loy (2010: 371)

Related questions on factors that have influenced career success reinforce a differentiated pattern of perception of achievement on the part of men and women: a higher proportion of men (37%, compared to 24% of women) indicated that they progressed more quickly than those with whom they had completed their studies and a higher proportion of women (38% compared with 31% of men) indicated that they had progressed more slowly than others with whom they had completed their studies (Q45). A much higher proportion of women (34%, compared to 7% of men) felt that time out of their career for family reasons was a major factor in their slower career progress, and more women (43%) than men (25%) reported feeling unprepared or unready to apply for promotion (Q46). These results make it unsurprising that men reported higher levels of confidence in their ability as helpful to their career advancement (Figure 4.11).

**Figure 4.11: Confidence and career advancement by gender**



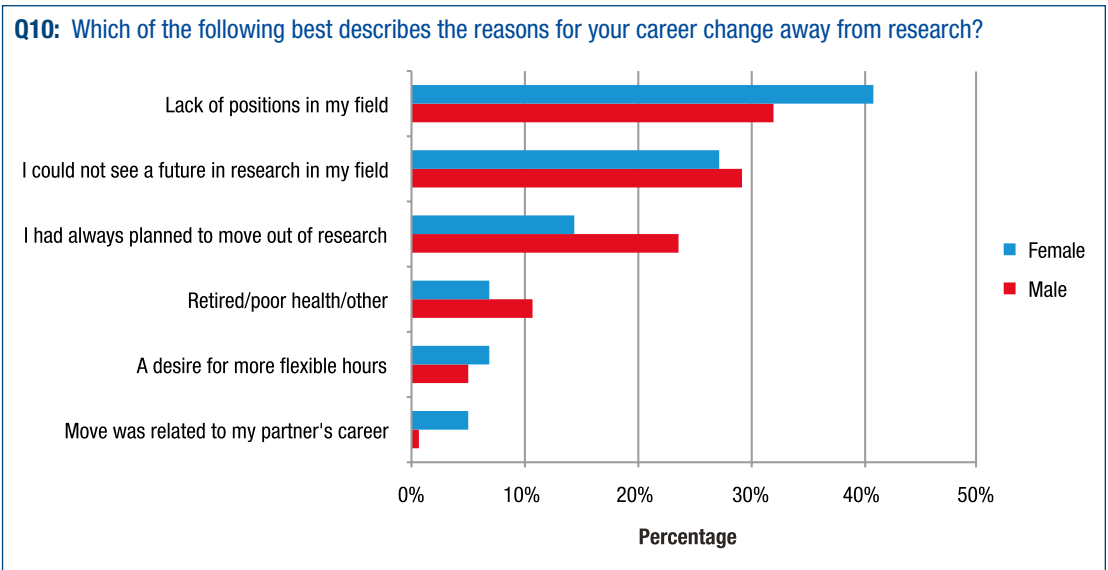
# Career Change and Satisfaction

There is something generally disheartening about a profession which provides so much constant, negative feedback to hardworking, intelligent, highly skilled individuals.

## Survey Respondent

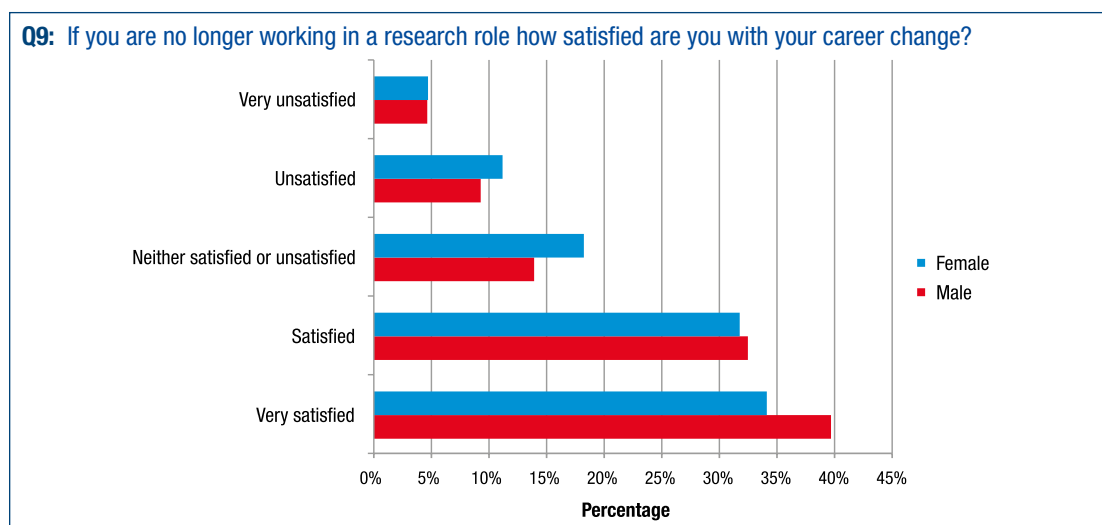
One important aim of the survey was to understand the career paths of respondents who had left the research workforce. Three hundred and eighty-two respondents were not working in a research role at the time of the survey. These respondents were asked questions about their satisfaction with their career change, the reasons for that change and their assessment of how their skills and experience gained through their formal qualification were used in their current role. Male and female respondents gave different responses to the question about why they made a career change (Figure 4.12). Large proportions of female respondents cited ‘lack of positions in my field’ and ‘could not see a future’, while male respondents gave a greater variety of responses, including ‘lack of positions’, ‘could not see a future’ and that they had ‘always planned to move out of research’. More men than women reported planning career changes, whereas more women had responded to lack of opportunities in their field, but **overall the responses indicate a lack of prospects in a research career (64%) rather than a lack of continuing interest in research (23%), implying that the workforce is losing scientists who would prefer to remain in research roles.**

Figure 4.12: Reasons for career change by gender



As evidenced in Figure 4.13 below, whilst there are some differences between men and women and between the biological and chemical sciences, most respondents reported being satisfied or very satisfied with their career change.

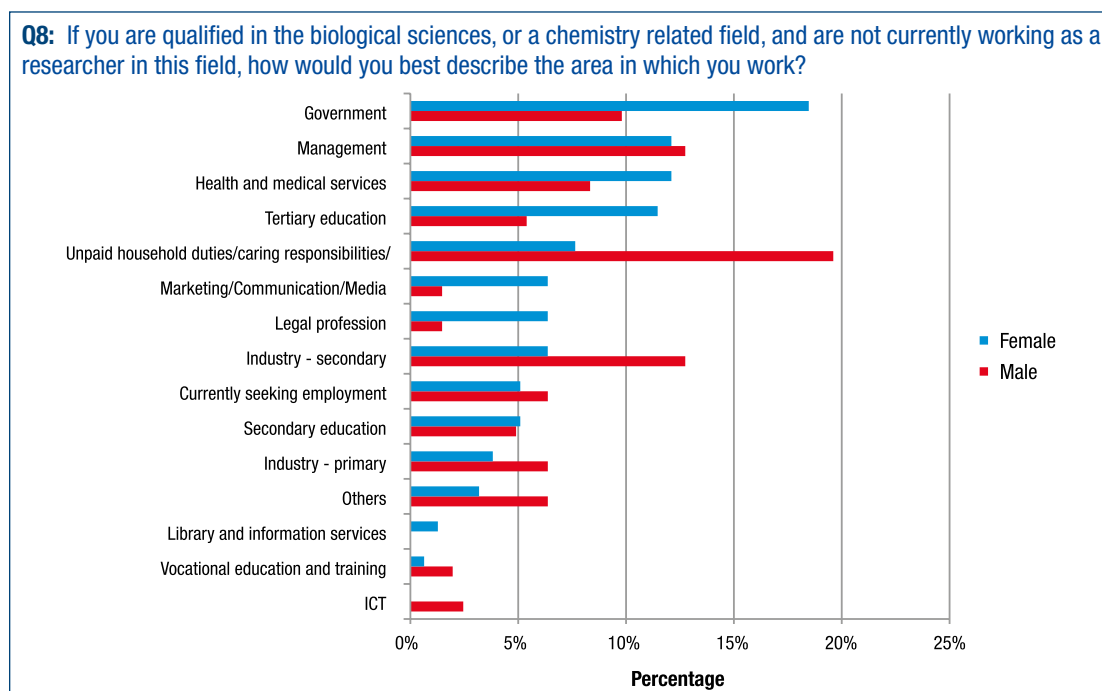
**Figure 4.13: Satisfaction with career change by gender**



Nevertheless, conclusions drawn from these responses should allow for an element of defensiveness or bravado. The research culture is very judgemental of those who seem unable to make the grade, and those who leave the research workforce may be relieved to find satisfying employment but also defensive regarding this career change.

Figure 4.14 below shows the major fields of employment of respondents who have left the scientific research workforce. This data (n=322), together with the responses to the question as to whether skills and experience gained through their formal qualification were used in their current role, indicate that many of those who leave the research workforce are employed in cognate fields, not as research scientists but using their scientific knowledge and skills. (Note that the category 'unpaid household duties includes retirees, most of whom are male (n=36).)

**Figure 4.14: Major fields of non-research employment**



In the context of the survey data and the analysis presented above regarding those who have left the scientific research workforce, we were keen to explore in more detail through regression analysis the factors that influence job satisfaction and ultimately retention. We used regression to examine the association of the 11 explanatory variables assessed previously with job satisfaction, position change and career change. In order to assess job satisfaction, the following satisfaction questions were used to construct a single dependent variable:

- 1 'I have good career or promotion opportunities'
- 2 'I have good job security'
- 3 'I am satisfied with the opportunities I have within my field of science'
- 4 'Overall I find my work rewarding'
- 5 'Generally speaking I am satisfied with my job'
- 6 'I have considered a major position or career change during the past five years'.

Responses to these five questions were given on a four-point Likert scale: strongly agree (assigned a score of 0), agree (25), disagree (75) and strongly disagree (100). Adding the individual item scores for each respondent produced a continuous job satisfaction variable.

**Regression analysis indicated that the variables most strongly associated with job satisfaction were those related to terms of employment, that is, whether the respondent was employed on a fixed-term, casual, or self-employed basis. These employment modes were consistently negatively associated with the job satisfaction measure, even after controlling for the impact of other characteristics on responses.**

Interestingly, for most of the regression models developed, gender did not independently explain differences in attitudes of respondents. Gender was only significant in relation to general job satisfaction for women qualified in chemical sciences (women were more satisfied than men) and – possibly as a consequence – women qualified in chemical sciences were less likely than men to have considered a career change. Employment status influences responses on these issues regardless of gender, qualification, age, or whether the person was in a research role. Employment in biological or chemical sciences did not explain differences in satisfaction measures.

If these findings are considered together with the NRSS analysis and census data, the picture is one of an employment sector undergoing structural change in employment patterns but with a disjunction between career prospects and advanced education and training opportunities. For the reasons outlined above, these factors cumulatively hamper women's careers.

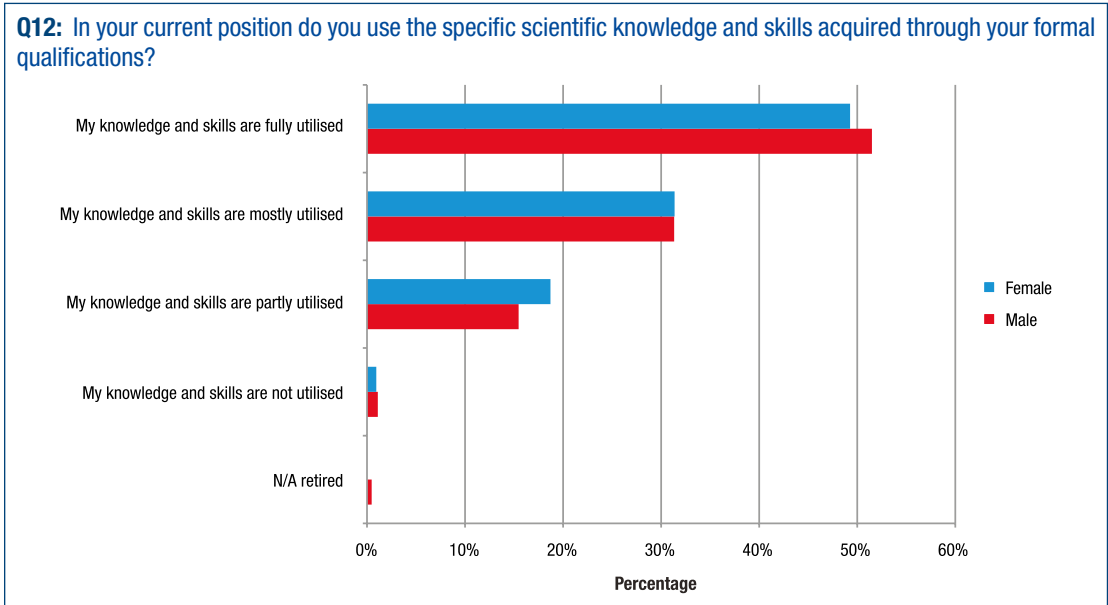
## Scientific Skills and Knowledge

Among the important propositions that this research explored are to what degree respondents' knowledge and skills are fully utilised, whether the responses are different for women and men, and whether those who leave the scientific research workforce have 'quit' science, as is often assumed. This is a critical question as individual, institutional and government investment in the education of scientists to postgraduate level is substantial and critically important to Australia's future.

Survey responses exploring these issues were sought from both those in the research workforce and those who no longer worked in research. Not surprisingly, respondents currently working in a research role reported high levels of knowledge and skills utilisation in their current positions. Eighty-two per cent of these respondents (n=639) indicated that their knowledge and skills were fully utilised or mostly utilised, and there was only a marginal difference in gender (Figure 4.15).

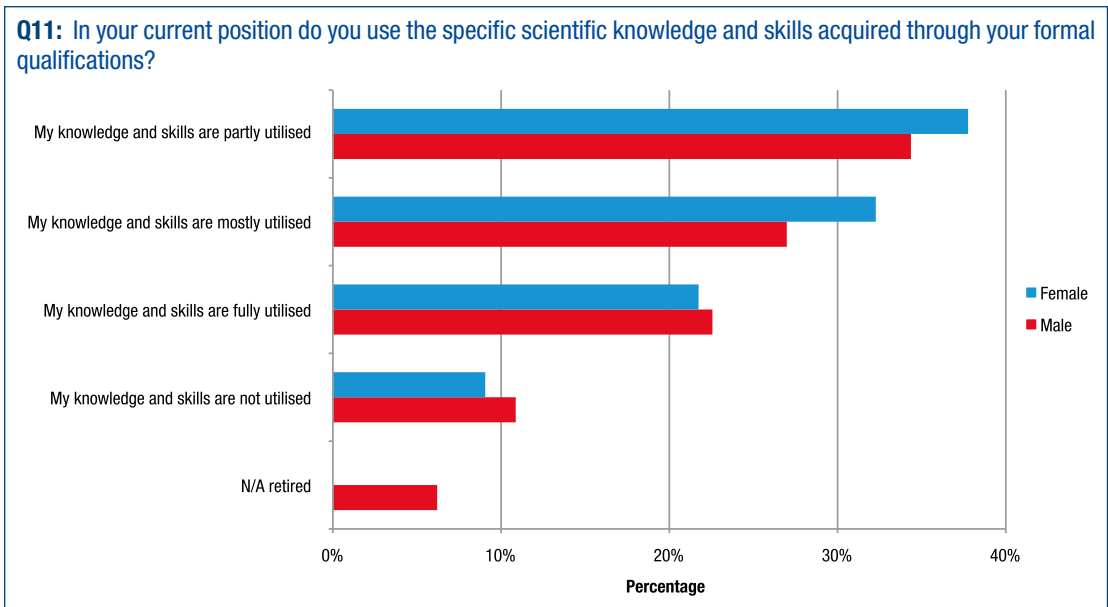


**Figure 4.15: Knowledge and skills of those in the research workforce**



Of those who had left the research workforce, 52% of respondents (n=231) indicated that their knowledge and skills were fully utilised or mostly utilised in their current (non-research) position (Figure 4.16). There is very little difference in the results by gender. Of those not working in a research role, 10% indicated that their knowledge and skills were not utilised, compared to 1% of those currently in the research workforce.

**Figure 4.16: Knowledge and skills of those no longer working in a research role**



This data, together with feedback from participants in focus groups, tests the assumptions behind the concept of a large population that ‘quits’ science. The focus group data in particular provides evidence that some people go to extraordinary lengths to remain in the scientific research workforce or continue to be optimistic re re-engagement. Women, particularly in the post-doctoral

phase, transition to occupations that offer satisfying science-related careers in which the skills and knowledge obtained in research careers are relevant and useful, but do not align with the dominant definitions of SET occupations – this raises questions relating to ‘the leaky pipeline’ versus socially constructed concepts of science (Metcalf, 2010).

## Key Findings from the Survey

Postgraduates in the fields of biological sciences and chemistry are part of an exceptionally highly qualified, small but rapidly growing population in Australia. Consistent with the census data for postgraduates in these fields, most female survey respondents were under 40 years of age and most male respondents were over 40. Mirroring the census data, women were over-represented amongst those qualified and working in the biological sciences, and men were over-represented amongst those qualified and working in the chemical sciences. **Less than half the respondents who identified as currently in the research workforce were employed in full-time continuing positions, with older men dominating this employment category.**

The survey data confirms that the overwhelming majority of the survey population was motivated to pursue a career in science primarily by passion for their field of study and the prospect of intellectually stimulating work, with no significant differences between men and women. Most people commencing their doctoral studies in the fields of biological and chemical sciences saw a career as a research scientist as ideal. There is strong evidence, however, of a growing disjunction between this career aspiration and employment opportunities for emerging doctoral graduates and early career researchers.

Who succeeds in the demanding Australian research environment? The survey data confirms the well-documented fact that scientific research roles demand high levels of commitment from those working full-time and also from those working part-time. For most respondents passion for the field of study, intellectual stimulation and autonomy and control were the most highly valued factors, closely followed by the opportunity to contribute to new knowledge. These responses suggest that the high levels of commitment and motivation of research scientists is an important contributor to the cultures of long hours, which is therefore partly driven by the scientists themselves, who realise what it takes to succeed. Importantly, an intensive period of research productivity in the postdoctoral career stage, typically a critical stage for family formation for women, is key to establishing a career as an independent researcher, and this is a clear tipping point in many women’s careers.

Questions exploring career success indicate some interesting dynamics, with more women than men displaying confidence at the undergraduate level, but at all later career stages age and employment in a research role becoming more significant factors than gender. This dynamic may be strongly associated with the emerging disjunction in career opportunities for younger generations, particularly in the higher education sector, and particularly in the female-dominated biological sciences.

Related questions on factors that have influenced career success reinforce a gender-differentiated pattern of perception of achievement. A higher proportion of men indicated that they progressed more quickly than those with whom they had completed their studies, and a higher proportion of women indicated that they had progressed more slowly than others with whom they had completed their studies. Three times as many women as men had taken long periods of leave and believed that time out of their career for family reasons was a major explanation for their slower career progress. It is not surprising that more men than women reported higher levels of confidence in their ability as helpful to their career advancement.

More men than women reported planning career changes, whereas more women had responded to lack of opportunities in their field. **Overall, the responses indicate career changes are influenced by a lack of prospects in research careers rather than a lack of continuing interest in research, indicating that the research workforce is losing scientists who would prefer to remain in research roles.**

**Terms of employment – employment on a fixed-term, casual, or self-employed basis – had the strongest (negative) association with job satisfaction, even after controlling for other influential characteristics.**

Among the important propositions that this research tested were to what degree respondents' knowledge and skills are fully utilised and whether those who leave the scientific research workforce 'quit' science, as is often assumed. Individual, institutional and government invest heavily in the education of scientists to postdoctoral level and this is critically important to Australia's future.

Data on knowledge and skills utilisation were sought from scientists in the research workforce and those no longer working in research. Not surprisingly, **respondents currently working in research reported high levels of knowledge and skills utilisation in their current position. Most respondents who had left the research workforce indicated that their knowledge and skills were fully or mostly utilised in their current (non-research) positions.** There is very little difference in the results by gender but there is evidence that women, particularly in the postdoctoral phase, transition to a wider range of occupations than men. There are also differences between the biological and chemical sciences. Non-research roles can enable continued utilisation of scientific knowledge and skills, but in employment data and institutional staffing profiles scientists pursuing these alternative career paths are represented as having 'quit' science. The focus group data provides strong evidence that people no longer in scientific research roles continue their engagement with science, and examples of individuals who have gone to great lengths to re-engage with or re-enter the science research workforce.

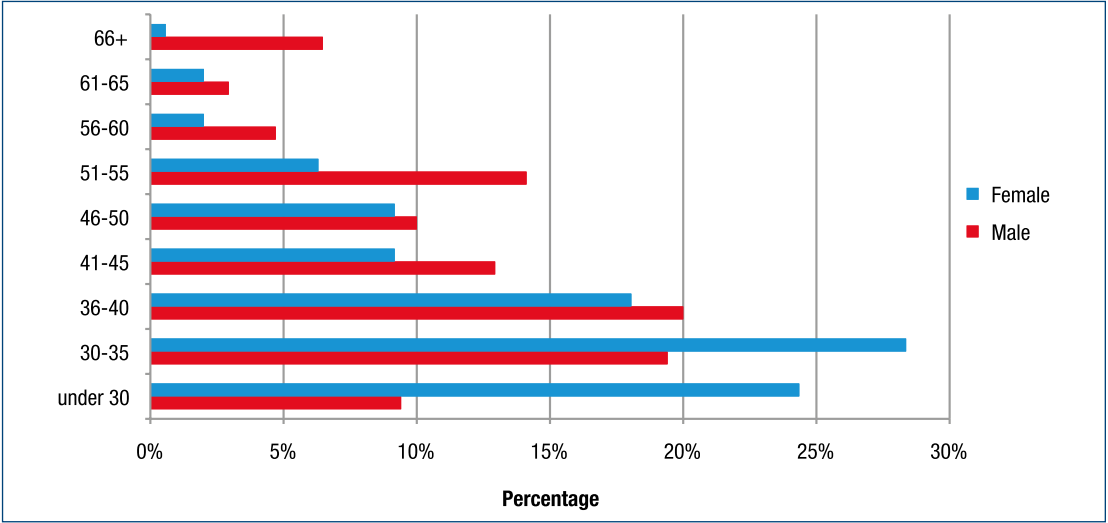
# SECTION 5: DIFFERENCES BY FIELD

The project survey data indicates that, whilst there are many similarities, there are significant differences between the biological sciences and chemistry-related industries with respect to gender profile, employment status, research funding, career aspirations, job satisfaction and private sector employment. These differences are sufficiently large to warrant presentation of some key data by field for the biological sciences and chemistry-related industries. They also serve as a reminder that ‘whole of science’ policies and initiatives, as foreshadowed above, are unlikely to be effective unless their relevance by field and organisational context has been established.

## Biological Sciences

This section focuses only on the survey respondents qualified in the biological sciences (n=519). The gender profile of this field is almost the opposite of that for respondents qualified in chemical sciences, as respondents are two thirds female and one third male. The age profile of biological science qualified respondents is gendered: female respondents were younger, with half under 35 years of age, whereas most male respondents were over 41 years of age. Figure 5.1 illustrates the age profile of survey respondents qualified in biological sciences.

Figure 5.1: Age profile by gender, biological sciences

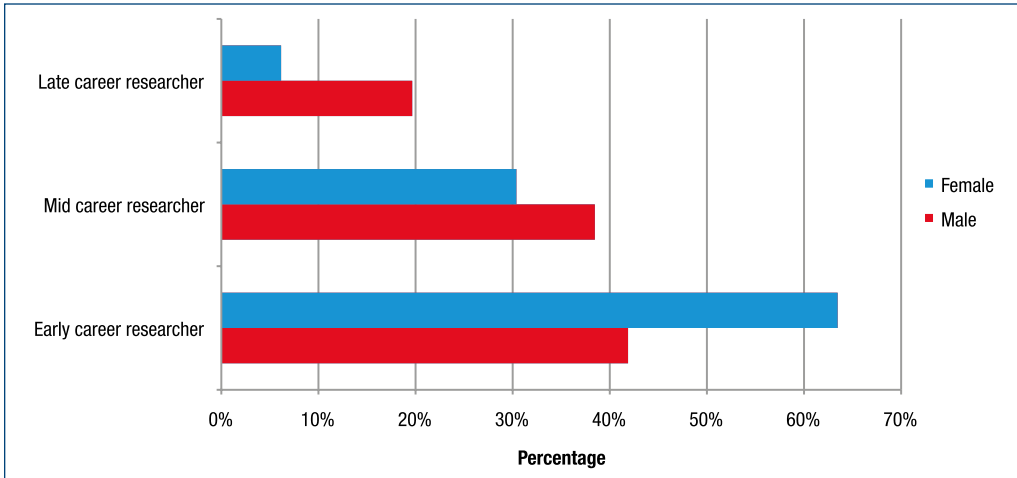


This age profile is consistent with that indicated by analysis of 2011 census data of the total cohort of biological science postgraduates in Australia. The census data shows that the median age of a man with postgraduate qualifications in biological sciences is 48, and for women, 40. Seventy-four per cent held a PhD qualification; this was higher than in the total project survey population at 63%, and significantly higher than among the chemical sciences qualified respondents (58%).

## Career stage

As illustrated in Figure 5.2 the age profiles of biological science qualified men and women are reflected in differences in career stage. Almost two thirds of women reported that they were early-career researchers, whereas men were more likely to describe themselves as mid-career, with 20% reporting that they were late-career. The numbers of respondents at senior levels are small; senior researchers might have been less motivated to complete the questionnaire due to time pressures or satisfaction with their achievements.

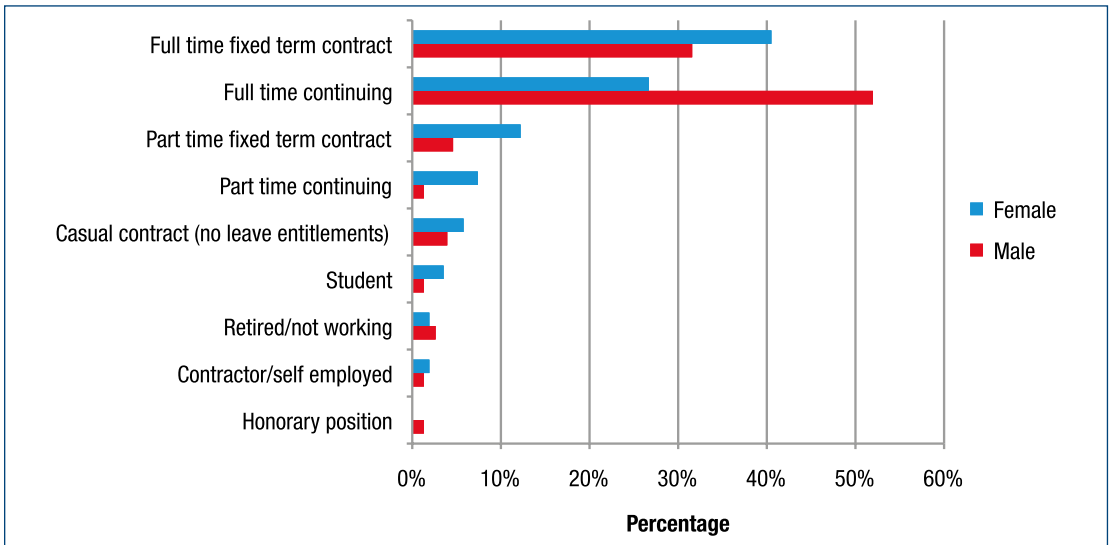
**Figure 5.2: Career stage by gender, biological sciences**



## Employment status

For respondents qualified in the biological sciences, significant gender differences in contract of employment were evident (Figure 5.3). Men, more of whom were mid- or late-career researchers, were twice as likely to be employed on a full-time continuing basis (52%) than women (27%). Women were more likely to be employed on fixed-term contracts basis, with 40.5% of women employed full-time on these terms and a further 12% employed on a fixed-term part-time contract basis.

**Figure 5.3: Employment status by gender, biological sciences**

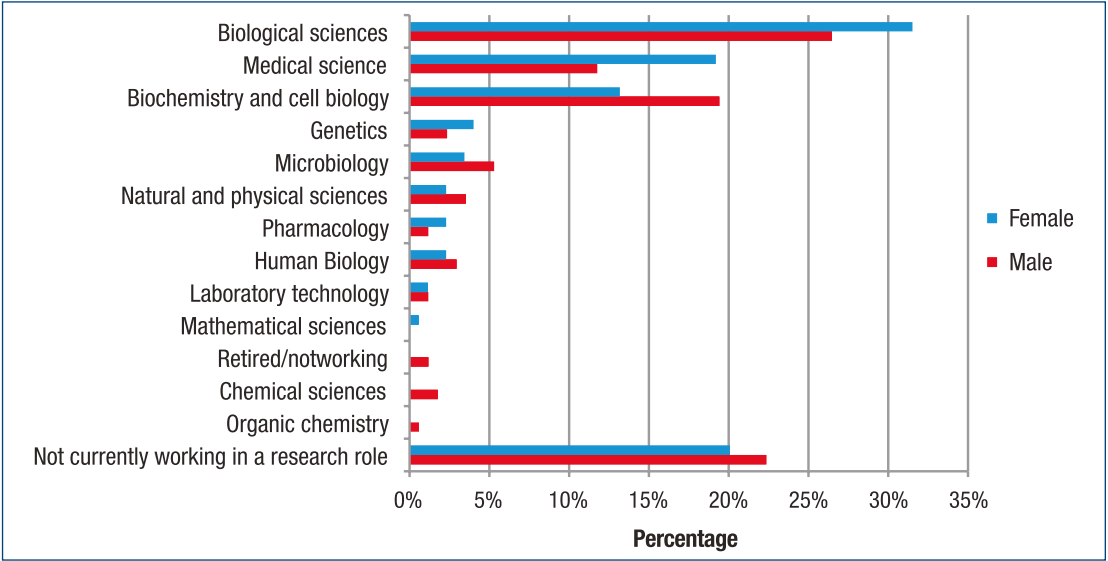


Consistent with career stage, most respondents (74%) had been in their current position for less than five years, and only just over a quarter had been in their current position for greater than five years or more.

Respondents were asked to identify the field in which they were working, or if they were not working in a research role. The ABS Australian Standard Codes of Education (broad and narrow fields) were used to specify the categories. Of those respondents qualified in biological sciences, just over 20%

of women and men were no longer working in a research role (Figure 5.4). A further 30% were working in medical sciences, and 17% in pharmacology. The remainder were working in a range of biology related and cognate fields.

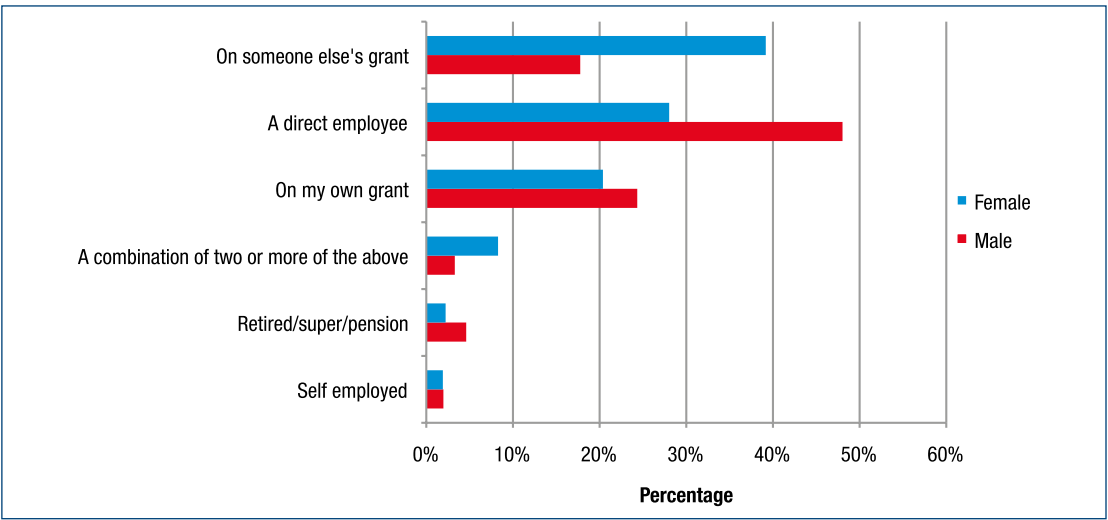
Figure 5.4: Current role by gender, biological sciences



### Employment conditions

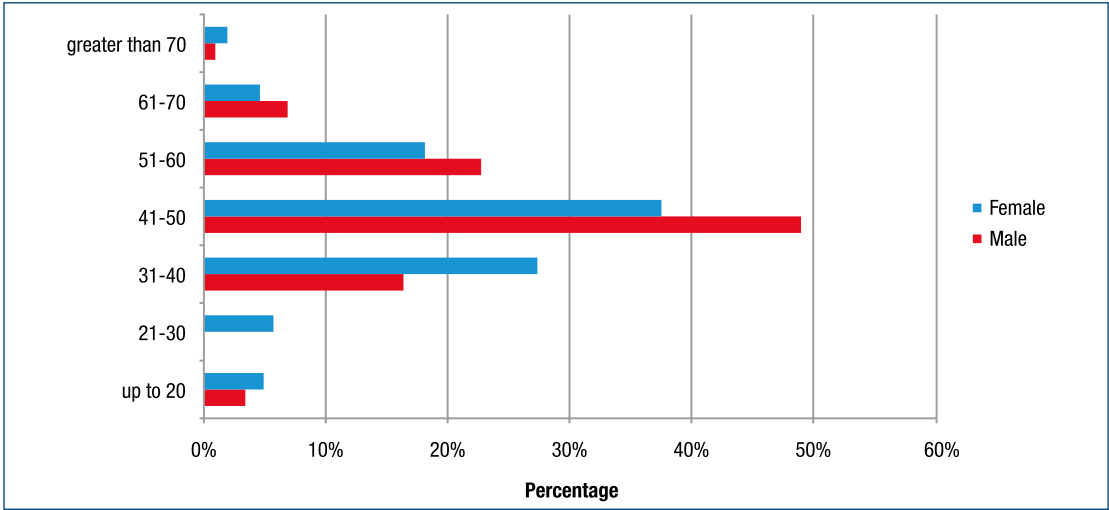
Self-employment was very rare amongst men and women in the biological sciences. **In contrast to the chemistry-related industries, women qualified in the biological sciences (39%) are much more likely to be employed on someone else’s grant and much less likely to be either directly employed or have their own grant than men.** Just over 24% of male respondents had their own grant compared to 20% of female respondents, and a further 48% of male respondents were directly employed, compared with 28% of women (Figure 5.5). These responses include people not currently working in a research role. This may be a reflection of the age profile of the survey cohort, but is also likely to reflect patterns of generational change in competitive science funding that negatively affect employment conditions and science careers.

Figure 5.5: Major source of salary by gender, biological sciences



The data on hours of work per week confirms the particularly demanding nature of this field of science, which is even higher than the overall survey population. Sixty-eight per cent of respondents (80% of men and 62% of women) reported working more than 40 hours per week, with 31% of men and 24% of women working over 50 hours per week (Figure 5.6).

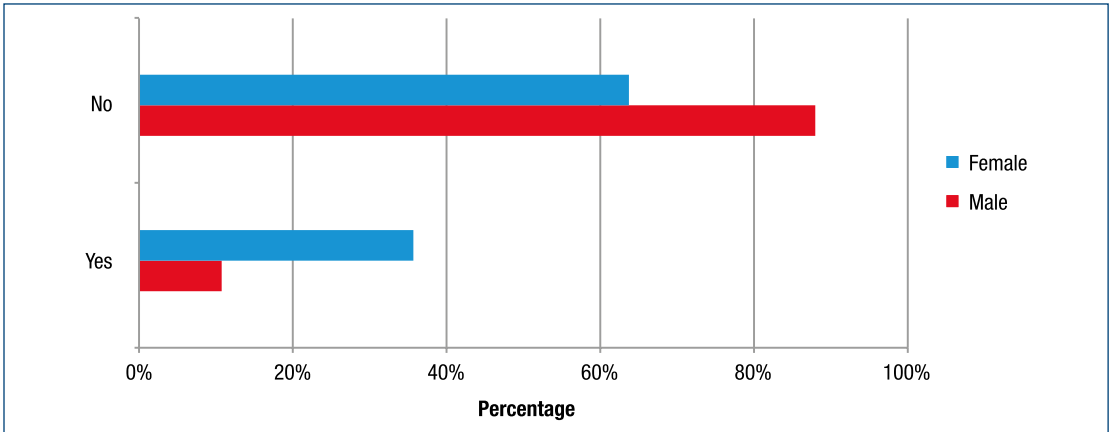
Figure 5.6: Hours per week by gender, biological sciences



## Careers and career paths

This section covers various factors associated with the careers and career stages of respondents qualified in the biological sciences. In common with the chemical sciences, geographic mobility is an established expectation in this field. Eighty-six per cent of men and 75% of women had moved location at least once for their career, with **men more likely to have done so than women**. Significantly more men had moved more than twice, although this may be related to the differing age profiles of men and women in this sample.

Figure 5.7: Career Break by Gender



Men and women reported similar career paths, with almost two thirds describing their career paths as ‘traditional linear’ career paths. Men (31%) were more likely than women (22%) to have experienced work in other sectors, but this differential may be indicative of career stage. As in the overall population, and in a pattern duplicated in the chemical sciences, over 36% of women had taken a career break of longer than six months, compared with just 11% of men (Figure 5.7).

# Measures of satisfaction with work and career

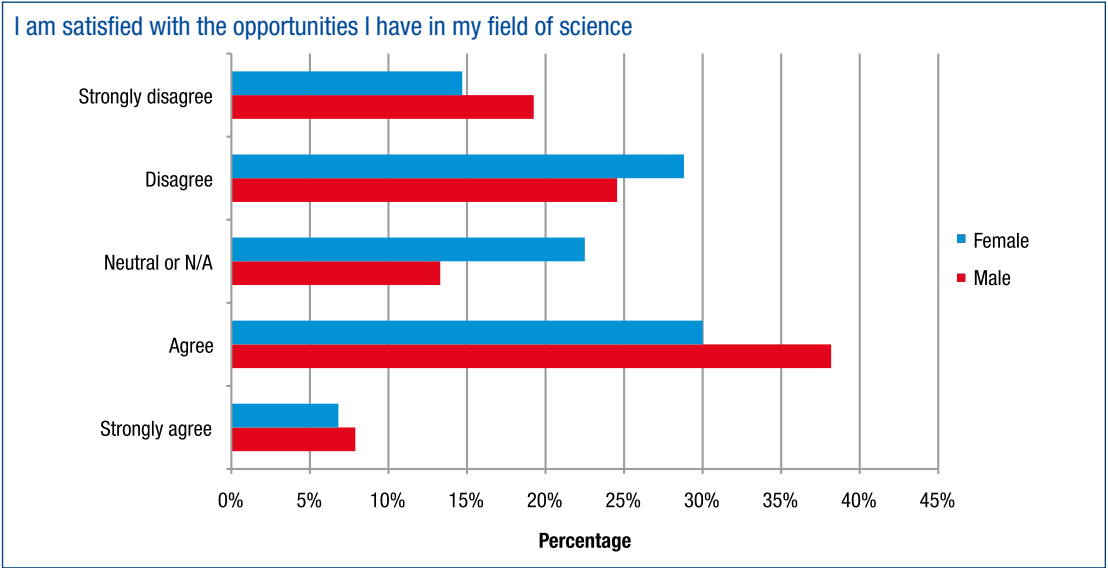
This section briefly examines responses to a series of ‘satisfaction’ questions:

- I am satisfied with the opportunities I have within my field of science
- Overall I find my work rewarding
- Generally speaking I am satisfied with my job
- I have good job security
- I have good career or promotion opportunities.

In each case respondents were asked to nominate a point on a five-point scale that most closely represented their response to the particular question (strongly agree, agree, neutral, disagree, or strongly disagree).

Analysis of responses to the first question, ‘I am satisfied with the opportunities I have in my field of science’ (Q53), indicates that only 39% of the biological sciences sample agreed or strongly agreed with the statement, compared with 47% of those qualified in the chemical sciences, and 42% disagreed or strongly disagreed, compared to 30% in the chemical sciences (Figure 5.8).

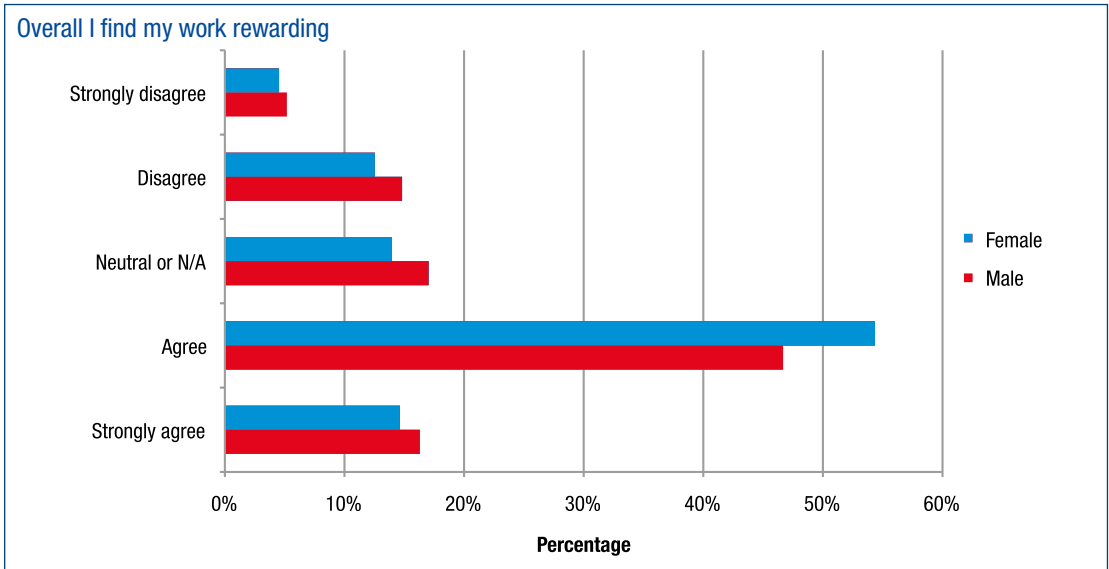
**Figure 5.8: Level of satisfaction with career opportunities, biological sciences**



Men and women provided similar responses to the question ‘Overall I find my work rewarding’ (Q57) although women were marginally more likely to say they ‘strongly agreed’ (Figure 5.9). Seventy-six per cent of the sample agreed or strongly agreed that they found their work rewarding. A slightly lower proportion, some two thirds of the sample, said ‘Generally speaking I am satisfied with my job’, but women (69%) were slightly more likely than men (63%) to report that they agreed with the statement.

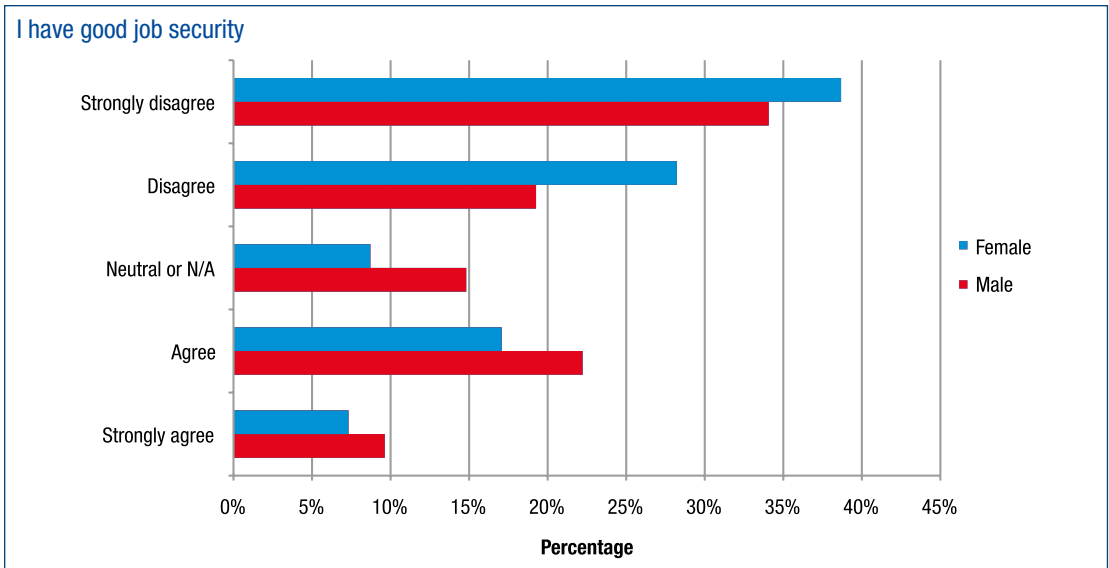


**Figure 5.9: Level of satisfaction with work by gender, biological sciences**



Just over a quarter of the biological sciences sample said that they thought they had good job security (Q57), and 63% said that they disagreed or strongly disagreed with the statement ‘I have good job security’ (Figure 5.10). **Women were more likely than men to report that they did not have good job security.** These findings undoubtedly reflect the differing employment contract profile of men and women reported above, which may be partly explained by career stage.

**Figure 5.10: Perception of employment security, biological sciences**

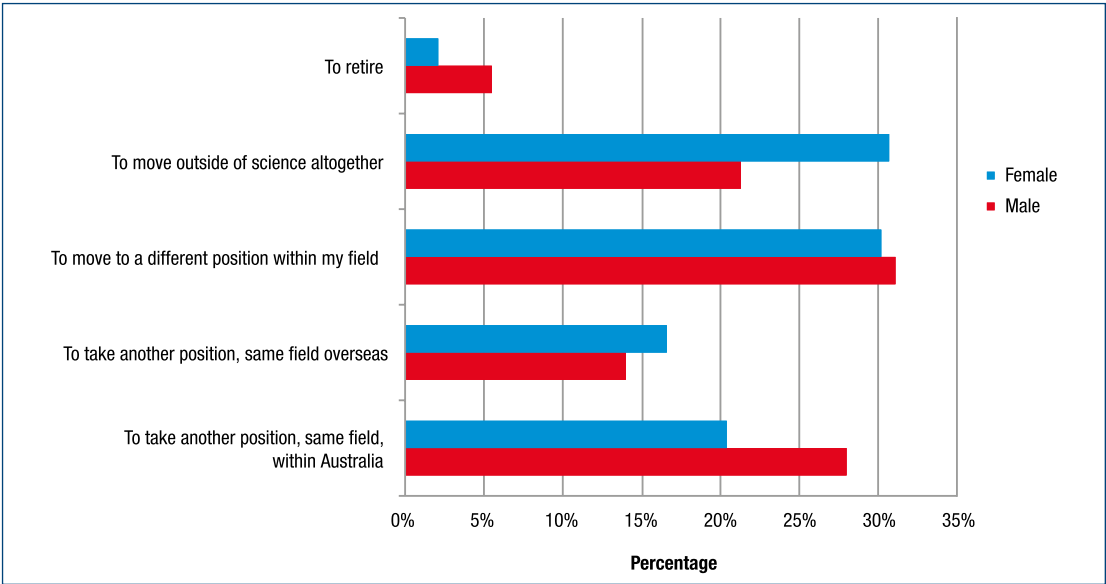


The final ‘satisfaction’ question revealed that just over 30% of the biological sciences sample agreed or strongly agreed that they had good career or promotion opportunities (Q57), compared to 40% of those qualified in chemical sciences, and women were less likely than men to agree with the statement. **Forty-two per cent of people qualified in biological sciences, compared to 25% of those qualified in chemical sciences, disagreed or strongly disagreed with the statement ‘I have good career or promotion opportunities’.**

The sample data is indicative of a highly qualified and committed workforce engaged in work that is rewarding but demands long hours. Levels of satisfaction are compromised by a disjunction between career aspirations and career opportunities. This is compounded by fragile conditions of employment, reflected in the data on job security and career prospects.

It is not surprising that 85% of female and 75% of male respondents qualified in the biological sciences had considered a major career change within the last five years (Q61). Men were slightly more likely than women to take action, but overall three quarters of those who said they had considered a change acted on that by applying for a position either within their field or outside their field. **Twenty-eight per cent of all respondents indicated that they intended to move out of science altogether.** Reasons for considering a career change are depicted in Figure 5.11.

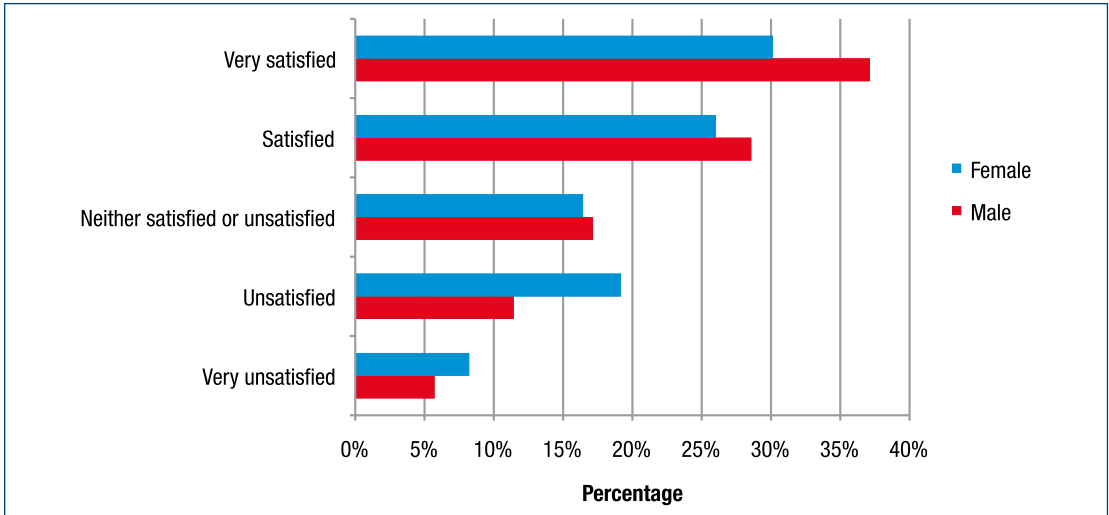
**Figure 5.11: Main reasons for considering a career or location change, biological sciences**



## Career Change

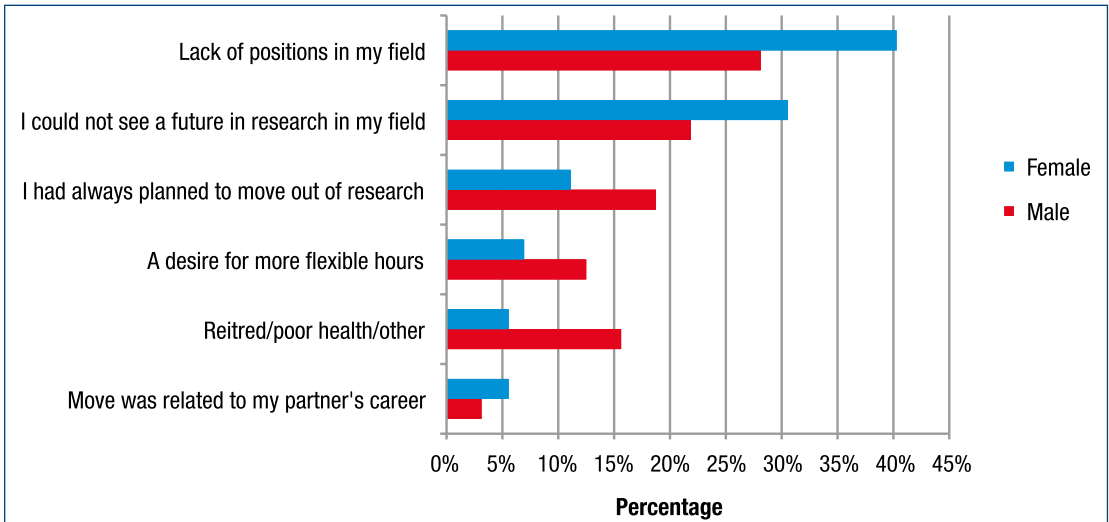
Of respondents qualified in biological sciences who were no longer working in a research role (n=108), male respondents were more satisfied with their career change than female respondents (Q9). 66% per cent of male respondents were satisfied or very satisfied with their career change compared with 56% of female respondents (Figure 5.12). Conversely, 27% of female respondents were unsatisfied or very unsatisfied with their career change, compared to 17% of male respondents.

**Figure 5.12: Career change and satisfaction by gender, biological sciences**



These differing patterns of satisfaction may be related to the fact that male and female respondents gave different reasons for making a career change (Q10). Most female respondents (71%) cited 'lack of positions in my field' or 'could not see a future' (Figure 5.13); in contrast, male respondents provided a variety of responses, including 'lack of positions' (28%), that they 'could not see a future' (22%) and that they had 'always planned to move out of research' (19%). The female responses indicate 'push' factors, essentially lack of opportunity, whereas male the responses suggest relatively greater agency and more active career decision-making.

**Figure 5.13: Reasons for career change by gender, biological sciences**



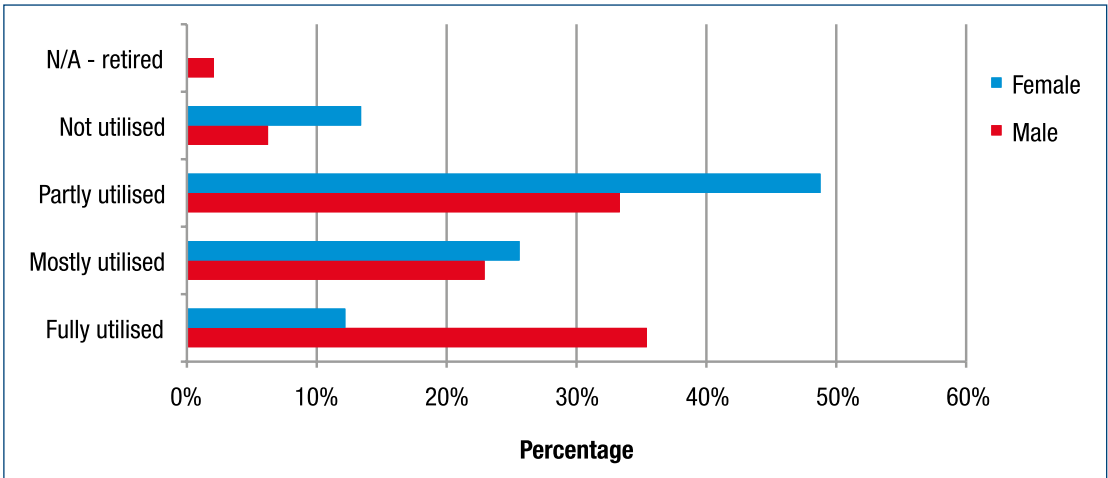
In the biological sciences, women in non-research roles were also less likely to be able to use their scientific knowledge and skills, which may have contributed to lower levels of satisfaction.

## Scientific Knowledge and Skills

Of biological science qualified respondents who were no longer working in a research role, male respondents were much more positive about how their knowledge and skills gained through their formal qualification were being utilised (Q11), with over half (58%) noting that their knowledge

and skills were either fully or mostly utilised (Figure 5.14). On the other hand, only 38% of female respondents provided similar responses, with almost half (49%) noting their knowledge and skills were only ‘partly’ utilised.

**Figure 5.14: Knowledge and skills of those no longer working in a research role, biological sciences**

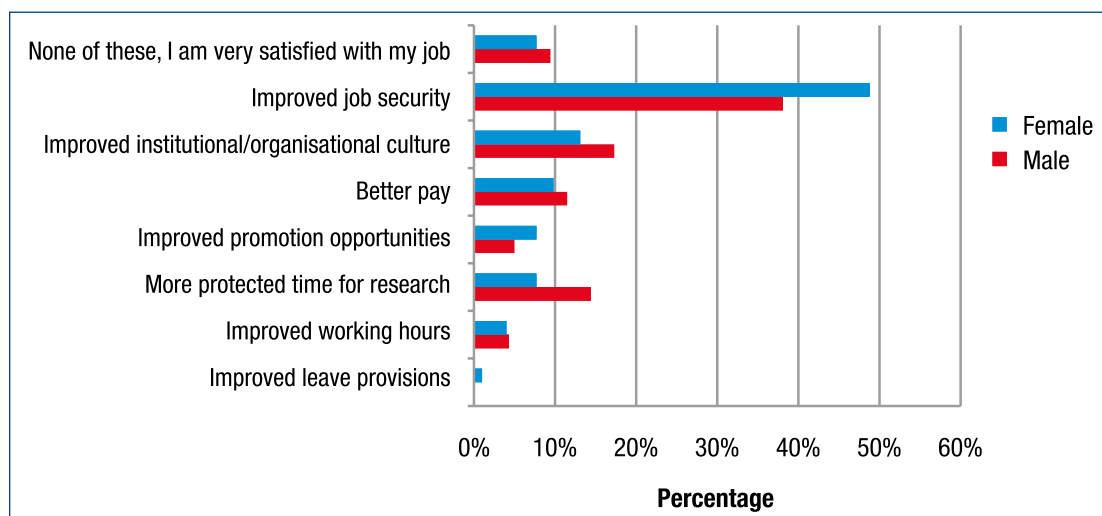


This is in stark contrast to women in the chemical sciences (see Figure 5.29); those respondents (60%) were more likely than their male counterparts to report that their skills and knowledge were mostly or fully utilised. This may be due to a greater range of employment opportunities in the private sector in chemistry-related industries that better accommodate women’s career ‘branching’.

### What factors would make a difference to job satisfaction?

Survey respondents were asked to identify factors that would make a major difference to their levels of job satisfaction (Q53). For those qualified in the biological sciences, job security is a significant issue, particularly for women. **Almost half of these women (49%) said that improved job security was the single most important factor that would improve their job satisfaction, compared with 38% of men** (Figure 5.15). The second most important factor was improved organisational culture, and interestingly this was important for a larger percentage of men (17%) than women (13%). **Fewer than 10% of men and women indicated that none of these factors would make a difference, as they were very satisfied with their jobs.**

**Figure 5.15: Factors that would make a difference to job satisfaction, biological sciences**



The survey also sought opinions on a range of factors that might have helped or hindered career advancement (Q51). Respondents were asked to note on a five-point scale (very helpful, helpful, neither helpful or a problem, a problem, a major problem) how they felt about each factor. For 42% of respondents, access to research funding was a major problem. For nearly a quarter of female respondents, lack of support from a supervisor in applying for promotion was a problem or major problem, as was geographic mobility. Informal mentoring was seen as helpful or very helpful for over 40% of men and women. **For respondents qualified in the biological sciences, 20% of men and 32% of women noted that their level of confidence in their ability was either a problem or a major problem.** This may reflect the highly competitive, grant-driven nature of this field of science compared with the chemical sciences, where a quarter of female respondents noted that their level of confidence in their ability was either a problem or a major problem, and only 7% of male respondents indicated this was the case.

## Summary – Sample qualified in Biological Sciences

The respondents qualified in biological sciences were mostly female and young; most were under 35 years of age. This group is also highly qualified, with three quarters holding a PhD, and only 20% were not currently in a research role.

Gender differences existed in hours of work, in contract of employment and in how their salary was funded. Women were much more likely to be employed on a fixed-term basis and men were much more likely to be employed on a continuing basis. Consistent with career stage, men were much more likely to be either directly employed or holding their own grant and women were more likely to be employed on someone else's grant.

Male and female respondents were at different career stages, reflecting differing age profiles. Men were evenly spread between early and mid-career, whereas two thirds of women were early-career researchers. As a result, men were more likely to have moved residence for their career, but women were much more likely to have taken a career break of more than six months.

Job security was seen as a problem for almost two-thirds of the sample, with women being more negative about it than men. Almost half of all female respondents said that improved job security was the factor that would most increase their job satisfaction. In a plausibly linked finding, most had considered a career or location change and most of those had made that change.

Many respondents noted that access to research funding was a major hurdle to their career advancement; the highly competitive research environment affects the professional confidence of large proportions of both female and male respondents.

Most respondents considered being geographically mobile, informal mentoring, and having confidence in their ability helpful or very helpful to their career advancement.

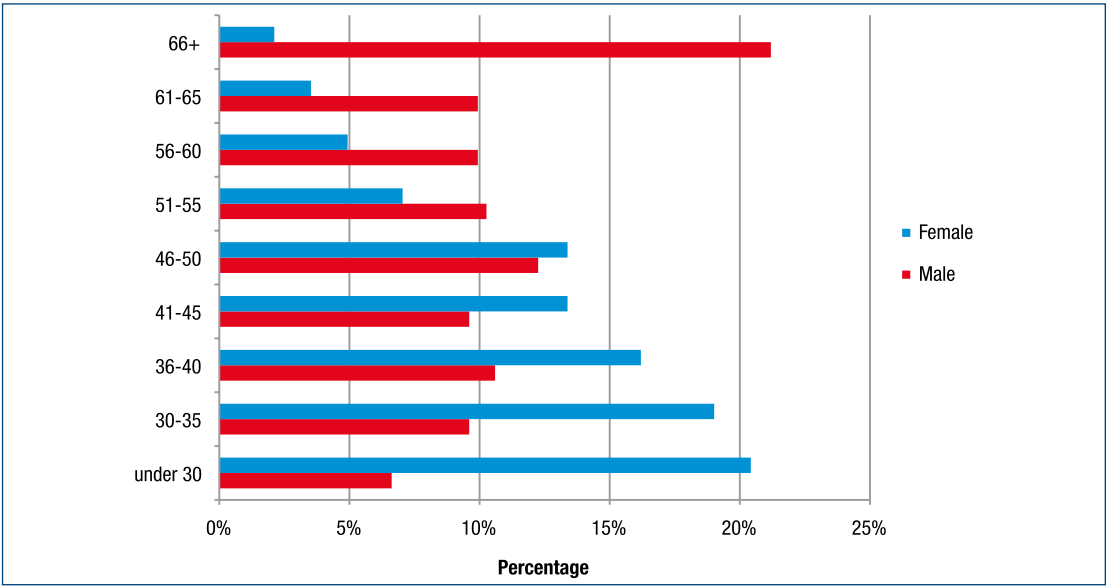
**The data portray a highly qualified and committed workforce engaged in work that demands long hours but is rewarding. However, levels of satisfaction are compromised by a disjunction between career aspirations and career opportunities. This is compounded by unstable conditions of employment, reflected in the data on job security, together with perceived poor prospects for promotion/career progression.**

## Chemistry Related Industries

This section focuses only on the sample of respondents whose highest qualification is in the chemical sciences (n=445). **In contrast to the biological sciences, two thirds are male and one third is female.** Analysis of 2011 census data for the cohort with postgraduate qualifications in chemical sciences found that the median age for women with such a qualification was 40 years and the median age for men was 52. This age profile is reflected in the sample of survey respondents.

Of the respondents qualified in chemical sciences, 70% reported a postgraduate qualification. The level of PhD qualification for this population is slightly lower, at 58%, than for the overall survey population, at 63%, indicative of the currency of Masters level qualifications in this field. Analysis of chemical sciences qualified respondents with a postgraduate qualification showed that women had a median age of approximately 40 years (n=89) and men 50 (n=207). Figure 5.16 presents age and gender detail.

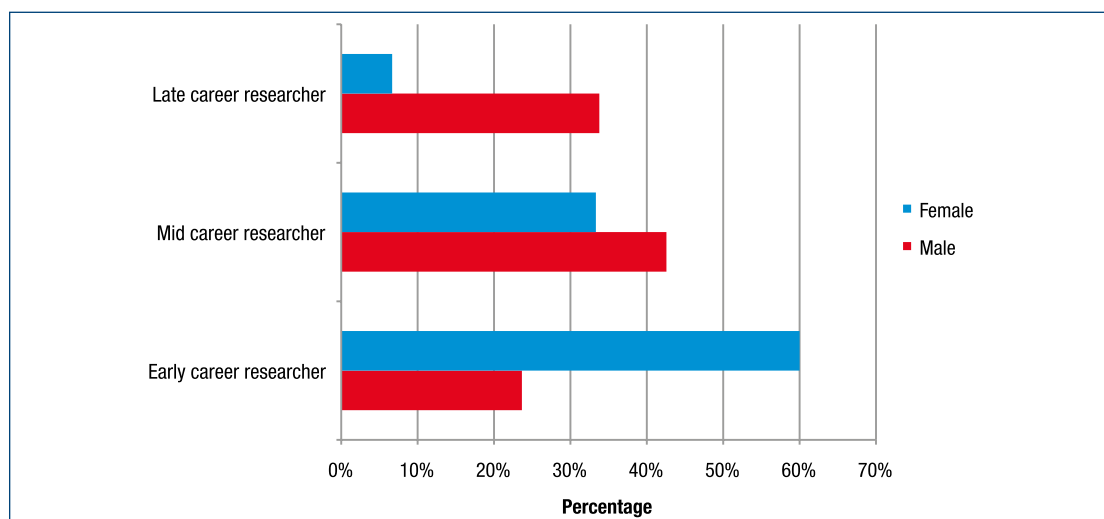
**Figure 5.16: Age profile by gender, chemical sciences**



## Career stage

As in the biological sciences, women qualified in the chemical sciences were much more likely to be early-career and much less likely to be mid-career than men (Figure 5.17). Sixty per cent of women described themselves as being early career. Men were much more likely to describe themselves as either mid-career or late-career.

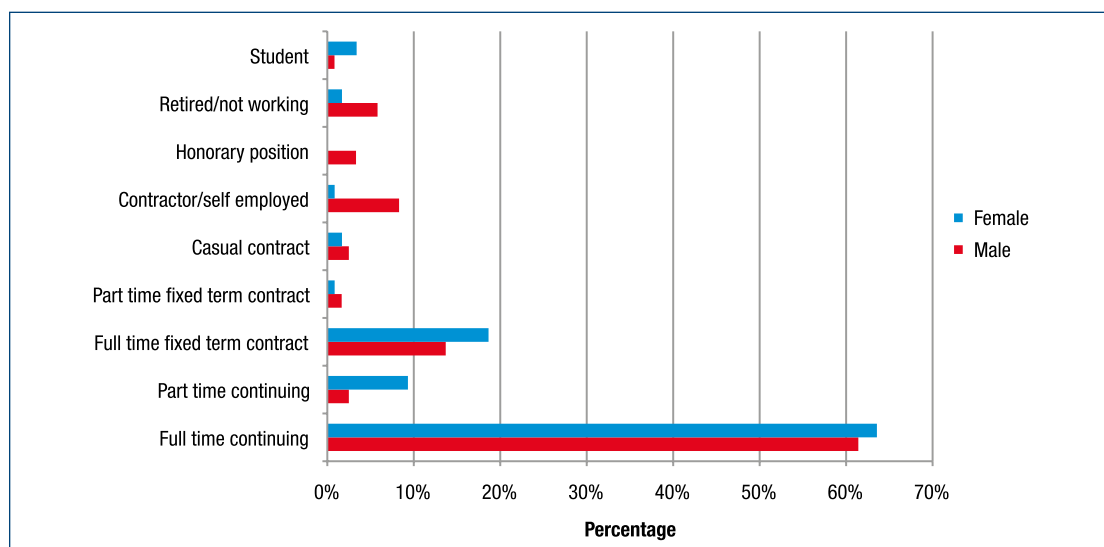
**Figure 5.17: Career stage by gender, chemical sciences**



## Employment status

In contrast to the biological sciences, **most respondents qualified in chemical sciences were employed on a full-time continuing basis (women, 63.6%, men 61.4%)** (Figure 5.18). A further 15% were employed on full-time fixed-term contracts of employment. Women were much more likely than men to be employed on a part-time continuing basis, although overall those employed part-time form only a very small proportion ( $n = 22$ ) of the chemical sciences sample.

**Figure 5.18: Employment status by gender, chemical sciences**

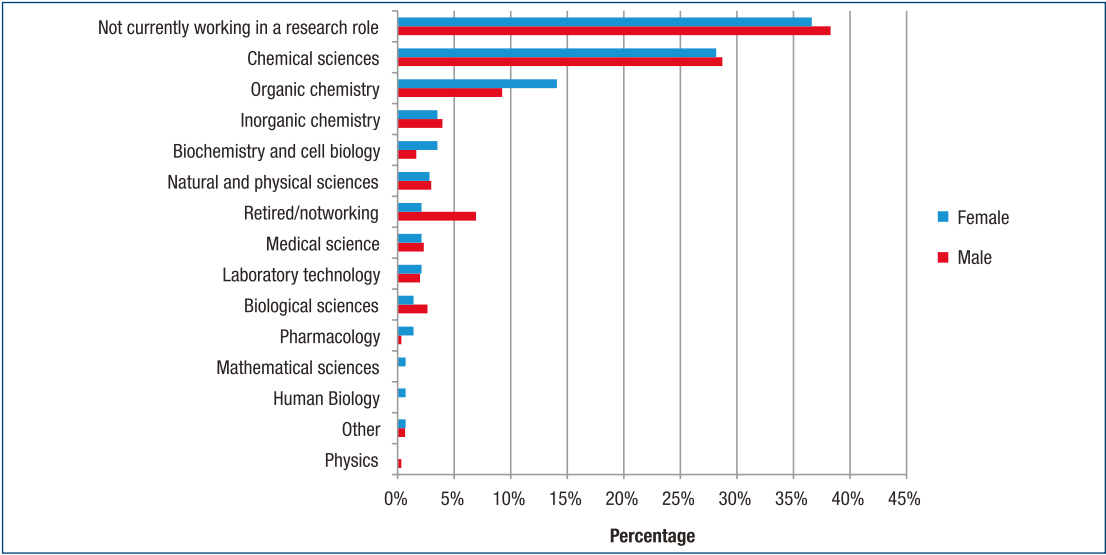


Respondents qualified in the chemical sciences had been in their current position for an average of just over five years, and 16% had been in their current position for longer than 15 years.

The questionnaire asked respondents to identify their field, or if they were not working in research. The ABS Australian Standard Codes of Education (broad and narrow fields) were used to specify the

categories. Of those respondents qualified in chemical sciences, just over a third were not currently working in a research role (Figure 5.19). The remainder were working in a range of chemistry-related and cognate fields.

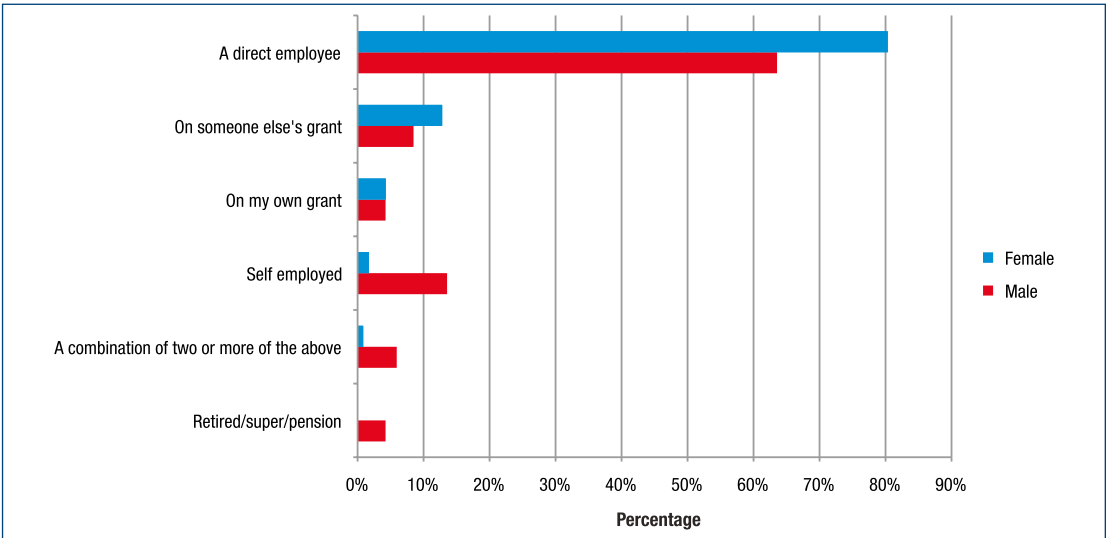
**Figure 5.19: Current role by gender, chemical sciences**



## Employment conditions

This section examines hours of work and how respondents' salaries were funded. Of those respondents qualified in chemical sciences, 80% of women and 64% of men were direct employees (Figure 5.20). Men were more likely than women to be self-employed (14% vs 2%). These responses include those not working in a research position.

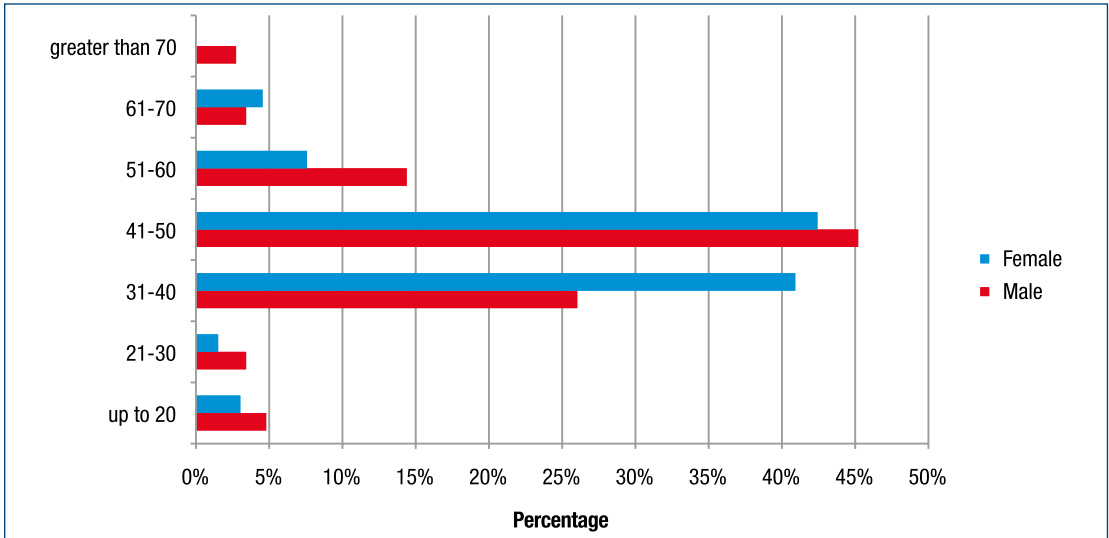
**Figure 5.20: Major source of salary by gender, chemical sciences**



Sixty-two per cent of chemical sciences respondents worked more than 40 hours per week, with 21% of men and 12% of women working in excess of 50 hours per week (Figure 5.21). Only five respondents reported working outside research.



**Figure 5.21 Hours per week by gender, chemical sciences**

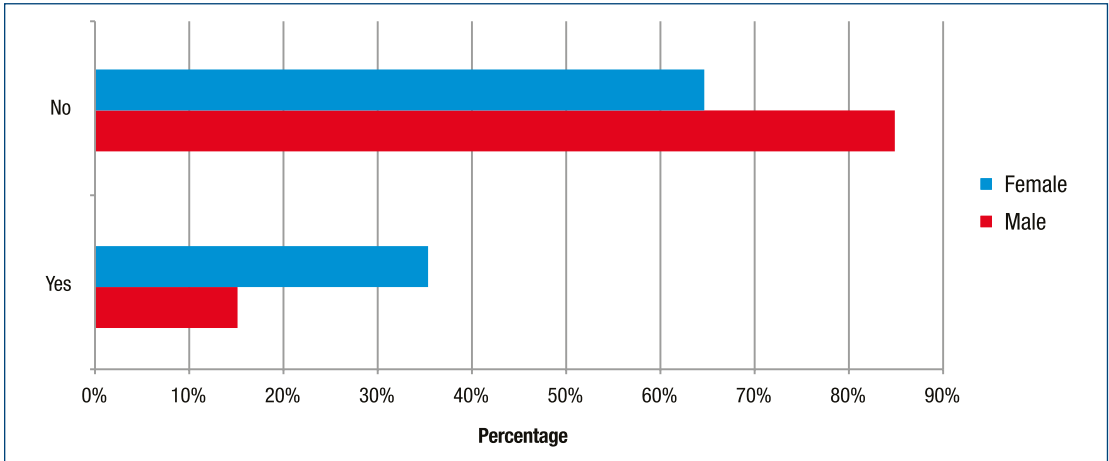


## Careers and career paths

This section covers various factors associated with the careers and career stages of those qualified in the chemical sciences. In common with the biological sciences, geographic mobility is an expectation in this field, with over 80% of men and 70% of women saying that they had moved residence at least once for their career. Indeed, 44% of men and 30% of women said they had moved location more than twice for their career, and only 23% (19% of men and 30% of women) indicated that they had never changed location for their career.

As in the overall survey population, over 35% of chemical science qualified women had taken a career break of longer than six months, compared with just 15% of men.

**Figure 5.22: Career break by gender, chemical sciences**



Whilst 45% of men and women had spent time out of the research workforce or worked in other sectors, the most common career trajectory (53% of respondents) was a traditional linear path from undergraduate to PhD and then to employment (Figure 5.22).

## Measures of satisfaction with job and career

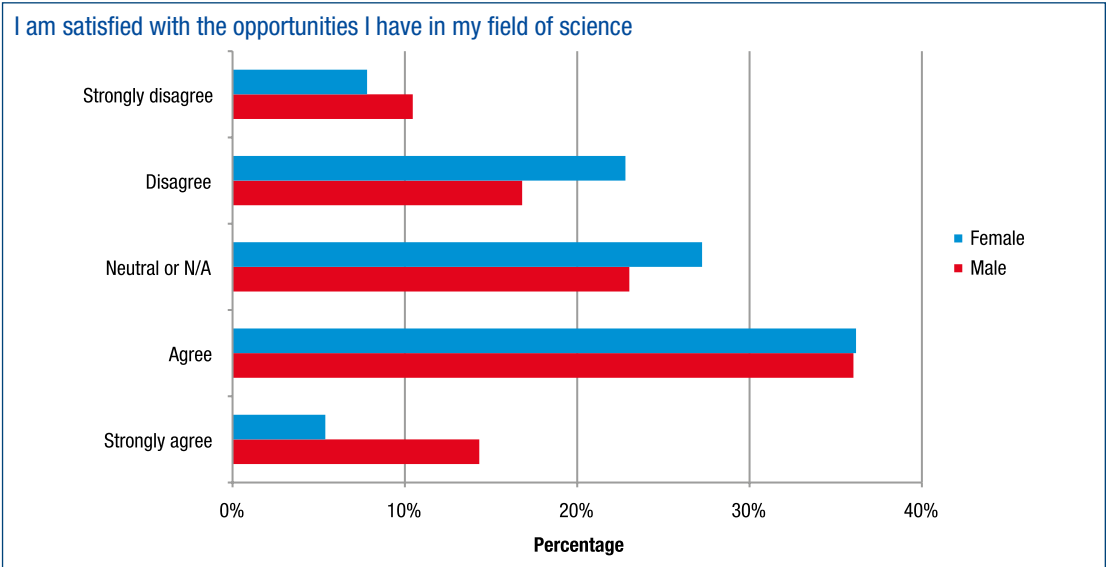
This section briefly examines responses to a series of ‘satisfaction’ questions:

- I am satisfied with the opportunities I have within my field of science
- Overall I find my work rewarding
- Generally speaking I am satisfied with my job
- I have good job security
- I have good career or promotion opportunities

In each case respondents were asked to nominate a point on a five-point scale that represented their view (strongly agree, agree, neutral, disagree, strongly disagree).

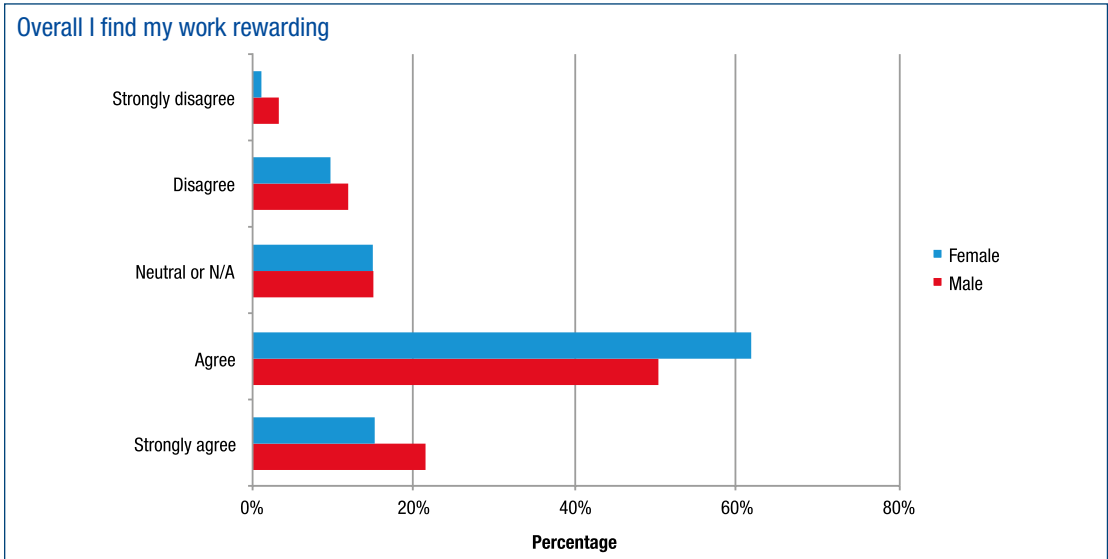
Analysis of the first question, ‘I am satisfied with the opportunities I have in my field of science’ (Q53), indicates that 47% agreed or strongly agreed with the statement, and fewer than 30% disagreed or strongly disagreed (Figure 5.23).

**Figure 5.23: Level of satisfaction with career opportunities, chemical sciences**



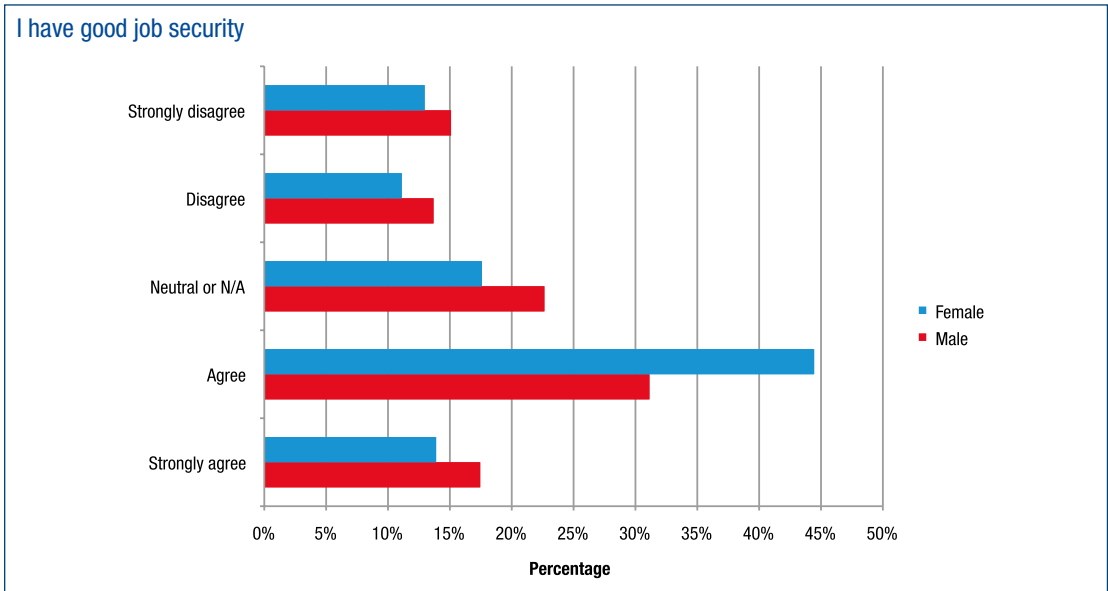
Men and women provided similar responses to the question ‘Overall I find my work rewarding’ (Q57) although men were slightly more likely to say they ‘strongly agreed’ (Figure 5.24). An overwhelming majority, just over 80% of the sample, agreed that they found their work rewarding. Men were also more likely to ‘strongly agree’ that they were satisfied with their work, and women were more likely to simply ‘agree’. Overall, 73% of the sample said they were satisfied with their work.

**Figure 5.24: Level of satisfaction with work by gender, chemical sciences**



Fifty-two per cent of the respondents agreed that they had good employment security (Q57) – much lower than the percentages of respondents satisfied with their work and who found their job rewarding (Figure 5.25). Of respondents who enjoyed good employment security, men were slightly more likely to say that they ‘strongly agreed’ with the statement ‘I have good job security’ and women were much more likely to say they ‘agreed’. Twenty-seven per cent disagreed or strongly disagreed that they had good job security, with only marginal differences between male and female respondents.

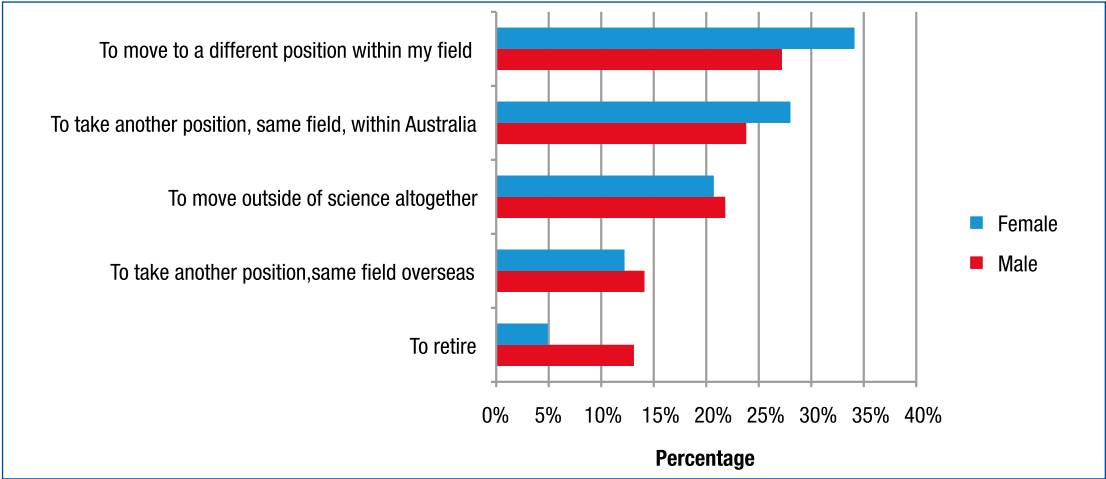
**Figure 5.25: Perception of employment security, chemical sciences**



Examination of responses to the final ‘satisfaction’ question revealed that 40% of the sample agreed or strongly agreed that they had good career or promotion opportunities (Q57), and women were more likely than men to agree with the statement. Nevertheless, one quarter of the sample disagreed or strongly disagreed with the statement ‘I have good career or promotion opportunities’.

Considering a major career or position change was extremely common, with over two thirds of the sample saying that they had done so in the last five years (Q61). Evidence of mobility may reflect dissatisfaction, or it may represent a desire for career advancement. Men (70%) were more likely than women (60%) to say that they had considered a change, and most had acted on that by applying for a position either within their field or outside their field (Figure 5.26). Notably, only 20% of respondents indicated that they intended to move out of science altogether.

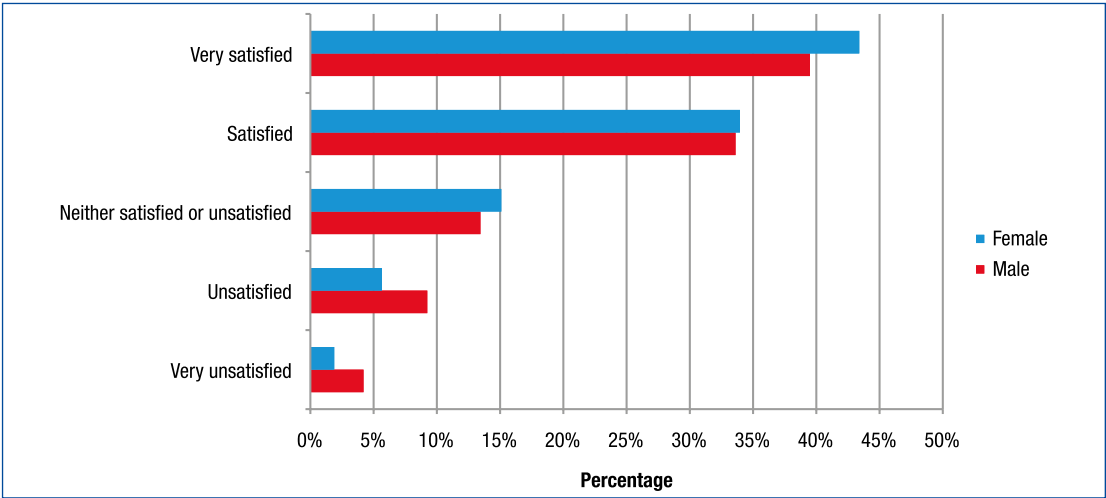
Figure 5.26: Main reasons for considering a career change, chemical sciences



### Career Change

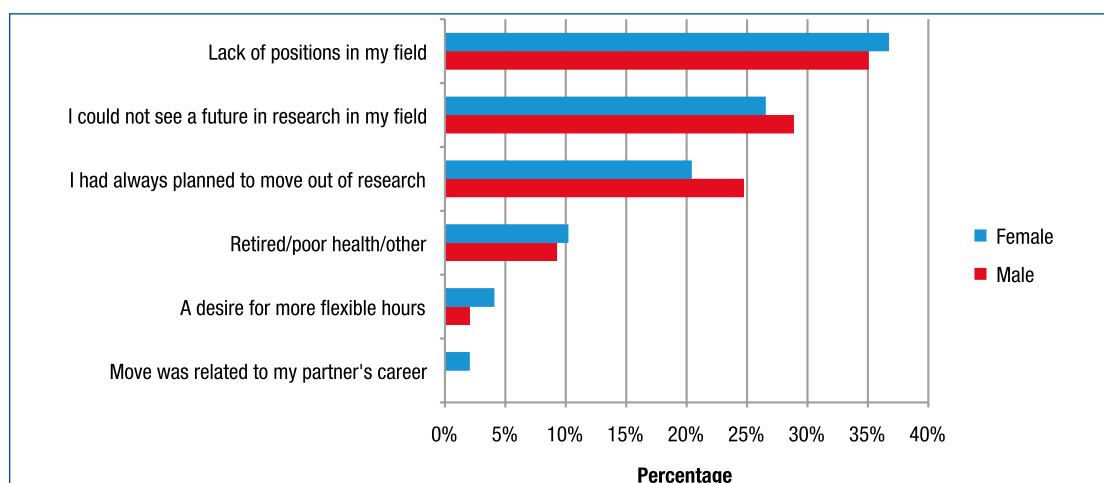
Of those no longer in a research role (n=195), women (43%) were slightly more likely to say that they were ‘very satisfied’ with their career change than men (39%), and **over three quarters said they were satisfied with their career change** (Q9) (Figure 5.27).

Figure 5.27: Career change and satisfaction by gender, chemical sciences



A ‘lack of positions in my field’ was the most commonly cited reason for career change (Q10) (Figure 5.28). Just under 30% reported that they ‘could not see a future in their field’, and just under 25% said that they ‘had always planned to move out of research’. Men and women gave similar reasons for their career changes, with men slightly more likely to say that they ‘had always planned to move out of research’.

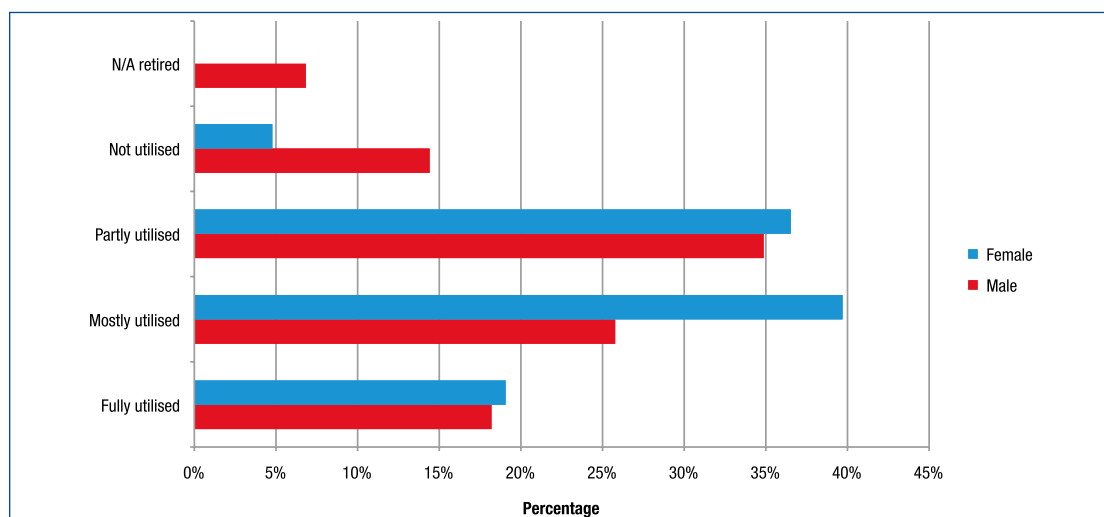
**Figure 5.28: Reasons for career change**



## Scientific Knowledge and Skills

Almost half (48%) of the respondents who had left the research workforce indicated that their scientific knowledge and skills were mostly or fully utilised (Q11). Female respondents (59%) were more likely to note that they ‘fully’ or ‘mostly’ utilised their knowledge and skills (Figure 5.29). Similar percentages of women and men indicated their scientific knowledge and skills were partly utilised. Fourteen per cent of men but only 5% of women claimed that their skills were not utilised.

**Figure 5.29: Knowledge and skills of those no longer working in a research role, chemical sciences**

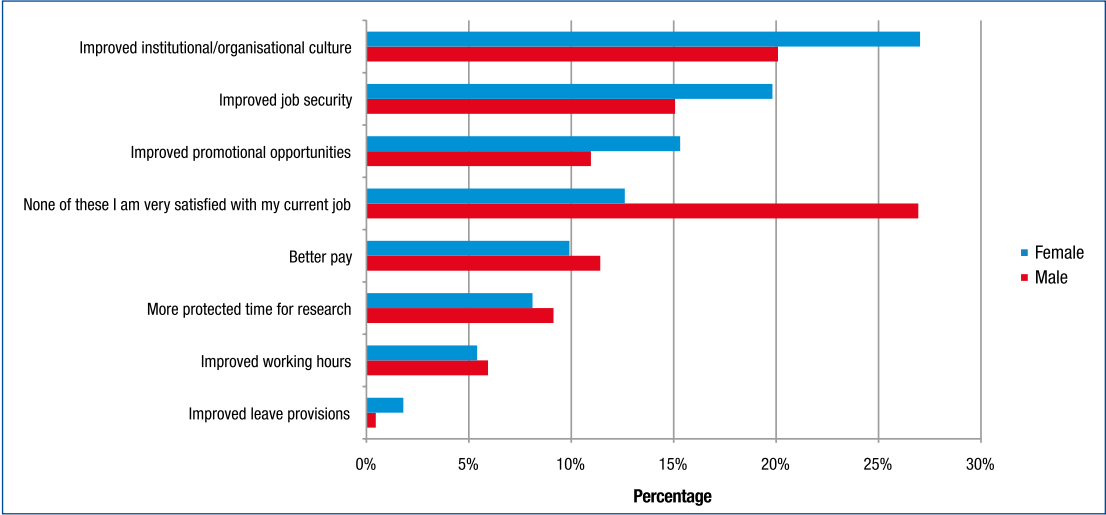


## What factors would make a difference to job satisfaction?

Survey respondents were asked to consider what factors would make a major difference to (improve) their levels of job satisfaction (Q53). In contrast to respondents in the biological sciences, who emphasised job security, chemical scientists’ responses were varied, including improved organisational culture (22%), improved job security (16%), improved opportunities for promotion (12%) and better pay (11%), with 22% recording that none of these would make a difference as they were satisfied with their position (Figure 5.30). Gender differences were apparent in the responses to

this question; the highest proportion of men (27%) said that nothing would make a difference, while 27% of female respondents said that improved institutional or organisational culture would make a difference, followed by improved job security (20% of women).

**Figure 5.30: Factors that would make a difference to job satisfaction, chemical sciences**



As reported for the overall survey population, significant gender differences were apparent in responses to questions regarding factors that had made a difference to respondents’ careers (Q51). **Men were much more likely to say that their level of confidence in their ability was either very helpful or helpful for career advancement and women were much more likely to say that this was a problem.** Close to three quarters of men noted that their level of confidence in their ability was helpful or very helpful, compared with 56% of women. A quarter of female respondents noted that their level of confidence in their ability was either a problem or a major problem, compared with only 7% of male respondents. However, women were much more likely to report that informal mentoring was either very helpful or helpful to career advancement.

### Summary – Sample qualified in Chemical Sciences

The sample is representative of the different age and career stage profiles of men and women qualified in this field, as evidenced in the census data. The median age for men was 50 and for women under 40. Likewise, differences existed in career path and stage. Women were much more likely to have taken a career break, and men were more likely to have moved location for their career, although geographic mobility was common across the sample.

The overwhelming majority of those qualified in the chemical sciences were employed on a full-time continuing basis, and most were direct employees. Gender differences were found in rates of part-time and fixed-term employment, but these differences applied to a small proportion of the sample. Women were more likely to be employed part-time or fixed-term, and men were more likely to be self-employed.

Men and women provided similar responses to the ‘satisfaction’ questions. Just under half indicated that they had good career or promotion opportunities and most respondents said they had considered a major career or position change over the past five years. Of those who had considered a change, most had taken active steps to that end, and men were more likely to have both considered and pursued a change.

When asked what single factor would make the most difference to their job satisfaction, a quarter of women qualified in the chemical sciences cited improved organisational or institutional culture and

20% of women said improved job security. In contrast, a quarter of men said that there was nothing that would improve their job satisfaction as they were very satisfied, and 20% said that improved institutional or organisational culture would make a difference.

When asked about factors that might have assisted career advancement, men and women gave different responses about the value of informal mentoring and their level of confidence in their ability. This may reflect the very different age profiles of men and women in the sample, with older men having longer to develop confidence in their work, or it may reflect broader gender differences.

## Summary – Comparing the Biological Sciences and Chemical Sciences Subgroups

Respondents in the biological sciences were more likely to report a traditional linear career path than those in the chemical sciences. This reflects the higher proportion of those in the biological sciences who worked in universities and research institutes, and the higher proportion of respondents in the chemical sciences sample who worked in the private sector or were no longer in research roles.

Major differences in job satisfaction and perceived means of improving it existed between the two groups. In particular, women qualified in chemical sciences were more likely to cite improved organisational culture as the key factor that would improve their job satisfaction, whereas for women in the biological sciences job security was the major issue. This reflects the different employment profiles across the two fields, with those qualified in the biological sciences, in particular women, more likely to be employed on fixed-term contracts. In the grant-dependent biological sciences insecure employment overrides other factors, including the continuing, well-documented importance of organisational culture.

Across both samples, majorities of men and women reported considering a career or position change in the last five years. Consideration of a change was more common amongst men than women in the chemical sciences qualified sample and more common amongst women in the biological sciences qualified sample.

Similarities were observed amongst women in both samples in relation to the factors that were helpful or problematic for career advancement. **Women in both samples reported that confidence in their ability was an inhibiting factor for career advancement; men were much less likely to report this.** Indeed men in both samples overwhelmingly reported that their confidence in their ability was either helpful or very helpful to their career advancement. Women were more likely than men to rate the value of informal mentoring as helpful to career advancement.

The results highlight quite distinct gender and employment status differences between these two fields of science, differences that are reflected in the 2011 census data. The differences between the two fields highlight the importance of examining the experience of work within particular fields of science, rather than viewing science as a homogenous set of disciplines. Data from both fields indicated that a large proportion of women (three times higher than for men) take career breaks, but the data also suggests that part-time work, which might lessen this need, is not normalised within either field.

The participation, retention and success of women can be improved in both the biological and chemical sciences. However, the highly feminised field of biological sciences is characterised by a longstanding dependency on large numbers of female early-career researchers, together with systemic structural and funding attributes that exploit the passion and commitment of the workforce but reward only a minority with good career prospects and job security. As this field has become increasingly complex and technically sophisticated, the technicians, laboratory assistants and 'wash up and tea ladies' of Charlesworth's 1980s Walter and Eliza Hall Institute (Charlesworth et al 1989) have been replaced by an extremely highly qualified female workforce, with correspondingly high aspirations that are proving extremely difficult to realise.

## SECTION 6: FOCUS GROUPS

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Eleven follow-up focus groups were held in Brisbane, Sydney, Canberra and Melbourne for a purposive sample of the survey respondents who had indicated they would like to participate. Focus group respondents were clustered (some all male, some all female, some mixed, and including men and women from different career stages and industry types) to provide detail and experiences and to explore issues that emerged in the survey responses and large data analysis, prior to work on the Toolkit. Survey and database findings flagged for further attention in this phase included:

- job security as a major issue associated with job satisfaction and career decision-making
- career change to non-research roles and satisfaction with that decision
- use of science knowledge and skills in non-research roles
- organisational culture as a key component of job satisfaction
- differentiated outcomes of women and men in terms of employment, pay and promotion that continue to be apparent in census data and in some responses to the survey.

In particular we wanted to explore the degree to which small differences in some of these survey findings (for example, on confidence and mentoring) were part of the ‘accumulated small differences’ that produce gender differentiation in careers. We also wanted to use the focus groups to probe participants’ perceptions about the transition from PhD to scientific work; about different imperatives in different sectors and organisations; and about experiences that had been positive or negative for women’s career development. Focus groups produced greater detail about issues raised in the survey and census data, and allowed us to directly investigate individuals’ experiences and choices and the thinking behind their decisions.

We began the focus groups by inviting participants to talk about the experience of working in the scientific research workforce compared with being a PhD student aspiring to be a scientific worker, and asked them ‘What do you know now that you didn’t know then?’

Next we focused on their choices and experiences of changing employers and of ‘tipping points’. Here we asked specifically about any experiences of moving between industry and the academy or out of research, and about organisational culture. We asked participants to comment on job security and how it had affected their careers and career choices. In relation to the current highly competitive situation with competitive grant schemes and with employment opportunities in industry and universities, we asked them to talk further about what realistic aspirations of job security might look like.

On gender we asked a very open and neutral question ‘Do women and men have different experiences in your field?’ Later participants were invited to talk about any practices (mentoring, conditions, etc.) that had made a difference, positively and negatively, to their own careers.

With the consent of participants discussions were recorded, transcribed and translated to NVivo to facilitate thematic analysis. The thematic NVivo frequency analysis provided confirmation of key emergent themes. Frequently occurring key words included: time/timing, career, funds/funding, family, contract and security. The descriptors competitive/tournament were recurring themes as were a cluster of key words around research stage and performance: research career, the PhD and postdoc, track record and publications.



## The PhD and transition to employment

The motivation for recruiting you into the PhD program is to have you in the PhD program, it's not actually about what happens at the other end of it.

**Mid-career researcher, CSIRO**

A characteristic response to our opening question 'What do you know now that you didn't know then?' was 'I didn't know how hard it would be.' For most participants, their PhD experience had been heavily focused on their research project and academic achievement, a period in which they were mainly judged by their academic success at key milestones. People aiming to go on to research careers in universities and research institutes faced stiff competition for postdoctoral positions in Australia or overseas, and then for subsequent short-term positions. Most were prepared for an initial postdoc or even a second, but many spoke of their frustration as they moved into their mid-30s and beyond and were still chasing short-term contracts. For many, the uncertain nature of employment in universities had been a surprise, recognised only towards the end of the PhD or soon after completion.

Those in biomedical research were very critical of the difficulties posed by the Australian grant regime in the mid-career phase. Both women and men spoke of their struggle (in Australia in particular) to get a mortgage without secure employment, and of finding a practical residential location when both partners were scientists, given the likelihood of their workplaces being widely geographically separated. In some cases women had sought (and occasionally found) work with more reasonable hours (lab manager, for example), but others spoke of their determination to remain in research and pursue their area of interest despite the hurdles – moving to different parts of the world, leaving partners in other countries, retraining in medicine to gain better employment opportunities but retaining the aspiration to return to research. Those pursuing research careers of this type were very clear that they understood that science is in principle competitive and they accepted the performance-based selective processes as an important part of what science is and does. Even so, they decried the ways in which uncertain conditions of employment and the consequent difficulties of securing a mortgage and beginning a family impacted differentially on women and men.

It's like an inverted triangle often and it's that narrowing ... where you probably lose people because there's a lot of PhDs and postdocs and then you have to get squeezed through this little hole and then you're okay....

**Medical Research Institute (MRI) researcher who had moved to an administrative role**

Those who sought work outside universities and research institutes reported two basic trajectories. A minority (more men than women) had planned since early in their undergraduate studies to take this path; they recognised the need to build up contacts and opportunities and some diverse experience during that phase, and as a result were largely happy with the careers they had developed. Others felt that in retrospect they had been very naïve in their expectations about what employers wanted – they found their academic record was a surprisingly minor element, and felt insufficiently prepared to be competitive in other sectors.

Most thought that doctoral students should be made more aware of the employment situation inside and outside universities, and learn how to 'sell yourself' in the post-PhD phase. Some, however, argued that although these things were needed, it was not the role of universities to provide this, suggesting that many students were too passive with respect to their future.

## On making a career change

...and again it was through having networks I then got my actual job. So I moved out of the lab into more of an office-based job as a trainee patent attorney. And part of that reason was because I saw everybody going through science, short contracts, the uncertainty of biotech in Australia and the funding support, not only in academia but also in industry, there's not that big support.

### **Chemistry PhD, retraining as patent lawyer**

One of the things I've noticed ... with the science profession is that there are often a series of doors that if you pass through the doors they shut behind you and it's very hard to re-enter. So for example if you leave academia or a research field and then for whatever reason and you're not publishing papers, then you're no longer active, you're no longer in the game and you're no longer in the hunt to be employed where a condition is you are an active player in the field.

### **Chemistry PhD, mid-career academic**

We selected the 38 focus group participants to capture a diversity of work types and work situations: tenured, fixed-term but essentially continuing (from contract to contract), casual and under-employed, and unemployed. Participants included scientists working in research support roles, as science communicators, as consultants, as patent attorneys, or running start-up companies. Many who had moved into science-related fields such as science writing and patent law were very happy with their decision. In some cases they had spent time investigating various kinds of jobs and conditions before making the change and undertaking retraining (if needed). For women, these moves often meant more secure employment with less 'crazy hours' – but still in a science-related area and performing work they perceived as valuable.

In terms of cross-sector movement, most agreed that Australian norms make it difficult for those who have worked in industry to re-enter universities and vice versa. Those working in the industry sector mentioned that many industries were unable to properly define what they needed from scientists; simultaneously, they saw scientists as poor at selling their skills to industry and identifying opportunities.

There was broad agreement that going part-time means you are taken less seriously and exploited as a worker and that it has a negative impact on your career in research. As the census data shows very clearly, part-time work is strongly gendered.

In research in particular, I think it's really hard to work part-time unless you have a specific role and you have a lot of support around you and you're on a project with multiple people. Most of the projects I'm involved in, I'm the driver and you know the main investigator on that project and if I go away the project kind of stops.

### **CSIRO researcher**

...especially if you come back part time [you are treated] as though you're not really serious about your career, you're just there. You stop becoming a researcher, you're a working mum, so you're not really serious, you're not available for meetings whenever they want to do it. I do a lot of fieldwork, I do a lot of travelling, I wouldn't have been available for that when I was having children, to the same extent. So there are those sorts of issues. But I think seriously in [this organisation] there's been such a culture of passing over and removing people from publications that has had a significant impact on a lot of careers...certainly the publication protocol has been strengthened greatly over the last five years. So I'm not sure that that's still occurring but it was quite common for people, you know I got bumped down to third author on my own work.

### **Mid-career researcher**

## On funding and science in Australia

Academia is a tournament model, in the sense that, there's a lot of people competing for one position and it's winner takes all and the structure of that is – that's what you're really competing at. And things which prevent you from competing to your utmost potential relative to those outputs, they're the things that will knock you down. Generally speaking if you're going into that tournament and you have kids or you need [to work] part time, that's one arm tucked behind your back ...

### Mid-career researcher

The options, I think are better than they were but the harsh reality is still the fact that it is an incredibly sharp pyramid and it's incredibly competitive and you know while you may be given the opportunities, for example, to work part-time, it may not actually help you because at the other end or at the next step somebody's going to be looking at the number of publications or the number of grants you've got and I don't think they take that into account.

### Mid-career researcher

Several focus group participants commented that science funding in Australia makes basic and longer-term science difficult, and is 'fashion driven' in the areas it funds. Many had done postdocs or worked in other countries, and they perceived that Australian research grants were often shorter and had less establishment funding than those offered overseas. The unforgiving nature of the fellowship and grant cycle, characterised by increasing competition and quality but low success rates, was perceived to be 'a lottery', with many excellent proposals failing to gain funding and leaving researchers with limited career options.

The demand for unbroken performance was frequently commented on, particularly by those working in biomedical research. Maternity breaks not only interrupt productivity but also cause you to miss grant application deadlines, and in Australia funding sources are less diverse than in many other countries.

There was a lot of discussion (especially from men) of the illogical structure of Australian competitive funding, which in their view is heavily skewed towards very early postdoctoral researchers and very established researchers, with insufficient emphasis on supporting people in the mid-career phase. Common conversation across groups was a concern on the one hand that economic conditions and the science funding environment had become more difficult in the past decade and, on the other hand, great commitment, enthusiasm and optimism about the work they were doing.

A few people in our focus groups had experienced very discriminatory workplaces, but as noted in relation to the survey data above, this was frequently overshadowed by insecurity of funding and attendant insecurity of employment.

## On job security

I guess as a postdoc you see job security as probably three years rather than twelve months. I mean it just gives you an opportunity to get some decent – a decent track record behind you, to be able to publish within that time.

### PhD on third 'postdoc' appointment in an MRI

I think that that kind of job security that they had in Japan a generation ago or that Australia had in the public service, that doesn't exist any more. I think that somebody famously had this quote that 'job security is now defined as how long it would take you to get a new job if you lost your job rather than how secure your job is'. And I think if you taught that to people along the way that would probably be a very powerful thing to equip them with.

### CSIRO researcher

My experience of job security is there is none in science and that when you are young and full of energy, say in your twenties, a two or a three-year postdoc was as far as the horizon presented itself. But by the time I got to my thirties and also I will add when I got married, a three-year horizon that just keeps on reappearing and you have to...even a three year which is about as good as you can get, I think, in most cases anyway, you just end up justifying your existence time and time again and often they're incredibly draining and unproductive. And it just eroded my enthusiasm for the profession.

#### **Academic, PhD chemistry, mid-career**

I think that there's more and more recognition that the future is not so bright and people are earlier on becoming more and more aware, they need to be aware. If I wanted a solid career path and a decent wage, I would definitely be doing something else.

#### **PhD student**

The survey and census data provided important data on the high levels of insecure employment in the science research workforce and the impact of this on job satisfaction and career decisions. Focus groups gave greater understanding of the impact of insecure employment on participants, particularly in the postdoctoral and mid-career phases.

We were keen to explore the question of 'What would make a difference?' to scientists' job security. It was clear that many participants had experienced poor employment practices, such as a sequence of one-year contracts, designed to eliminate the need for appropriate performance management and to avoid employer obligations. It was also suggested that these short-term contracts had become increasingly common with the risk of increasing inter-institutional mobility of senior researchers and their teams. Elimination of such poor employment practices is a clear imperative.

Another issue participants raised was communication about employment. Examples were provided of institutional contexts in which short-term contract employment conditions were managed well. For example, some participants on short-term research contracts described being treated as part of the group and always knowing whether a further contract was likely and what would determine that eventuality, and had some confidence in their workplaces notwithstanding the formal contract situation. Others were not well informed about their short-term employment futures and felt extremely vulnerable and marginalised in their workplaces.

**It was suggested that longer fixed-term contracts, five years rather than three years, would make a significant difference to career prospects and planning, easing the pressures that accumulate with family formation through changes such as becoming eligible to take out a mortgage.**

## **On mobility**

I moved three different countries in the space of five years and each time I had to go get the same stuff from IKEA, like every single move, you can buy exactly the same stuff in a different country.

#### **PhD, mid-career researcher**

I love the way the US does science. I hate the way Australia does science. [But] I want to live in Australia. I don't want to live in the US. I'm constantly – I may just move back and forth the rest of my life, I can see that, I can see that unfolding horribly.

#### **PhD, unemployed**

And another thing, which more affects females, is that you're often displaced from your extended family and that's the family support that's not there when you've got young children.

#### **PhD, now working in business development at an MRI**

In focus group discussions gendered patterns of mobility were often cited as inhibitors of women's careers. Significantly more men than women indicated that they had changed location more than twice to advance their career. Most men and women indicated that their moves had involved international relocation. Discussions indicated that geographic mobility was expected for a successful career in science, particularly in the postdoctoral phase. Many were neutral about the importance of mobility, but it should be noted that most of this research workforce is located in major metropolitan centres, especially Sydney and Melbourne, in which inter-institutional mobility does not always necessitate relocation of place of residence. Participants did indicate that moving away from family support structures created pressures for those with young families.

## On gender differences and disadvantage

I think that it's true that generally speaking men do better in science than women but obviously it's not an absolute and I know examples of women, primarily childless but some with children, who have done very well and I know men who haven't fitted that mold of ambitious men, who have struggled because there is a little bit of, ah – still that old boys network, kind of playing the game, being there, self-promotion as well. I think a science career as a researcher is geared to the single male who's got time on his hands and wants to make his career. And it benefits and advantages anyone that fits that model.

**PhD, mid-career, now working as a medical writer**

The whole career structure is built on, at least as far as I've seen, in the top university in Australia, it's built on the motive of an alpha male scientist with a wife and family devoted to supporting his career. It worked and so it will continue to work, the alpha males choose students and postdocs in their own image and those sorts of students are attracted to them. So it's ... a tightly embedded international self-perpetuating system. So it's a very powerful and resilient dynamic that's not going to change. Yeah I can see it with quite a lot of perspective from the inside.

**Australian Research Council Future Fellow, mid-career researcher, PhD**

Several groups discussed issues related to organisational culture and unconscious preferences.

One of the challenges that our institute particularly faces is the lack of women in top positions and it's not just in science, it's also in leadership and in admin positions. It's all male, there are a few females on the Board but in all the operational positions and strategic positions it's all men and most of the senior scientists are primarily men. We're losing a lot of women in the sort of mid-postdoc years and it's and I think we're not alone in that challenge, I think a lot of institutes face that challenge. And so you know – getting more equality would be good because I think we lose a lot of talent.

**Researcher, MRI**

Women in all-women focus groups were more likely to speak about tacit discriminatory elements of the workplace culture. They noticed different patterns of sponsorship for men and women, and senior men feeling more comfortable interacting with other men, and sometimes direct examples of discrimination and biased appointments at which they felt powerless to protest – or protested but at the expense of having to leave their research group or department.

Some conversations touched on women's own contributions to their career patterns – their reluctance to take on some responsibilities, or, conversely, their taking on time-consuming but ultimately personally unrewarding 'good citizen' responsibilities on committees and the like. The following quote is a quite complicated reflection on this issue, in which the participant describes being aware of who was being promoted or asked to contribute but also of women's reluctance to take on some opportunities.

...the other year when there were twelve [appointments], you know several of the men that got the positions were tapped on the shoulder and were told 'you should apply'. So then the question is how many women was that done for and if women were approached in the same way, why then did they not get it. Was it because they didn't – they chose not to put themselves forward or is it – I don't know, I think that's the kind of questions that we should be asking. I mean I think possibly more women don't want that responsibility and the issue then is what are you going to do, you're wasting all these experienced senior women who don't want that career path.

#### **Early Career Researcher, MRI**

There's this problem of women will only apply when they think they have a ninety per cent chance of getting through where guys will apply if they think they've got ten per cent chance of getting through.

#### **Mid-career researcher, MRI**

In relation to maternity leave and its impact, there was some discussion of the greater scope for making provision for it in larger organisations than in small companies and institutes. There was considerable discussion about pregnancy and leave timing, including examples of a few workplaces where this had been managed well. The following quote captures some of the dynamics:

**A:** '...you do tend to hear 'oh another pregnancy' and other types of comments which I kind of always feel a bit resentful...

**B:** And nobody says that when the man's wife or partner gets pregnant.

**A:** Yeah it's just like 'your wife's pregnant' but when the girls get pregnant it's 'Oh they're going to be stopping work' you know it's a big – not that it's a drama you know everyone around them tends to get excited but you do kind of think that you know management kind of go 'Oh okay here we go, we've got to reshuffle jobs and work it all out'.

**Facilitator:** Did you feel like that in your circumstance?

**C:** Ah yeah actually, when I told my boss his first reaction was 'oh shit'. it was like 'thanks a lot'. Yeah I can definitely agree with the relative to opportunity bit, it's you know hard to judge what that really means and the, yeah the pregnancy issues as well.

**A and B are researchers in hospital settings; C is a researcher working in a university**

Another focus group participant referred to her own way of managing work-life balance as 'informed' but also 'opportunistic':

You know I did (looked after) the kids and I worked nights because that's what worked at the time and did a couple of courses to keep sort of on top of things and at the top of my game and sort of just took opportunities as they arose – informed but more looking what's opportunistic and not, not necessarily thinking where is that going to lead me. Just thinking that's what's going to work for now and like I said it's got me somewhere where I didn't think I would be. You know I'm working in research. I'm a working clinician. I've got incredible opportunities that I didn't think you could get.

**Researcher with nursing qualifications working in a hospital**

## Summary of Key Findings – Focus Groups

The focus group discussions confirmed the evidence of the NRSS and the survey responses in terms of the relative lack of understanding among postgraduates of the research workforce, conditions of employment and career prospects, partly because the PhD process itself is so competitive and often has an inward disciplinary focus and institutional emphasis.

The difficulty of negotiating the mid-career phase was evident, and particularly when participants spoke about trying to manage careers and personal relationships; mobility and workload and other pressures accumulate, meaning something (one partner's career) usually has to give. For women with young children, losing family support due to relocating to pursue their career was a major problem. Family formation and the career impact of periods of leave and part-time work were seen as major issues for women. In several focus groups, women referred to frequent discussions about the question 'Is there a right time to have a child?' Several participants referred to the value of a supportive wife in a man's scientific career, but other discussions indicated that many younger men are now questioning the unreasonable demands made of scientists and stating their desire to accommodate other priorities in life, particularly in relation to family.

Job insecurity hangs over everything – especially at the nest-building, child-rearing stage – and powerfully affects career decisions. Participants reflected on the brutality of the Australian grant system (in fact it was hard to get them to stop talking about it) and of the huge downsides of increasingly ubiquitous one-year contracts. Longer (three-to-five-year) contracts were perceived as an initiative that could make a significant positive difference.

The focus groups offered examples of some scientists, both men and women, who had proactively and successfully explored and switched to non-research options and cognate areas of work, and of many others who felt trapped and demoralised in their current circumstances. It was clear from these discussions that there is still very poor translation (mutual understanding) and few opportunities for moving between academia and industry. The restricted number of research positions in Australia in multinational companies, as well as genuine resource constraints in small business, featured in this discussion.

In terms of organisational culture, participants reported that blatant discrimination continues in some workplaces, but participants rarely recognised gender pressures until they started to have conversations about 'do women and men in science have different careers?' Participants (both men and women) often began that discussion by saying that science is not gendered, 'good science is good science', but as they talked further they realised the under-representation of women in senior positions, particularly of women perceived to be role models or mentors, makes a difference to other women. Participants also identified organisational culture and unconscious gender preferences in patterns of appointment, promotion, and opportunity. The 'crazy hours' problem was a recurring theme.



# CONCLUSION: ADDRESSING A WICKED PROBLEM

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Analysis of the findings of the focus group data together with the large dataset and survey data produced valuable evidence of the ongoing need to reframe patterns of participation, employment and criteria for success for a wider range of entrants to the science research workforce. The research has advanced understanding of decision-making in scientific careers and the factors that would make a difference to retention of women, including the demand for flexible and less linear career options, normalisation of part-time work and the need to address the gendered experience of organisational cultures. The case for increasing the diversity of career destinations and the concomitant importance of capacity for career mobility between the academy, the public sector and industry is clear.

The analysis provides evidence of the multiple ways in which women are expected to conform, particularly in universities and research institutes, to the 'masculine ways of thinking and doing' that are characteristic of a 'heroic' concept of science that does not reflect the reality of how innovation actually occurs (Ashton, 2015). Working in 'greedy' organisations with cultures of long hours that do not easily accommodate other claims on scientists' lives presents challenges that women feel more acutely than men, especially at mid-career stage.

The survey data on those qualified in biological sciences and those qualified in chemical sciences suggests that there are problems to be resolved in both fields to improve the participation, retention and success of women. Nevertheless, the feminised biological sciences, characterised by a longstanding dependency on large numbers of female early-career researchers, together with systemic structural and funding issues and fewer opportunities for employment in the private sector, offers good career prospects and job security to a relative minority of a highly qualified population.

Even though more women than men considered themselves amongst 'the best and brightest' at undergraduate level, a large proportion of women in these fields of science experience a disjunction between ability, aspirations and reality that undermines their confidence and hampers their career progression. Women do not experience the same levels of 'fit' and satisfaction that many men reported. More women than men leave the science research workforce because they cannot see a future in it due to a lack of career prospects rather than a lack of continuing interest in research. Thus, the research workforce is losing scientists who would prefer to remain in research roles. This is more than a loss of talent; it represents a loss of diversity and therefore capacity for innovation within the science research workforce. If it were not for scientists' resilience, passion, commitment and persistence, as evidenced in the focus group discussions, this would be an even more troubling scenario for Australian research.

The issues are well-documented and consistent. It is now time for action to be taken to address the well-known impediments to women in science. It is time for science research to be seen as a marathon, in which participants are desperately competing against one another whilst striving to achieve extraordinarily demanding goals under the duress of employment and career uncertainty. As in a marathon, they are most likely to achieve this if they are confident and supported by colleagues, pacemakers, mentors and sponsors, and a supportive partner (Murakami, 2008), but systemic change will only be achieved through realistic appraisal of the importance and value of the Australian research environment and the development of a funding environment that generates appropriate conditions of employment.

Recommendations arising from this research are presented in the executive summary of the report. It must be emphasised that our analysis relied upon cross-sectional data. If we wish to develop a more sophisticated understanding of this 'wicked' problem and emerging patterns of generational change, a longitudinal study of the science research workforce is needed.





# APPENDIX 1: RECOMMENDATIONS FROM FASTS, WOMEN IN SCIENCE IN AUSTRALIA (2009)

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Following the approach of the US National Science Foundation (NSF, 2009), FASTS supports a multifaceted strategy to broaden participation in the science and technology workforce – in particular to realise the potential of women's participation. FASTS encourages institutions of higher education and the broader science community (including government, professional societies, the learned academies, science and technology related industries and not-for-profit organisations) to address various aspects of science and technology organisational culture and institutional structure that may negatively affect women. The following recommendations have been drafted with the input of a range of key stakeholders.

## Advancing the Agenda

- 1 The Minister for Innovation, Industry, Science and Research takes a leadership role in ensuring the urgent prosecution of the agenda outlined in the following recommendations, including identifying and co-ordinating the appropriate responsible agencies.
- 2 Identify incentives for change including a stronger business case linking diversity with innovation.

## Scientific Career Paths

- 3 Clearly map scientific career paths with opportunities for leadership and mentorship identified in tandem with the systematic identification and elimination of barriers to women.
- 4 Address the mechanisms that will enable women to 'thrive and excel', not just 'survive', in science and technology careers, including supporting flexible, non-traditional career paths.

## Institutional Cultures and Decision-making

- 5 Following the US ADVANCE program, support leadership and employers to implement policies and practices that generate positive organisational cultures which create contemporary family friendly and equitable workplaces that value diversity.
- 6 Following the EU example ensure that women constitute one third of policy-making, funding and decision-making boards.

## Evidence and Evaluation

- 7 Improve the evidence base – institute consistent, systematic reporting of gender data in the sector on the part of the major research and research funding agencies (including CSIRO and the NH&MRC), the centres of excellence (the Learned Academies, the CRCs, the ARC Centres and Networks) and industry. Ensure that the ABS and Office for Women generate data sets that link participation to innovation in keeping with international practice.
- 8 Create a clearinghouse for best practice in the sector comparable with the UK's Resource Centre for Women in Science, Engineering and Technology. The responsibilities of the clearinghouse will include the monitoring and evaluation of SET initiatives.
- 9 Continue the monitoring and research in schools on gendered participation with a renewed emphasis on the four questions: Which girls? Which boys? Which disciplines? Why?

## Leadership

- 10 Empower leaders to address these issues through resources, interventions, and a robust policy and evaluation framework; and on an organised and ongoing basis identify high profile male and female individual and organisational champions.

## APPENDIX 2: PROJECT SURVEY

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### Careers in the Scientific Research Workforce Survey

**You are invited to participate in a survey examining careers in the biological sciences and chemistry related research workforce.**

There has been a lot of discussion recently in the popular media about careers in science and about the sustainability of the scientific research workforce in Australia. Whilst a lot is known about careers in the academy, there is less knowledge about careers in the science workforce. Researchers at the University of Melbourne together with industry partners, the Bio21 Cluster, the Royal Australian Chemical Institute (RACI) and Science and Technology Australia (STA) have been awarded an Australian Research Council Linkage grant to investigate the experience of careers and career paths of those in the scientific workforce and make suggestions for improvements. You have received this survey because either you or your employer is a member or associate of one of the industry partners.

Your participation in this survey is voluntary and is anonymous. Results will be collected by the researchers and results reported in aggregate form only. Survey results will be publically available. The survey has ethics approval from The University of Melbourne and the contact person for the survey is the Project Coordinator.

Whilst we are interested in the experiences of those currently working in the scientific research field, we are also interested in the experiences of those who are qualified but no longer working in the field. If you have colleagues who fit this description, would you please forward the survey to them.

The survey should take no more than 20 minutes to complete

We look forward to receiving your response by 30 November 2012. Thank you for your consideration and participation,

**Professor Sharon Bell**, Charles Darwin University

**Professor Lyn Yates**, University of Melbourne,

**Project Chief Investigators**, ARC Linkage LP110200480

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### 1 What is the highest level of education you have completed?

- ☐ PhD
- ☐ MD
- ☐ MBBS or equivalent
- ☐ Masters by thesis
- ☐ Masters by coursework
- ☐ Undergraduate degree with Hons
- ☐ Undergraduate degree

Other (please specify):

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### 2 In which year did you complete this qualification?

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### 3 Are you currently studying for a qualification?

- ☐ No
- ☐ Yes – PhD
- ☐ Yes – MD
- ☐ Yes – MBBS
- ☐ Yes – Masters
- ☐ Yes – Undergraduate degree
- ☐ Yes – Diploma
- ☐ Yes – Other

Other (please specify)

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### 4 What is your age?

- ☐ under 30
- ☐ 30 – 35
- ☐ 36 – 40
- ☐ 41 – 45
- ☐ 46 – 50
- ☐ 51 – 55
- ☐ 56 – 60
- ☐ 61 – 65
- ☐ 66+

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## 5 Are you male or female?

- ☐ Male
- ☐ Female

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## 6 Which of the following best describes the field in which you received your highest degree?

- ☐ Mathematical sciences
- ☐ Chemical sciences
- ☐ Biological sciences
- ☐ Other natural and physical sciences
- ☐ Computer science
- ☐ Information systems
- ☐ Engineering and related technologies
- ☐ Medical studies

Other (please specify)

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## 7 Which of the following best describes the field in which you currently work?

- ☐ I am not currently working in a research role
- ☐ Biochemistry and cell biology
- ☐ Genetics
- ☐ Microbiology
- ☐ Human Biology
- ☐ Biological sciences
- ☐ Medical science
- ☐ Pharmacology
- ☐ Laboratory technology
- ☐ Natural and physical sciences
- ☐ Mathematical sciences
- ☐ Organic chemistry
- ☐ Inorganic chemistry
- ☐ Chemical sciences

Other (please specify)

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**8 If you are qualified in the biological sciences, or a chemistry related field, and are not currently working as a researcher in this field, how would you best describe the area in which you work?**

- ☐ Health and medical services
- ☐ Government
- ☐ Industry – primary
- ☐ Industry – secondary
- ☐ Library and information services
- ☐ ICT
- ☐ Tertiary education
- ☐ Secondary education
- ☐ Vocational education and training
- ☐ Legal profession
- ☐ Marketing/Communication/Media
- ☐ Management
- ☐ Currently seeking employment
- ☐ Unpaid household duties/caring responsibilities

Please specify your current role

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**9 If you are no longer working in a research role how satisfied are you with your career change?**

- ☐ Very satisfied
- ☐ Satisfied
- ☐ Neither satisfied or unsatisfied
- ☐ Unsatisfied
- ☐ Very unsatisfied

Other (please specify)

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**10 Which of the following best describes the reasons for your career change away from research?**

- ☐ Lack of positions in my field
- ☐ A desire for more flexible hours
- ☐ Move was related to my partner's career
- ☐ I had always planned to move out of research
- ☐ I could not see a future in research in my field

Other (please specify)

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**11 In your current position do you use the specific scientific knowledge and skills acquired through your formal qualifications?**

- ☐ My knowledge and skills are fully utilised
- ☐ My knowledge and skills are mostly utilised
- ☐ My knowledge and skills are partly utilised
- ☐ My knowledge and skills are not utilised

Other (please specify)

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**12 In your current position do you use the specific scientific knowledge and skills acquired through your formal qualifications?**

- ☐ My knowledge and skills are fully utilised
- ☐ My knowledge and skills are mostly utilised
- ☐ My knowledge and skills are partly utilised
- ☐ My knowledge and skills are not utilised

Other (please specify)

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**13 How would you describe your current position/primary role?**

- ☐ Research scientist
- ☐ Clinician
- ☐ Teaching/Research academic
- ☐ Research focussed academic
- ☐ Technical support
- ☐ Management

Other (please specify)

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#### 14 Which of the following best describes your occupational level?

- ☐ Student
- ☐ Post doc
- ☐ Research Assistant
- ☐ Operational management
- ☐ Middle management
- ☐ Laboratory Manager
- ☐ Senior Management
- ☐ Academic Level A
- ☐ Lecturer/Research Fellow/Academic Level B
- ☐ Senior Lecturer/Senior Research Fellow/Academic Level C
- ☐ Associate Professor/Academic Level D
- ☐ Professor/Academic Level E
- ☐ CSIRO Level 4
- ☐ CSIRO Level 5
- ☐ CSIRO Level 6
- ☐ CSIRO Level 7
- ☐ CSIRO Level 8
- ☐ CSIRO Level 9

Other (please specify)

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#### 15 How would you describe your career stage?

- ☐ I am an early career researcher
- ☐ I am a mid career researcher
- ☐ I am a late career researcher

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#### 16 Would you say your career path has been?

- ☐ A traditional linear career path, ie undergraduate study followed by post graduate study, doctorate and post doc research
- ☐ A non-traditional career path, with undergraduate and post graduate/PhD study combined with work in other sectors
- ☐ A non-traditional career path with undergraduate and post graduate/PhD study combined with time out of the research workforce

Other (please specify)



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**17 On average, how many hours per week do you work in your workplace, including in field or clinical settings?**

- ☐ up to 20
- ☐ 21--30
- ☐ 31--40
- ☐ 41--50
- ☐ 51--60
- ☐ 61-70
- ☐ greater than 70

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**18 On average, how many hours per week do you undertake work related to your employment at home?**

- ☐ Up to 5 hours
- ☐ 6--10 hours
- ☐ 11-15 hours
- ☐ 16--20 hours
- ☐ 21--30 hours
- ☐ greater than 30 hours

Other (please specify)

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**19 Would you have described yourself to be amongst the 'best and brightest' at any/all of the relevant stages of your career? Choose all that apply**

- ☐ As an undergraduate
- ☐ As a post-graduate/during doctoral studies
- ☐ As an early career researcher
- ☐ As a mid career researcher
- ☐ As a late career researcher

Other, please elaborate

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**20 What has been your most rewarding career stage to date?**

- ☐ As an undergraduate student
- ☐ As a PhD student
- ☐ As an early career researcher
- ☐ As a mid-career researcher
- ☐ As a late career researcher

Please elaborate why?

21 What has been your least rewarding career stage to date?

- ☐ As an undergraduate student
- ☐ As a PhD student
- ☐ As an early career researcher
- ☐ As a mid-career researcher
- ☐ As a late career researcher

Please elaborate why?

22 Are you a member of a professional society? (please enter 0, or number of memberships that apply)

General Professional society \_\_\_\_\_

Field-specific general society \_\_\_\_\_

23 Are you a member of a trade union?

- ☐ Yes
- ☐ No

24 How important were the following aspects in your decision to pursue a career in science?

	VERY IMPORTANT	SOMEWHAT IMPORTANT	NEUTRAL	NOT IMPORTANT
Autonomy and control over working life	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Genuine passion for field of study	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Job Security	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Opportunity to contribute to development of new knowledge	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Intellectually stimulating work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Opportunity to travel	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Collegial work environment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Status of profession	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Financial reward	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inspired by a school teacher	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inspired by a university lecturer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Past personal experience	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Family influence	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Helping society/others	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## 25 What do you value most about working in your current field, even if it is not a feature of your current position?

	HIGHLY VALUED	VALUED	NEUTRAL	NOT VALUED
Autonomy and control over working life	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Genuine passion for field of study	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Job Security	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Opportunity to contribute to development of new knowledge	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Intellectually stimulating work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Opportunity to travel	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Collegial work environment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Status of profession	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Financial reward	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Intellectual challenge	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## 26 Is your primary workplace:

- ☐ A research institute
- ☐ A university
- ☐ Other educational institution
- ☐ In the private sector/industry
- ☐ A hospital
- ☐ CSIRO
- ☐ Another government department/agency

Other (please specify)

## 27 What is the size of the workforce at your place of employment?

- ☐ fewer than 20 employees
- ☐ 20 – 100 employees
- ☐ 101 – 500 employees
- ☐ 501 – 1000 employees
- ☐ more than 1000 employees

## 28 Are you employed:

- ☐ Full time continuing
- ☐ Part time continuing
- ☐ Full time fixed term contract
- ☐ Part time fixed term contract
- ☐ Casual contract (no leave entitlements)
- ☐ Contractor/self employed

Other (please specify)

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**29 If you are employed part time, what is your fraction? (ie 0.2 =one day per week)**

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**30 How is the major component of your salary funded?**

- ☐ I have my own grant
- ☐ I am employed on someone else's grant
- ☐ I am a direct employee
- ☐ I am self employed
- ☐ A combination of two or more of the above

Other (please specify)

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**31 How long have you been in your current position?**

- ☐ less than one year
- ☐ 1 – 2 years
- ☐ 2 – 5 years
- ☐ 5 – 10 years
- ☐ 10 – 15 years
- ☐ more than 15 years

Other (please specify)

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**32 How many times in your career have you had to change location in order to advance your career?**

- ☐ I have never changed location
- ☐ I have moved once
- ☐ I have moved twice
- ☐ I have moved more than two times

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**33 What has been the most significant impact of the move/s?**

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**34 Have any of the moves involved international relocation?**

- ☐ Yes
- ☐ No

### 35 Have you ever accessed the following conditions/workplace benefits in your current position?

	YES	NO	NOT AVAILABLE AT MY WORKPLACE	N/A TO MY POSITION
Study leave (sabbatical)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Protected time for research	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Exchange or collaboration program	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Funding to attend conferences	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Paid parental leave	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Unpaid parental leave	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Return to work (after parental leave) assistance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Return to work part time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Childcare	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Long service leave	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Internal Research grant	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bridging funding	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Professional development program related to my work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Professional development program in a different area to my work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Time off to undertake or complete a qualification	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Leadership program	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mentoring program	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### 36 Have you have ever taken a period of 6 months or longer away from work anytime during your career?

- ☐ yes  
☐ no

Other (please specify)

### 37 How long was the break that you took?

- ☐ Up to one year  
☐ 1 – 2 years  
☐ 2 – 5 years  
☐ greater than 5 years

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### 38 Which best describes your return to work after the break?

- ☐ I returned to the same position, full time
- ☐ I returned to the same position and became part time
- ☐ I returned to the same employer but to a different position – full time
- ☐ I returned to the same employer but to a different position – part time
- ☐ I did not return to my position, I returned later to a different employer – full time
- ☐ I did not return to my position, I returned later to a different employer – part time

Other (please specify)

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### 39 When you first started at your current workplace were you given lab/office space?

- ☐ N/A to my position
- ☐ No
- ☐ Yes the same space I have now
- ☐ Yes but I have less space now
- ☐ Yes and I have more space now

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### 40 When you first started in your current workplace, were you given access to the equipment and resources that you needed to do your research?

- ☐ Yes I was given access to all the equipment and resources I needed
- ☐ Yes I was given access to some of the equipment and resources I needed
- ☐ No I was not given access to the equipment and resources I needed
- ☐ N/A to my position

Other (please specify)

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### 41 What are the key activities of your current position? Please identify up to 3

- ☐ Undertaking directed research
- ☐ Undertaking self directed research
- ☐ Managing research project/s
- ☐ Managing or supervising others
- ☐ Teaching
- ☐ Training/mentoring students and/or staff
- ☐ Providing professional advice/consultancy
- ☐ Employee relations including hiring and training
- ☐ Technical/laboratory support
- ☐ Process Improvement
- ☐ Financial management
- ☐ Administration
- ☐ Marketing

Other (please specify)

## 42 How important were the following factors to you in seeking your current position?

	VERY IMPORTANT	IMPORTANT	NEUTRAL	NOT IMPORTANT
Pay and conditions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Flexible hours	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Capacity for promotion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reputation of the workplace	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The position is in a field of scientific interest	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The position is in a field of my expertise	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Workplace location	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The type of work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The type of research	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify)				

## 43 How did you obtain your current position?

- ☐ By internal competitive appointment
- ☐ By external competitive appointment
- ☐ By internal direct appointment
- ☐ By external direct appointment

## 44 Thinking about your first position after graduation, what factors were important to you in seeking that position?

- ☐ Same as for current position
- ☐ Pay and conditions
- ☐ Field of scientific interest
- ☐ Flexible hours
- ☐ Location of workplace
- ☐ Reputation of workplace
- ☐ Type of work
- ☐ Capacity for promotion
- ☐ No other option available

Other (please specify)

## 45 In your opinion, how do you think your career has progressed compared to others with whom you completed your studies?

- ☐ I have progressed at the same level as others who qualified when I did
- ☐ I have progressed more quickly than others who qualified when I did
- ☐ I have progressed more slowly than others who qualified when I did

Other (please specify)

**46 To what extent do you think the following issues have been a factor in your career progress being slower than others?**

	A MAJOR FACTOR	A FACTOR	N/A	NOT A FACTOR
I am not ambitious in my career	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I have taken time out for family reasons	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I have taken time out for other reasons	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The field of science I have chosen	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Disruptions due to funding	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inappropriate choice of employer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Not feeling prepared or ready to apply for promotions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I have taken a direction change in my career	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My research productivity is low compared to others	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify)				

**47 In the last five years how many times have you applied for, and been successful in obtaining promotion or appointment to a higher level job?**

**48 In the last five years have you been mentored in a formal mentoring scheme in your workplace or through a professional society?**

- ☐ Yes through a professional society
- ☐ Yes in my current workplace
- ☐ Yes as part of my work, but in another workplace
- ☐ No

Other (please specify)

**49 How beneficial was the mentoring?**

- ☐ highly beneficial
- ☐ beneficial
- ☐ neutral
- ☐ not beneficial

**50 Was the person who mentored you the same gender as you?**

- ☐ yes
- ☐ no



## 51 To what extent have the following been helpful or problematic to your career advancement?

	VERY HELPFUL	HELPFUL	NEITHER HELPFUL NOR A PROBLEM	A PROBLEM	A MAJOR PROBLEM
Being geographically mobile	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Level of support from supervisor/manager in applying for promotion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Time away from work due to family care responsibilities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My partner's career	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Guidance received in performance reviews	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Opportunities for professional development	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Opportunities to undertake/complete qualifications	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Access to research funding	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The attitude within my workplace towards people of my age	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The attitude within my workplace towards people of my gender	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The attitude within my workplace towards people of my ethnic background	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Informal mentoring	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My level of confidence in my ability	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The current economic conditions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify)					

## 52 If there was one factor you could change that would make a major difference to your levels of job satisfaction what would it be?

- ☐ Improved working hours
- ☐ More protected time for research
- ☐ Improved leave provisions
- ☐ Improved institutional/organisational culture
- ☐ Improved promotional opportunities
- ☐ Better pay
- ☐ Improved job security
- ☐ None of these I am very satisfied with my current job

### 53 To what extent do you agree or disagree with the following statements?

	STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE
I have career mobility between my current place of employment and other employers within my field of science	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I would like to remain in my current place of employment for the rest of my career	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I would like to remain in science for the rest of my career	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I am satisfied with the career opportunities I have with my current employer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I am satisfied with the career opportunities I have within my field of science	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I would move interstate or overseas to advance my career	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I intend to seek a career change in the next 5 years	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### 54 What factors do you rank as being most important for having a successful career in science research?

	VERY IMPORTANT	IMPORTANT	NEITHER IMPORTANT NOR UNIMPORTANT	NOT IMPORTANT
Having a PhD	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Having a PhD from a leading university	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Having good connections and networks and knowing the right people	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Joining the right professional societies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Being good at your work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Projecting a positive image at work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Conforming to organisational goals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Working long hours	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gender	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Having a supportive partner	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Being from the right social background	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Being from the right ethnic background	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A good track record	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify)				

### 55 Do you work as part of a research team?

- ☐ Yes
- ☐ No

Other (please specify)

## 56 Who comprises your primary research team? (please indicate all that apply)

- ☐ More senior staff than you
- ☐ More junior staff than you
- ☐ Other research/technical staff
- ☐ Post docs
- ☐ Graduate students
- ☐ Administrative assistant

Other (please specify)

## 57 To what extent do you agree with the following statements about your current job?

	STRONGLY AGREE	AGREE	NEUTRAL OR N/A	DISAGREE	STRONGLY DISAGREE
I am confident my work/contributions are valued by my employer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My overall workload is reasonable and manageable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Overall I have a good work/life balance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I'm confident I can get research grants	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I'm confident I can publish in good journals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Levels of grant funding are adequate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Overall I find my work rewarding	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I have good career or promotion opportunities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I have an unreasonable amount of administrative work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I have good job security	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I have freedom to pursue my own research interests	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My job is a source of considerable personal stress	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
This is not a good time for a young person to aspire to a career in my field	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Generally speaking I am satisfied with my job	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I have adequate equipment and resources to do my job	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I am satisfied with my level of income	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## 58 What is the most rewarding aspect about your current position?

## 59 What is the least rewarding aspect of your current position?

## 60 Thinking about your current workplace to what extent are you satisfied with the following?

	VERY SATISFIED	SATISFIED	NEUTRAL	UNSATISFIED	HIGHLY DISATISFIED
The criteria for promotion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The culture of my workplace	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The leadership and management of my workplace	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Opportunities for attending conferences and study leave	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Support for career development/professional development	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Level of resources and equipment to do my job	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Flexibility of working hours	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## 61 Within the last five years have you considered any major career or position changes?

- ☐ No I have not considered any major changes in my job  
☐ Yes, to take another position in the same field of science within Australia  
☐ Yes, to take another position in the same field of science overseas  
☐ Yes, to move to a different position within my field such as management/academia/industry  
☐ Yes, to move to work outside of science altogether  
☐ Yes, to retire

## 62 Did you take any concrete action to make such changes?

- ☐ No  
☐ Yes I applied for another position in the same field in Australia  
☐ Yes I applied for another position in the same field overseas  
☐ Yes I applied for a different position within my field (eg to move to management)  
☐ Yes I applied for a position outside of science  
☐ Yes I plan to retire within the next five years

Other (please specify)

## 63 Where would you like to be in 5 years time and where do you expect to be?

	In my current role and position	In a higher level role same workplace	Similar role different workplace	Similar role and field overseas	In a management role	Not working in science; working elsewhere	Retired/ not working
I would like to be in 5 years time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I expect to be in 5 years time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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**64 Were you born in Australia?**

- ☐ Yes  
☐ No

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**65 In what country did you obtain your highest academic qualification?**

- ☐ Australia  
☐ USA  
☐ UK  
☐ Europe  
☐ China  
☐ India

Other (please specify)

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**66 Do you live with a partner or spouse?**

- ☐ Yes  
☐ No

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**67 What best describes your partner/spouse's employment status?**

- ☐ My partner works full time in science  
☐ My partner works part time in science  
☐ My partner works full time in another sector  
☐ My partner works part time in another sector  
☐ My partner is retired or not employed

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**68 Do you have any children under 18 living at home with you?**

- ☐ Yes  
☐ No

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**69 Who is mainly responsible for the care of these children?**

- ☐ I am  
☐ My partner is  
☐ We share the care equally

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**70 How long do you estimate you have had primary carer responsibilities?**

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**71 Are you responsible for the care of any adult due to their ill-health, age or disability?**

- ☐ Yes  
☐ No

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**72 Do you have a long term health condition or disability that restricts you in your every day activities and has lasted, or is likely to last at least 6 months?**

- ☐ Yes  
☐ No

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**73 Is there anything you would like to add that you feel has not been covered in the survey?**

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**74 If you would be willing to participate in a focus group, or interview, as part of this research – to follow up some of the themes and issues that emerge from the survey – please enter your contact email here:**



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