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**Citation:**

Barnacle, R, Cuthbert, D and Laurie, R 2016, 'Exploring researcher motivation: Implications for PhD education' in Deane E. Neubauer and Prompilai Buasuwan (ed.) *Asia Pacific Graduate Education: Comparative Policies and Regional Developments*, Palgrave Macmillan, New York, United States, pp. 199-215.

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Version: Accepted Manuscript

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## **Chapter 12**

### **Exploring Researcher Motivation: Implications for PhD Education**

Robyn Barnacle, Denise Cuthbert, and Richard Laurie

#### *Introduction*

As Cuthbert and Molla (2015, 33) argue, “[c]ontemporary higher education (HE) systems function within a political context of high optimism about the transformative potential of knowledge for individuals and for national economies.” “Knowledge economy optimism” is prevalent across Europe, North America, South East Asia, and China, as well as Australasia. Higher education, and more specifically, research and its potential for innovation, are ubiquitously positioned as the drivers of future economic and social prosperity. As is shown by a recent Organization for Economic Cooperation and Development (OECD) report, doctoral graduates are considered central to this endeavor given that they are trained specifically in research with the explicit aim of most national governments of building innovative and competitive economies (Auriol, Schaaper, and Felix 2012). Such policy assumptions are predicated on PhD programs capable of producing graduates both willing and able to drive innovation and social and economic advancement. In Australia, this is reflected in the now-firmly established conception of PhD education as “research training,” clearly echoing a labor market preoccupation. But to what extent do PhD candidates and graduates share—or participate—in such policy visions? This chapter explores this issue through a focus on researcher motivations.

The issue of researcher motivation is an important one for various reasons. Research training requires a significant investment of both public and private resources—financial, human, and technical. Retaining graduates as productive members of a research labor force is

critical to this investment. However, evidence suggests highly trained researchers are exiting research in some areas due to cultural, gender, and other issues (Royal Society of Chemistry 2008a; 2008b; Dever et al. 2008; Hakala 2009). The “abandoning science” confessional is an emerging genre on academic blog sites and in the press (Academic Anonymous 2014; Stein 2014; Teytelman 2014). Two recent studies conducted by the Royal Society of Chemistry on the career intentions of chemistry PhD candidates in the United Kingdom (UK) provide evidence of cultural factors in science souring the aspirations of early career researchers (Royal Society of Chemistry 2008a; 2008b). These studies found that while in the first year of their PhDs the majority of candidates envisaged a research career, by the final year about half had changed their minds and decided to abandon research in chemistry. The authors argue that science itself is often to blame for this, due to its structures, cultures, environment, and norms of practice. Contrary to what we might assume to be a key objective of PhD programs, candidates’ actual experience of science can act as a major deterrent to pursuing a scientific research career upon completion. In addition to the questions this raises about the cultures of research in some disciplines, the scale of disenchantment and withdrawal raises questions about the nature and sustainability of researchers’ expectations and motivations.

Ensuring successful doctoral completion rates is one issue that has received sustained interest from scholars over many years. Initiated by Bowen and Rudenstine’s (1992) landmark study, concern and interest in the factors that enable strong and timely PhD degree completions have continued under increased political scrutiny by governments, including the Australian government, seeking greater returns from their research training investments (Rodwell and Neumann 2008). Fewer studies, however, have examined the role of the doctorate in preparing graduates for a research career post-completion (Sinclair, Barnacle, and Cuthbert 2013) and factors that might influence attrition from research in post-doctoral

populations. Understanding researcher motivations and whether such motivations are sustainable may provide one clue to the factors, which lead to successful research careers.

The findings presented in this chapter—while preliminary—seek to contribute to a better understanding of these under-researched issues. The cohort of successful mid-career researchers included in the study has successfully traversed the perilous journey through the doctorate into the postdoctoral phase and, maintaining research productivity, on to successful mid-career researcher status. As such, while far from a typical population of doctoral graduates or mid-career academics, their reflections on their experiences provide valuable insights into the suite of motivations that have sustained them. While we do not know the extent to which respondents’ motivations may have changed since the doctorate, the findings suggest that researchers are motivated by a variety of factors—particularly personal curiosity and lifestyle benefits but also enjoyment of the *processes* involved in their area of enquiry to more altruistic motivations to do with “making a difference” and improving the lives of others. By providing a snap-shot of researcher motivations at the critical mid-career phase, the findings provide insight into the motivations of successful researchers with implications for those involved in the delivery of PhD education.

### ***Personal Factors in Researcher Development and Motivation***

Given the prominence in our findings of personal motivations to do research, we are interested in the extent to which personal motivations are recognized in the existing literature on researcher development and motivations. As has been argued elsewhere by Barnacle and Cuthbert (see Sinclair, Barnacle, and Cuthbert 2013), the great majority of productivity literature tends to focus on external drivers in researcher success rather than intrinsic or internal motivators. One area that has sustained considerable attention is that of motivations

to do a PhD. Of these motivations, the role of the personal—personal development/satisfaction and interest in a particular topic—are widely documented (Leonard et al. 2005; Dever et al. 2008; Brailsford 2010; Mokhtar 2012; Guerin et al. 2014). By distinction, relatively few studies examine the factors influencing successful researcher careers post-doctoral completion. In particular, there is little research on what factors ensure the necessary appetite and skills to pursue and succeed in research post-graduation.

A recent study undertaken by Brew, Boud, and Namgung (2011), highlights the importance of the doctorate in forming active researchers, although it also makes the point that many graduates do not feel the doctorate provides adequate preparation for a research career. This finding is at variance with the findings of our study (see: Sinclair, Barnacle, and Cuthbert 2013) and points to a salient difference between our high-performing sample and more general post-doctoral populations. Numerous other studies focus on research productivity during and/or following doctoral completion (Grove and Wu 2007; Kim and Karau 2010; Chung and Petrick 2011). A related body of work focuses on academic and researcher identity formation and development (Archer 2008; Elizabeth and Grant 2013). This work demonstrates increasing recognition that to understand researchers' development requires looking at the early career phase, including the doctoral phase, with associated formative and identity challenges. Another factor that has been touched on by a range of studies is the role of emotional engagement and pleasure in the formation of active researchers, although less attention has been directed to this topic than to extrinsic research drivers. Explorations of the affective dimensions of research include those by Gardner (2009) and Turner and McAlpine (2011), who refer to the excitement, pleasure, and sense of emotional engagement and creativity that some associate with research. Other studies also hint at the pleasures of and emotional engagement with research, the role of passion, joy, and the thrill of producing new ideas (Akerlind 2008; McAlpine and Amundsen 2009). It is

perhaps no surprise, then, that emotional factors contribute to researcher motivation. We now turn to findings from our study of successful mid-career researchers to show how these factors manifest in the motivations of successful mid-career researchers.

### *About the Study*

In 2008, the Australian Research Council (ARC) awarded the first of five rounds of Future Fellowships to “promote research in areas of critical national importance” by giving outstanding researchers incentives to conduct their research in Australia. Despite earlier uncertainty, the Australian Government announced in its May 2014 budget that the scheme would continue albeit with a reduced number of supported projects. As the ARC stated on its website, September 24, 2014, the Future Fellowship Scheme aims is to attract and retain “the best and brightest mid-career researchers” (ARC 2013). Over the period 2009–2013 close to 1,000 Future Fellowships were awarded to outstanding mid-career researchers. The Future Fellow scheme reflects the nation building aspirations of the prevailing knowledge economy discourses: it aims to recruit to, or retain in, Australia highly productive mid-career researchers who will tackle research of national importance. Ostensibly at least, it is biased towards researchers “who can demonstrate a capacity to build collaboration across industry and/or research institutions and/or with other disciplines.”

Our pilot study of Future Fellows was designed to elicit data on the relationship between the doctoral experiences of this population of productive mid-career researchers and their research productivity and on their dispositions and motivations to do research. Contact details of Future Fellow recipients were obtained by accessing publicly available information from the ARC and university websites. The study was approved by the RMIT University Human Research Ethics Committee in 2012. The threshold for research success and

productivity was determined by the ARC and its assessors in selecting this group of awardees who comprise, in the ARC's terms, the "best and brightest" mid-career researchers in Australian and internationally.

### *Method*

The pilot study comprised an online survey containing 20 multiple-choice and five open-ended questions. Additionally, five of the multiple-choice questions allowed for alternative open-ended responses. This chapter focuses on responses to this survey question: "*Please briefly elaborate on your key motivations for doing research and seeking to disseminate it through publications and other means.*" It should be noted that this question asks respondents to comment on their motivations for both doing research *and* its dissemination as we are interested in how the two may be connected. We have chosen to focus on responses to this single question so as to report rich, qualitative descriptions concerning researcher motivations. Our view is that while these results are only preliminary, they can nonetheless offer insights with the potential to open new lines of enquiry.

Responses to this question were coded according to three key demographic variables: gender, ARC discipline grouping, and the awarding institution of the respondents' PhD (see Table 11.1) and then analyzed using an interpretative framework to identify emerging themes, which were then refined through a process of iteration into broad thematic categories. To assist integrity, this process was duplicated independently by two researchers neither of whom had access to gender, subject group, or doctorate university information.

Insert Table 11.1 About Here

### *About the Sample*

Of the 403 Future Fellows who returned the survey 330 (82 percent) responded to this question. As mentioned above, respondents were coded for later cross-analysis (see Table 11.1.). Forty three percent of respondents were under 40 years of age and 49 percent were between 41 and 50. This profile reflects the intention of the scheme to identify and support younger, mid-career academics. Most (61 percent) finished their PhDs when they were under 30 and 56 percent completed their doctorates since 2001.

Reflecting Australian government research priorities since the 1990s, most of the sample was drawn from the natural and physical sciences: 311 (77 percent) of the sample worked in the natural, biological or physical sciences, while 92 (23 percent) worked in the social sciences and humanities. The fields most represented included biological sciences (18 percent of natural science fields), physical sciences (14 percent), and medical sciences (11 percent). The majority of our sample graduated from elite research intensive universities in Australia or at overseas universities (78 percent in total). Almost half of all respondents (181 or 45 percent) were awarded PhDs from “Group of 8” Australian research-intensive universities and a further third of the cohort (137 or 33 percent) graduated from non-Australian universities. The remaining respondents (85 or 21 percent) were awarded PhDs from a pool of 21 other Australian universities. These include more applied—or self-designated “real world” focused—universities such as those belonging to the Australian Technological Network. In terms of gender, 247 (61 percent) of the sample were men, and 156 (39 percent) women. Women were slightly over-represented in our sample relative to the population of Future Fellows, given that in each of the five years of the scheme roughly 69 percent of the awards went to men and 31 percent to women. Our sample is broadly representative of the entire Future Fellow population on the other variables.



## Overview of Findings

Respondent motivations were categorized as belonging to one or more of the following three major themes:

1. Personal
2. Outcome
3. Process

Table 11.2 shows the proportion of responses identified as representing, either wholly or in part, each theme. The majority of individual responses were identified as reflecting more than one theme. In these cases each theme was counted. A “personal” motivation was identified in 66 percent of responses. An “outcome” motivation featured in 57 percent of responses. Finally, 55 percent of responses addressed “process” related motivations. We will now explore each theme in turn.

Insert Table 11.2 About Here

### *Personal (Intrinsic Motivation)*

Comments categorized as personal are those that emphasize the pleasure and personal fulfillment of doing research, disseminating results, and being a researcher. Curiosity, enjoyment, enthusiasm, love of subject, “the need to know,” and freedom of lifestyle were common words or expressions in these responses. For example, self-fulfillment can be achieved by satisfying curiosity or stimulating intellect:

- “I do research because I find it intellectually stimulating and personally fulfilling.” (MPO).

This perspective is echoed in these responses:

- “Picking a question and answering it, is immensely satisfying. Perhaps in the same way it is satisfying to complete a crossword puzzle” (FB8).
- “Mostly I just enjoy the intellectual challenge, and I find the subject matter very interesting” (MP8).
- “I do research to seek beauty in mathematics. I publish for personal satisfaction, and because it is essential for my career, which means that I can continue doing what I love” (MP8).

The personal fulfillment of doing research can also be linked to the lifestyle benefits of being a researcher:

- “I enjoy the independence and freedom to pursue issues that interest me” (FB8).
- “I do research because I enjoy the intellectual challenge, and the associated lifestyle” (MBO).
- “I like the lifestyle and associating with people with similar interests” (MBO).
- “To achieve success in an academic career: job security, good lifestyle, job satisfaction” (MB8).

The personal drive to research is sometimes expressed as a need almost beyond the control of the respondent—almost pre-destined, as here:

- “I’m not sure I do this by choice—research is an obsession, it’s just how we’re wired” (MPO).

- “I am driven to do research not because it is my job to do so (which it is) but because it is part of who I am to do so” (MHO).

Outcomes of research (beyond the personal), if they are mentioned in this category, are described not as ends in themselves (which we will see in the outcomes category explored next) but in relation to personal fulfillment, as here:

- “Long after all around me are dead and forgotten, you'll be able to look up my papers and see what I did” (MB8).
- “Peer recognition of my work (to be ‘famous’ for something)” (MB8).
- “I oscillate between being motivated by curiosity and being motivated primarily by career advancement/peer recognition” (FBO).

Outcomes may also appear in this category as unfortunate or necessary hurdles and by-products of the research process:

- Writing things down in publications is a necessary requirement that enables you to continue doing research, but it is not my favorite past-time” (MBO).
- “The main driving factor is still personal curiosity. Publishing regularly is necessary for promotion and career advancement” (MPO).
- Or as a bonus, “Basically, the tougher a challenge in research, the more motivated I get in researching the problem, irrespective of its potential impact on society and irrespective of the ability to publish the results. However, both publication and impact are big bonuses and I view them like one thinks of dessert at the end of a very tasty dinner” (MP8).

Notably, all of the above responses are characterized by recurrence of first-person singular pronouns: I, me and my. This is often absent in the next category.

### *Outcome (Extrinsic Motivations)*

In contrast to the sorts of comments in the personal category, comments categorized as outcome-related emphasized the role of research in contributing to knowledge advancement, identifying problems, finding solutions, “making a difference,” and directly improving peoples’ lives. To paraphrase John F. Kennedy, it could be said that outcome-driven respondents ask not what research can do for them but rather what they can do for research (or what they can do for others through their research). In this sense, the motivational direction of outcome is extrinsic. This orientation beyond the self was often signaled by the absence of reference to self and self-fulfillment in the choice of language. This is in stark contrast to the ‘I’ focus of the personal responses. For example:

- “Key motivation is to understand new things that could help others lives” (MBA).
- “Improving outcomes for stroke patients” (FBO).
- “To make a difference, and to identify the solution” (MBO).
- “Making a difference to the lives of individuals. Many separated parents often make contact with me, and use my research” (MHA).
- “Conducting research that makes a difference to the next generation is critical” (FBA).
- “My research has been strongly motivated by social justice objectives, particularly reducing health inequalities” (FHA).

Outcome related motivations not only focus on the direct benefits of research on the public, they also encompass motivations aimed at advancing the stock of human knowledge:

- “I do research to produce answers to key questions affecting people's health. By publishing my findings, I seek to move the science forward, and promote robust scientific discussion about what the findings mean” (MB8).
- “I have always conducted research with a clinical focus. I publish primarily to advance theoretical understanding of different clinical symptoms so as to ultimately inform the design of new psychological treatments” (FBA).

Outcome related comments also include recognition that outcomes are not always immediate or, indeed, clear. For example:

- “I really hope that it will one day be useful—and I do try to work on meaningful problems—but because I work on fairly fundamental research, it is hard to know exactly how it will be applied in the future, and how significant it will turn out to be” (MP8).
- “The usefulness of the present research is not always clear. I see the research process as part of a larger common movement, driven by the research community. Each publication, even if the application is not always clear, contributes to the overall movement” (MPO).
- “We do public funded research and the fruits should reach the public. (Fruits need not be a product or applied research, but just plain knowledge.)”

*Process (Intrinsic/Extrinsic Motivations)*

Motivations categorized as Process related emphasize the *what* and *how* of the research rather than the *who* (personal) and *why* (outcome). The focus here is on teamwork, collaboration, testing and exploring ideas, mentoring, teaching, and presenting results. Process motivated responses were often couched in affective terms: the joy of discovery or the satisfaction of completing a project:

- “the intellectual stimulation of thinking, writing papers, pushing forward with ideas, then grant writing, the competitive nature of this, fed by successes in getting grants, publishing papers . . . etc.” (FB8).

Motivation drawn from the processes and stages of research is evident in these responses:

- “I appreciate the ability to complete a project or series of experiments to a stage where it is a publishable body of work” (MB8).
- “I enjoy coming up with new ways to make measurements and advance understanding of how plants interact with the environment” (FB8).

Participants expressing Process-driven motivations also valued collaboration, mentoring, and teamwork as here:

- “. . . I get satisfaction from achieving this, as an individual and as a team . . . ” (MB8).
- “. . . enjoy doing research from fieldwork through to lab work through to completion of publications. [also] enjoy knowing that other researchers read your publications/attend and listen to conference presentations etc.” (FB8).
- “I really enjoy being an academic, undertaking research, writing and research-led teaching. I feel privileged to have the autonomy and opportunity to explore the world

of ideas and practice in my field. I particularly enjoy both national and international research collaborations as part of this exploration” (FHO).

- “. . . research in my field is dominated by colleagues that are very positive and collaborative. Students are equally there because they want to make a difference. It is great to link “good ideas that need to be addressed” with methodological ideas that allow us to tackle them” (MBA).

### *Combined Themes*

Of the total of 330 responses, 230 (70 percent) were classified as encompassing elements of more than one theme. The largest proportion of this multiple themes group were those designated as combining *personal and process* motivations. This represented 42 percent of responses. This is significantly more (by 11 percent) than those exhibiting *personal and outcome* motivations (31 percent).

### *Discussion*

These results suggest that the motivations of successful mid-career researchers may be understood as either personal, process, or outcome related, or a combination thereof. Motivations, therefore, can be said to encompass the “who” (personal), the “what/how” (process), or the “why” (outcomes). These correspond to a continuum, from motivations that are largely self-oriented on the one hand (personal) to those that are largely altruistic on the other (outcomes). The transitive nature of outcome oriented motivations means that the driver to do research and any pleasure derived from the process is attributable to a purpose that lies beyond the self. Interestingly, many of the outcome oriented comments were self-effacing in

the sense that self-fulfillment did not seem to factor at all. By contrast, some of the personal motivations are entirely self-directed. The combined comments—in which personal, process, and outcome related motivations coalesce—demonstrate that personal fulfillment in the narrow sense can coexist with a more expansive, transitive view such that satisfaction can arise through both self-fulfillment and fulfillment of the needs of others.

In our view the most striking finding is the large proportion of respondents—43 percent—who expressed their key motivations to do and disseminate research without including consideration of the outcomes of research. When reflecting on this finding it is important to keep in mind that respondents were asked to comment on *their* motivations for doing research and publishing it—not on what they consider to be the role and purpose of science. This latter question, if asked, may have generated different responses. It might be argued, then, that the form of the question itself encouraged a personalized response. While this is plausible—and it would certainly be worthwhile probing this more deeply through interviews, for example—in some respects it only serves to make the contrast in responses more interesting. To put it another way, given the emphasis placed by the question on the researchers' *own* motivations, the fact that some researchers' motivations encompass outcomes beyond themselves and others do not is worthy of further investigation. It should also be noted that while 43 percent of respondents did not refer to the outcomes of their work as a key motivating factor for their research, this does not mean that such considerations do not matter at all—they are just not a *key* motivator. It would be worthwhile fleshing this out further through follow-up interviews. We also have no data on if or how this lack of outcome-related motivation actually impacts on research outcomes. Nor do we have data on whether those researchers who expressed outcome-related motivations actually achieve such impacts through their research. Both issues are worthy of further enquiry.



With these cautionary notes sounded, a dramatic contrast in motivations remains, raising the question of why such a significant proportion of awardees of a national, flagship research-impact oriented funding scheme express their key motivation to undertake research with no reference to the value or significance of the outcomes of that research. It should be remembered that responses categorized as “outcome related” not only focus on the direct contribution of research to a public good, they also include motivations aimed at advancing knowledge. While personal motivations are clearly not an obstacle to mid-career research success (our sample are all Future Fellows), given the substantial public investment in research and research education, should we expect to see a greater emphasis from this cohort on the *results* of research? The objectives of the scheme itself are clearly oriented toward knowledge transfer. In the words of the initial consultation paper, the objectives of the scheme are to support research in areas of: “. . . national priority across all disciplines that *will result in economic, environmental, social, health, or cultural benefits for Australia*” (Carr 2013, 4, emphasis added). There is little evidence from the findings of our study that these somewhat instrumental aims resonate in the motivations of many researchers. This may not be terribly surprising given the scarcity of research funding. While this is only conjecture, it may be that researchers will apply for any source of funds—even if not entirely consistent with their research aims. This raises the question, of course, of whether motivations have a role to play in research outcomes. It may be the case that it doesn’t matter: that as long as there *is* motivation, the characteristics of that motivation are irrelevant.

While finding an answer to this question is beyond the scope of this chapter, assessments of Australia’s research and innovation systems suggest that motivations do matter. These assessments point to systemic factors inhibiting the translation of research into public benefits. A recent report by the Australian Academy of Science (AAS), for

example, identifies some of the prohibitive effects of the way researchers are rewarded, both in terms of career advancement and research profile (AAS 2014). In the Australian higher education system, as with many elsewhere, peer-reviewed publication history and competitive grant success form the basis of career advancement opportunities. This leaves little incentive for researchers to pursue research translation activities, which are both time consuming and under-recognized in research reward systems.

Our findings are consistent with this assessment. Whether in response to the lack of incentives for research translation, or as an additional factor which compounds this lack, our findings suggest that many researchers are focused on (and in many cases excited by) the internal processes of research as these lead to sustainable research careers and career progression: in short, the opportunity to do more research. While our findings suggest that satisfaction with the processes and practices of research as ends in themselves is sufficient for many researchers to maintain motivation, evidence of “abandoning science” type confessions in the literature certainly suggest that frustration with lack of incentives for research translation has led some to leave research careers to tackle “real world” problems in other career paths (Teytelman 2014).

### *Conclusion*

This chapter has sought to raise the issue of researcher motivations as one worthy of greater attention. The findings presented here, although preliminary, highlight a wide variation in researcher motivation as well as potential tensions between what motivates researchers and the expectations of research funding agencies. This has relevance for PhD programs concerned with the motivations they are hoping to instill in graduates that might be conducive to successful research careers post-graduation.

The increasing instrumentalism of research policy has implications for research education and researcher development more broadly. It also stands in stark contrast to the vastly more personal motivations that drive many researchers. It is not that self-fulfillment should be absent from researcher motivation. Competition between researchers for prestige and success can be highly productive as James Watson's own account of the discovery of the double helix testifies (2001). Individual researchers wanting to be "the first"—to identify the structure of DNA, for example—can lead to great advances in science. Similarly, a narrow, instrumental conception of research does not necessarily serve the interest of science or the broader community either. Nor does it seem that highly instrumental conceptions of research resonate with many researchers, and this may have implications for researcher retention. If a rich suite of motivations is desirable in researchers, incorporating both personal and more altruistic elements, then the issue of researcher motivation is an important one for PhD programs to consider. Some questions that might be addressed include: what role PhD education plays in developing researcher motivations and understandings of the role and purpose of research; whether and why researcher motivations change; what role, if any, the research environment and organizational context might play in the formation of researcher motivations and, finally; what relationship there might be, if any, between research motivations and the outcomes of research?

## References

- Academics Anonymous. 2014. "Why I'm leaving academia." *The Guardian*, May 10, 2014.  
Available online at: <http://www.theguardian.com/higher-education-network/blog/2014/may/01/academic-anonymous-leaving-academia>
- Akerlind, G. 2008. "An academic perspective on research and being a researcher: an integration of the literature." *Studies in Higher Education* 33: 17–31.
- Archer, L. 2008. "Younger academics' constructions of 'authenticity', 'success,' and professional identity." *Studies in Higher Education* 33: 38-403.
- Auriol, L., M. Schaaper, and B. Felix. 2012. *Mapping Careers and Mobility of Doctorate Holders: Draft Guidelines, Model Questionnaire and Indicators—Third Edition*. OECD Science, Technology and Industry Working Papers, No. 2012/07. Paris: OECD Publishing.
- Australian Academy of Science (AAS). 2014. "Submission to the Senate economic references Committee inquiry into Australia's innovation system." Available online at:  
<http://www.science.org.au/sites/default/files/usercontent/australiasinnovationsysteminquiry.pdf>. Accessed: April 13, 2015.
- The Australian Research Council (ARC). 2013. "Evaluation of the Future Fellowships Funding Scheme 2013." Available online at:  
[http://www.arc.gov.au/pdf/FT%20Evaluation%20Report/FT\\_Evaluation\\_Report.pdf](http://www.arc.gov.au/pdf/FT%20Evaluation%20Report/FT_Evaluation_Report.pdf). Accessed: September 24, 2014.
- Bowen, W. and N. L. Rudenstine. 1992. *In Pursuit of the PhD*. Princeton: Princeton University Press.
- Brailsford, I. 2010. "Motives and aspirations for doctoral study: career, personal, and inter-

- personal factors in the decision to embark on a History PhD.” *International Journal of Doctoral Studies* 5: 15-27.
- Brew, A., D. Boud, and S. U. Namgung. 2011. “Influences on the formation of academics: the role of the doctorate and structured development opportunities.” *Studies in Continuing Education* 33: 51-66.
- Carr, K. 2013. *Future Fellowship Consultation Paper*. Available online at: [http://www.arc.gov.au/pdf/future\\_consultation.pdf](http://www.arc.gov.au/pdf/future_consultation.pdf). Accessed: September 24, 2014.
- Chung, J. Y. and J. Petrick. 2011. “Doctoral students’ research productivity: An analysis of publications in tourism and hospitality journals.” *Journal of Hospitality, Leisure, Sport & Tourism Education* 10: 63-71.
- Cuthbert, D. and T. Molla. 2015. “PhD crisis discourse: a critical approach to the framing of the problem and some Australian ‘solutions.’” *Higher Education* 69: 33–53.
- Dever, M., P. Boreham, M. Haynes, M. Kübler, W. Laffan, K. Behrens, and M. Western. 2008. *Gender Differences in Early Post-PhD Employment in Australian Universities: The influence of PhD Experience on Women's Academic Careers*. Brisbane: The University of Queensland Social Research Centre.
- Elizabeth, V. and B. M. Grant. 2013. “‘The spirit of research has changed’: reverberations from researcher identities in managerial times.” *Higher Education Research and Development* 32: 122-135.
- Gardner, S. K. 2009. “Conceptualizing success in doctoral education: Perspectives of faculty in seven disciplines.” *The Review of Higher Education* 32: 383-406.
- Grove, W. A. and S. Wu. 2007. “The search for economic talent: Doctoral completion and research productivity.” *The American Economic Review* 97: 506-11.
- Guerin, C., A. Jayatilaka, and D. Ranasinghe. 2014. “Why start a higher degree by research?”

- An exploratory factor analysis of motivations to undertake doctoral studies.” *Higher Education Research & Development* 34(1): 89-104. doi: 10.1080/07294360.2014.934663.
- Hakala, J. 2009. “The future of the academic calling? Junior researchers in the entrepreneurial university.” *Higher Education* 57: 173-90.
- Kim, K. and S. J. Karau. 2010. “Working environment and the research productivity of doctoral students in management.” *Journal of Education for Business* 85: 101-6.
- Leonard, D., R. Becker, and K. Coate. 2005. “To prove myself at the highest level: The benefits of doctoral study.” *Higher Education Research & Development* 24: 135-149.
- McAlpine, L. and C. Amundsen. 2009. “Identity and agency: Pleasures and collegiality among the challenges of the doctoral journey.” *Studies in Continuing Education* 31: 109-25.
- Mokhtar, M. 2012. “Intentions and expectations of female PhD students in engineering at one university in Malaysia.” *Procedia—Social and Behavioral Sciences* 56: 204–212.
- Rodwell, J. and R. Neumann. 2008. “Predictors of timely doctoral student completions by type of attendance: the utility of a pragmatic approach.” *Journal of Higher Education Policy and Management* 30(1): 65-76.
- Royal Society of Chemistry. 2008a. *Change of heart: Career intentions and the chemistry PhD*. London: Royal Society of Chemistry.
- \_\_\_\_\_. 2008b. *The chemistry PhD: The impact on women’s retention*. London: Royal Society of Chemistry.
- Sinclair, J., R. Barnacle, and D. Cuthbert. 2013. “How the doctorate contributes to the formation of active researchers: what the research tells us.” *Studies in Higher Education* 39: 1972-1986.

- Stein, S. 2014. "America's Top Young Scientists Warn Of Systemic Brain Drain: Colleagues 'Sort Of Disappear.'" *Huffington Post*, May 10, 2014. Available online at: [http://www.huffingtonpost.com/2014/04/16/science-brain-drain\\_n\\_5161295.html](http://www.huffingtonpost.com/2014/04/16/science-brain-drain_n_5161295.html). Accessed: September 25, 2014.
- Teytelman, L. 2014. "Goodbye Academia." *Yes, Another Science Blog*, February 14, 2014. Available online at: <http://anothersb.blogspot.com.au/2014/02/goodbye-academia.html>.
- Turner, G. and L. McAlpine. 2011. "Doctoral experience as researcher preparation: Activities, passion, status." *International Journal for Researcher Development* 2: 46-60.
- Watson, J. D. 2001. *The Double Helix: A Personal Account of the Discovery of the Structure of DNA*. Touchstone: New York.