Effective self-management for early career researchers in the natural sciences

Natalia Z. Bielczyk¶[1], Ayaka Ando*[2], AmanPreet Badhwar*[3,4], Chiara Caldinelli*[5], Mengxia Gao*[6], Amelie Haugg*[7,8], Leanna M. Hernandez*[9], Kaori Ito*[10], Dan Kessler*[11], Dan Lurie*[12], Meena M. Makary*[13,14,15], Aki Nikolaidis*[16], Michele Veldsman*[17,18], OHBM Student and Postdoc Special Interest Group

* denotes equal authorship

[1] Stichting Solaris Onderzoek en Ontwikkeling, Veldstraat 48, 6533CD Nijmegen, the Netherlands
[2] Department of Child and Adolescent Psychiatry, Centre for Psychosocial Medicine, University of Heidelberg, Blumenstrasse 8, 69115 Heidelberg, Germany
[3] Centre de Recherche de l'Institut Universitaire de Gériatrie de Montréal (CRIUGM), 4545 Queen Mary Rd, QC H3W 1W6 Quebec, Canada
[4] Université de Montréal, 2900 Edouard Montpetit Blvd, QC H3T 1J4 Montreal, Quebec, Canada
[5] Trinity College Institute of Neuroscience, Trinity College Dublin, Dublin 2, Ireland
[6] The State Key Laboratory of Brain and Cognitive Sciences, The University of Hong Kong, The Hong Kong Jockey Club Building for Interdisciplinary Research, 5 Sassoon Road, Hong Kong
[7] Department of Psychiatry, Psychotherapy and Psychosomatics, University of Zurich, Lenggstrasse 31, 8032 Zurich, Switzerland
[8] Zurich Neuroscience Center, University of Zurich and Swiss Federal Institute of Technology Zurich, Winterthurerstrasse 190, 8057 Zurich, Switzerland
[9] Department of Psychiatry and Biobehavioral Sciences, University of California, Los Angeles, 660 Charles E. Young Drive South, Los Angeles, CA 90095, USA
[10] Neural Plasticity and Neurorehabilitation Laboratory, University of Southern California, 2250 Alcazar Street, CSC 133, Los Angeles, CA 90089
[11] Departments of Statistics and Psychiatry, University of Michigan, Ann Arbor, Michigan, 48109, USA
[12] Department of Psychology, University of California, Berkeley, Berkeley, CA 94702, USA
[13] Department of Psychiatry, Yale University School of Medicine, 300 George St, New Haven, CT 06519, USA
[14] The John B. Pierce Laboratory, 290 Congress Ave, New Haven, CT 06519, USA
[15] Systems and Biomedical Engineering Department, Faculty of Engineering, Cairo University, Giza, 12613, Egypt
[16] Center for the Developing Brain, Child Mind Institute, 101 E 56th St, New York, NY 10022, USA
[17] Department of Experimental Psychology, University of Oxford, Woodstock Rd, OX2 6HG Oxford, UK
[18] The Florey Institute of Neuroscience and Mental Health, University of Melbourne, 30 Royal Parade, Parkville VIC 3052, Melbourne, Australia

¶ Correspondence: natalia.bielczyk@gmail.com (NB)

Note to readers:
This is a working paper for a project launched and managed by the members of the OHBM Student and Postdoc Special Interest Group (SP-SIG, www.ohbmtrainees.com), in collaboration with two guest early career researchers, Dan Kessler from University of Michigan and Daniel Lurie from University of Berkeley. We would like to further develop the manuscript before submitting this work for peer review. Therefore, to provide advice that can be generalizable to a wide variety of situations, demographics, and countries, we are seeking contributions from the OHBM community. We would like to welcome everyone willing to participate to join us and discuss this subject on the associated Google group: https://groups.google.com/forum/#!forum/effective-self-management-for-ecrs
The deadline for contributions is **March 7th, 2019, 23;59 CEST**.
All the questions with respect to this project can be directed to: ohbmtrainees@gmail.com

Abstract

Early career researchers (ECRs) in the natural sciences work in a high-stakes and individualistic environment. ECRs are afforded a great deal of autonomy, making it crucial to hone effective self-management skills in order to develop a successful research career. Although many factors beyond individual control can influence the professional and personal development of ECRs, we believe that there are steps ECRs can take to increase their chances for a successful research career. We undertook a group effort within the Organization for Human Brain Mapping in order to collect information to help ECRs in self-management. In this article, we covered topics such as taking charge of one's career development by goal setting and making one's own opportunities, managing your time properly, tips on taking care of oneself and surrounding oneself with positivity, recognizing and addressing bottlenecks in one's projects, growing one's network, mentoring and being mentored, and staying vigilant to opportunities outside science and keeping several doors open. The essence of this set of guidelines is that, in order to move forward in academia, one should (1) be mindful and understand themselves; (2) reach out to people and (3) never stop searching for new opportunities.

In this work, we also discussed alternative career trajectories for PhDs in the natural sciences. We believe that more attention should be dedicated to equalising chances for developing careers in academia and beyond. We also hope that more research studies on optimal conditions and strategies for both non-academic and academic career development will be conducted in the future.

Running Title:

Effective self-management for ECRs in natural sciences

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Introduction

Research environment in the natural sciences is ideally a wonderful workplace where researchers often have the opportunity to work with a group of driven and committed individuals. They can work on projects with a societal impact, share their work with other researchers, and have plenty of space and opportunities for self-development. Lab mates eventually become dear friends and international collaborations are forged at conferences in the most beautiful parts of the world. Yet, there are also significant challenges. Academia is highly competitive: the working hours at prestigious institutions are often long (Powell, 2016, Woolston, 2017), and the disparity between the number of new PhD graduates and available faculty positions has been estimated as 7:1 (Schillebeeckx, Maricque, & Lewis, 2013). Given such a high-stakes environment, it is no surprise that PhD candidates exhibit higher rates of depression and burnout than the overall population (Academic, 2014, Bernstein, 2015).

We dedicate this article to all *early career researchers* (ECRs) in the natural sciences (Griffiths, 2016). For the purposes of this article, we define an ECR as an individual pursuing academic research at a sub-tenure level. This definition does not depend on the position (e.g. undergraduate research assistant, assistant professor seeking tenure) or associated sectors (e.g. academia, industry, self-employment). Finding success in today's scientific environment places competing demands on ECRs. They are expected to produce high-quality scientific publications, while rapidly developing a broad skill-set in designing and conducting experiments, scientific writing, computer programming, public speaking, mentoring and scientific salesmanship. In times when reproducible science is of great concern, expectations for research skills in ECRs grow even higher (Poldrack, 2019). Journals expect higher power in scientific studies (and therefore, also bigger sample sizes), along with elevated standards for experimental pipelines—pre-registrations, making software available through open-access repositories etc. (Poldrack, 2019). Trying to navigate this landscape can easily become overwhelming and discouraging, especially given that a number of extenuating circumstances can appear during your career as a researcher. While in industry changing jobs may be perceived as a positive sign of initiative in self-development, changing environments at early stages of a scientific career is often frowned upon. This is true especially when it comes to breaking a PhD contract. Furthermore, luck has a major influence on scientific careers, both in major scientific discoveries (Orzel, 2017, Dunbar & Fugelsang, 2005), as well as in the impact of the scientific work (Sinatra, Wang, Deville, Song, & Barabási, 2016). Altogether, developing a career as an ECR can be a formidable challenge.

This article was initiated under the umbrella of the Organization for Human Brain Mapping (OHBM) Student and Postdoc Special Interest Group (further referred to as SP-SIG, www.ohbmtrainees.com). The goal of the SP-SIG is to empower ECRs and to provide them with tools and resources that can assist in developing fulfilling careers in academia and industry (Bielczyk et al., 2018). The purpose of this article is to provide general guidelines so that the reader can choose the recommendations fitting their personal experience, rather than implement all recommendations simultaneously. There are already several career advice-oriented resources for ECRs online (Czerniawski, 2017, Santiago-Lopez, 2019). In this article, we aim to expand on this topic and propose recommendations that ECRs in the natural sciences can use to positively influence their personal and career successes in academia and beyond. The recommendations presented in this article are largely drawn from the personal experiences of the authors but where possible, citations are given for relevant research studies.

The reason is that research on optimal conditions and strategies for career development, and achieving a general life happiness is an underrepresented topic. The most prominent example in this field is the famous longitudinal Dunedin Multidisciplinary Health and Development Study (Poulton, Moffitt, & Silva, 2015) in which 1,037 individuals born between April 1st, 1972 and March 31st, 1973 in Dunedin, New Zealand, have been tracked for over 40 years with respect to their mental health, cognition, cardiovascular risk, respiratory-, oral- health, sexual- and reproductive health and social

functioning. To date, the Dunedin study resulted in over 1,100 academic publications. One of the core findings from this study, is that *self-discipline* in children can best predict their overall life success in adult life, including health, wealth and prosocial behaviors (Moffitt et al., 2011).

The advice provided in this article is organized thematically in the sections that follow. Lastly, this article was written following guidelines listed in *Ten simple rules for collaboratively writing a multi-authored paper* (Frassl et al., 2018).

1 Take charge of your own career development

1.1 Set Clear Goals

Discover your passions and find a lifestyle that is motivating.

As Jim Rohn once famously said, '*If you don't design your own life plan, chances are you'll fall into someone else's plan. And guess what they have planned for you? Not much*' (Investivate, 2017). An effective way to take charge of your own career development, is to develop a clear vision of what one ultimately wants in life and work out a plan consisting of a number of small steps towards these ultimate goals (Sinek, 2011b; Howes, 2012). With this type of long-term perspective on one's career ambitions, it is far easier to view small failures and setbacks as lessons and growth opportunities toward ultimate goals. For example, a single "failed" project no longer seems like a significant setback when viewed from the perspective of a 40-year long career. Focusing on how this obstacle could inform the approach towards future projects could turn a "failed" project into a valuable learning lesson (Sinek, 2011, Doerr, 2018, Sinek, 2011). As such, long-term goals can generate an incredible amount of energy, excitement, and curiosity that can propel one's career forward. Also, be proactive: define your own strengths and weaknesses, and identify your personal limitations to develop a plan towards improvement.

Research suggests that while having long-term goals can improve performance in learning certain skills, e. g. foreign languages (Moeller, Theiler, & Wu, 2012), only those goals that are clearly defined are usually achieved (Goerg, 2015, Locke & Latham, 2006). Therefore, personal goals should be chosen with care. There are techniques for developing the right goals, e.g. S.M.A.R.T. approach, where S.M.A.R.T. stands for Specific, Measurable, Attainable, Relevant and Time-Bound (Raia, 1965, Grant, 2012, Fig. 1A). Furthermore, goals should be engaging, but on the other hand, putting too much (time) pressure on the goal can lead to elevated stress resulting in either making errors or procrastination, and result in suboptimal performance. This effect is known in psychology as the Yerkes-Dodson law (Yerkes & Dodson, 1908, Fig. 1B). Research also suggests that over-planning can have negative impact on mental health by imposing elevated pressure on success, and inducing work-life imbalance (Ordonez et al., 2009).

Also, as mentioned in the Introduction self-discipline has been found to be a crucial factor for success across multiple areas of life (Moffitt et al., 2011). Therefore, work on your self-motivation. There are dozens of classic books on self-motivation and improving efficiency at work (Tracy, 2001, Newport, 2016, Covey, 2013, Robbins, 1992). Life advice from iconic motivational talks focused on industry and business translates surprisingly well to academia as all these fields are also highly competitive.

1.2 Manage your time well

ECRs are bombarded with many responsibilities, each requiring time and effort. Extracurricular activities such as courses, workshops and involvement in associations and committees have an important didactic role. Yet, they also compete with the everyday research routine. Therefore, it is best to learn to prioritize, identify core skills to acquire and learn to say 'no'. Saying 'no' can be difficult. To make this choice easier, you can establish personal rules for when to say 'yes' and 'no' (for some guidelines, see Rojas, 2016, Mackay, 2017). Having long term goals can help you decide which tasks provide delayed gratification rather than instant but insignificant rewards. According to Dwight D. Eisenhower (Eisenhower, 1954, Mackay & Mackay, 2013, Fig. 1C), activities

can be divided along two dimensions: as important / not important and urgent / not urgent. While important and urgent tasks are prioritized, proper management of the important and non-urgent tasks is the real key to success, as they require commitment and careful scheduling - otherwise the urgent tasks will always win your attention. You should also learn to delegate tasks and collaborate with people who have different strengths from you - the more senior you become, the more you will need this skill.

Furthermore, following Parkinson's law (Parkinson, 1955), work expands to fill all the time available: the more time you allocate for a given task, the more time the task will take you. To complete projects in a timely manner and maintain focus throughout the day, consider implementing productivity strategies such as the pomodoro (Cocirillo, 2011; free apps implementing pomodoro are available, e.g. Time Out and Stretchly) or timeboxing technique (Pash & Trapani, 2011, Frankton, 2014). These two popular techniques are presented and compared in Fig. 1D.

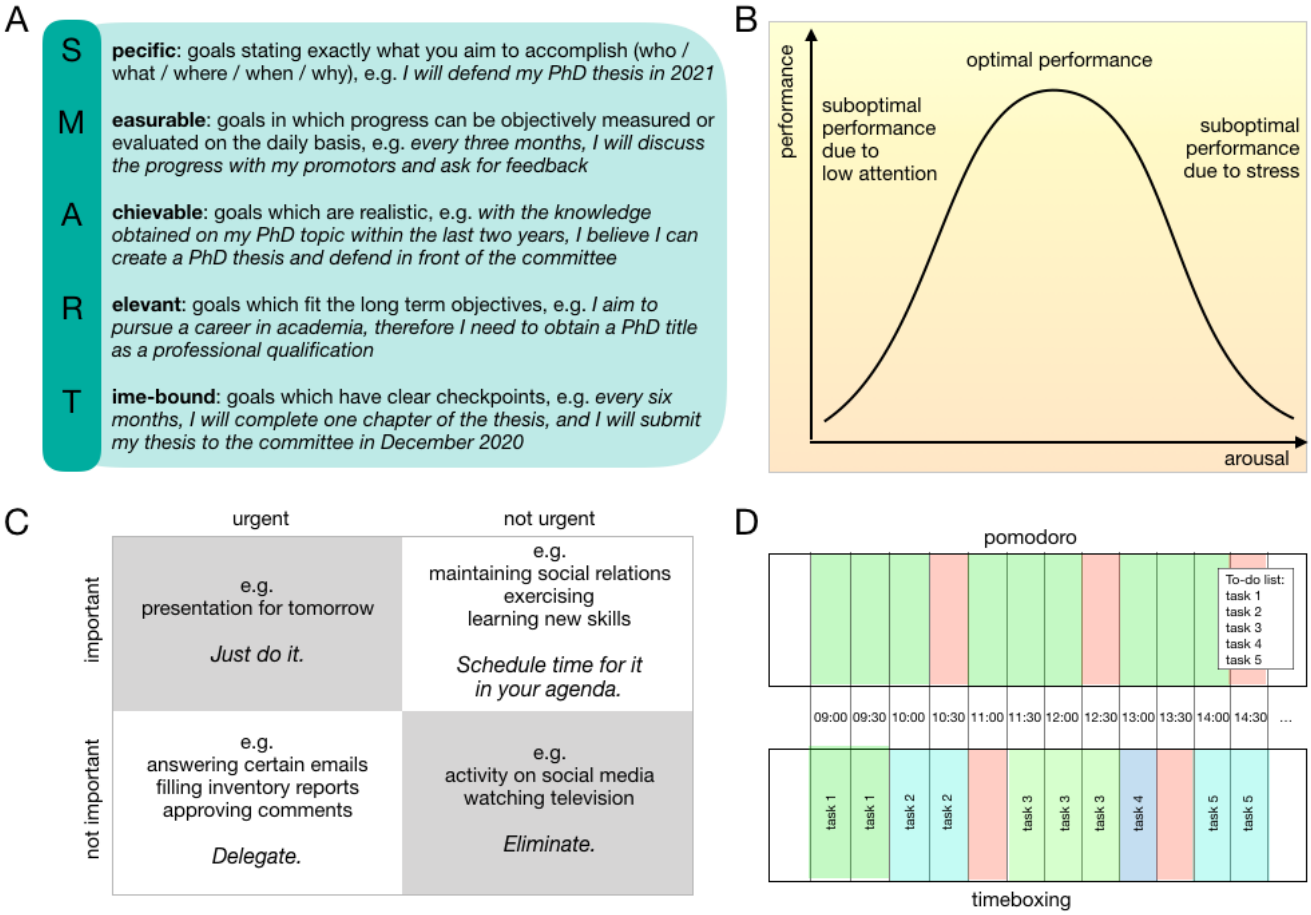

Figure 1 Several popular concepts in the domain of goal setting and time management. **A:** the S.M.A.R.T approach for setting personal goals (Raia, 1965, Grant, 2012), with examples. The goals should be Specific, Measurable, Achievable, Relevant and Time-bound. **B:** the Yerkes-Dodson law (Yerkes & Dodson, 1908): fulfilling goals requires attention, therefore low arousal leads to suboptimal performance. However, there is an optimum level of arousal over which performance decreases due to high levels of stress. If the goal is unrealistic (e.g., to graduate from a PhD within a year), the time pressure can lead to anxiety and subsequent procrastination. **C:** the Eisenhower chart for managing tasks (Eisenhower, 1954, Mackay & Mackay, 2013). Tasks can be divided into urgent versus not urgent tasks, and important versus not important tasks. The key to success in the long term is to properly manage important but not urgent tasks as one needs to actively find time for these tasks in the agenda, **D:** the pomodoro technique (Cocirillo, 2011) and timeboxing (Pash & Trapani, 2011, Frankton, 2014) for planning working time. In pomodoro technique, tasks are kept in lists and working time is pre-divided into periods of deep work (green) interleaved with breaks (red). In timeboxing technique, every task is given a precise slot; working on a given task precisely within the given frame is more important than completing the task. It is possible to combine these two techniques by setting regular time boxes for tasks and for the breaks between tasks.

1.3 Learn by doing

As Richard Branson once said, '*the best way of learning about anything is by doing*'. Many competencies can be acquired faster by learning-by-doing rather than by learning the theory,

including medical treatments, language acquisition or building electronic equipment (Reese, 2011). For example, many ECRs take a structured course dedicated to scientific writing to acquire this skill. While this is a good investment in professional skills, it can be beneficial to accompany such training by writing blog posts about your research topic, and asking for comments and edits from your peers and blog post readers. This approach allows you to learn the art of scientific writing in the doing (Silvia, 2007) while also demonstrating competence in conducting critical discussions on your research interests.

2 Take care of yourself

A feeling of helplessness and frustration at work can be caused by factors unrelated to your workplace. It is important to be mindful of your own well-being and discover your optimal working style: when are you most productive or most creative within a given day? What is your best sleep schedule? What type of diet makes you feel most energized? What makes you procrastinate (Donald, 2018)? Knowing your optimal work style can dramatically boost your productivity.

You might also consider celebrating mini successes to reward yourself for all the little steps on the way to major goals. Treat yourself to something you enjoy, whether a food, drink or activity, the important part is that you acknowledge your success. For instance, Dr. Melanie Stefan celebrates Ice Cream Day every time she submits a paper, a revision, has a paper accepted or published (Stefan, 2013).

Also, be mindful of your mental health: if for a prolonged period of time your mood stays low, you may benefit from therapy or counselling. Seeking professional help should not be shunned, but rather should be viewed as a healthy approach that can have a tremendous positive impact on career success and quality of life. Treat your mental health as you would treat your body: take good care of it, and go in for professional check-ups whenever you feel it is necessary. Typically, academic institutions offer mental health services to their employees. It is a good idea to find information about these opportunities early, keep it at hand and use whenever needed.

3 Find a positive circle of influence

Your circle of friends and coworkers highly influences your personal success (Ong, 2013; Stulberg, 2017; Otremba, 2016). Try to surround yourself with people who have a positive influence on you and your research; people you can learn from, who are driven, energetic and uplifting, who give honest and constructive feedbacks, and who encourage. Do not be afraid to be the least experienced person in the room! Asking yourself whether you have more energy or less energy after meeting a person should give you a good indication of the influence this person has on you.

It is also beneficial to have friends from outside of academia. Having social interactions not related to your work is helpful in maintaining work-life balance.

There is a popular saying in science: We're all smart. Distinguish yourself by being kind. This is a good personal and professional development advice in general, both in science and beyond. Developing kindness and gratitude does not require any unique talent, and it can make you a linchpin (Godin, 2011) in a high-stress or tense environment.

4 Start writing your personal CV of failures

Success rates in high impact journals and grants can be around 10% or lower, making academia very competitive and rejection rates high. In 2010, Dr. Melanie Stefan proposed writing a CV of failures, where only rejections and failures are documented (Stefan, 2010). Reading CVs of failures written by established researchers can be helpful to ECRs, as it demonstrates that failure is an integral part of science and should not be taken personally. Thankfully, it is becoming increasingly popular for established principal investigators (PIs) to divulge their CV of failures to the public (e.g. Haushofer,

2016, Voytek, 2018, ‘How I fail’ cycle, Chelpygina, 2018). Documenting rejections in a CV of failures can also be beneficial to ECRs as it serves as an index of productivity and a source of motivation. Once you start writing your CV of failures, your every action will add to your CV: either the official CV or the ‘shadow CV’.

5 Identify the main bottlenecks in your career path

You may find that your research project has certain bottlenecks or difficulties which impede the speed and successful completion of the project. For example, your supervisors might be busy managing multiple projects, limiting your access to timely feedback. Even with the full attention of a supervisor, it is often hard to predict the chances of success. Although there is no absolute guarantee that a project will be completed, you can attempt to increase the chances of a project having a successful conclusion by careful planning, gathering a good team and flexibly changing the strategy throughout the process. If bottlenecks appear, you should clearly communicate this to other members of your team. You can ask yourself: Can I decompose this problem into smaller and manageable chunks? Who is a contact person to address each one of these subproblems? For instance, if your project requires a skill which would take five years to learn, and you only have one year of the project left, do not procrastinate and instead ask for external help. Remember that time is an asset that cannot be reclaimed, and you will save yourself a lot of time by identifying potential bottlenecks upfront.

It may also be a good idea to find side-projects in case your main project is burdened with serious bottlenecks. It can be exciting and satisfying to be proactive and creative in collaborating and planning a feasible project that is of personal interest to you. However, it is important not to lose sight of your long-term goal, and not to over-dedicate your time to side-projects. When you do present your idea to your supervisors, treat it like a business pitch: it is often helpful to have a general project plan written out so that your superiors can see that the idea is worthwhile and well-thought out.

6 Grow your network

6.1 Hop on Twitter

Currently, one very popular tool for networking in academia is Twitter. Using tools such as Twitter has many benefits for ECRs. Twitter allows you to disseminate and advertise your own work (e.g., preprints, conference appearances), get first-hand information (e.g. open calls for travel grants and special issues in research journals in your field), have a voice in your community and to ask for opinions and get a clearer picture of reality and researchers as people from more experienced researchers in your community of interest.

6.2 Track granting agencies

You can find your own grant opportunities through networking, social media or subscribing to grant agencies in your field (e.g. International Brain Research Organization, IBRO: http://ibro.org/open-grants/). Occasional checking on the new opportunities does not require much effort and it highly increases your odds of landing a grant.

6.3 Follow an open-science framework

Consider posting preprints of your work (Bourne, Polka, Vale, & Kiley, 2017) and encouraging your research community to comment on your work before you submit to a peer-reviewed journal. There is a strong trend in posting preprints across the natural sciences (Lin, 2018). Post-preprint submissions to peer-reviewed journals are usually more highly cited than original submissions (Serghiou & Ioannidis, 2018). This is likely because feedback is collected and implemented after the preprint becomes available, and the visibility of the work is increased (Mudrak, 2018). There are also certain downsides of preprints, e.g., if your preprint does not gain enough attention, it might discourage certain high-impact journals from publishing (Enago Academy, 2018). However, in general, benefits are higher than potential costs.

Another way of networking is joining an open peer review process by commenting on preprints posted open-access at multiple servers (for examples, see Supplementary Material 1). When giving feedback in an open peer review, be diplomatic and helpful (i.e., give constructive criticism with suggestions for improvements) and be accepting even if the author does not agree with your input. You can also become an editor and propose your own collection of articles on a particular topic (e.g., at www.peeriodicals.com). In all these cases, your academic title does not matter, which gives you an opportunity to present your expertise to the community.

6.4 Network at conferences

Conferences are not only about attending talks; indeed the most valuable time is often spent engaging in a discussion with fellow conference attendees. There is also a substantial value in horizontal networking: ensure you are cultivating relationships with other ECRs and not just trying to connect with senior researchers. Make sure that you step out of your comfort zone and initiate conversations with researchers you have never met before. You can consider the following:

- read the program before arriving at the conference, find presentations relevant to your research and actively approach people at poster sessions and after the talks
- email other researchers ahead of time and ask to meet during the conference - make sure to also follow up after the conference!
- attend Open Science initiatives, as people involved are typically very collaborative
- attend social events organized by ECR special interest groups
- spend a substantial portion of your conference time outside your daily circle, i.e., in the accompany of researchers from other research institutes

6.5 Join Hackathons

Hackathons are themed sprint-like events in which groups of participants conduct research projects over a period of a few hours to a few days. Hackathons are becoming more popular across multiple fields of science. For instance, in neuroimaging research, the Brainhack organization (www.brainhack.org, Craddock et al., 2016) coordinates hundreds of hackathons dedicated to brain research all around the world. Hackathons are also popular in other fields such as computer science (e.g., http://web.stanford.edu/group/wics/hackoverflow/spr2018/), physics (e.g., http://www.physics.mcgill.ca/hackathon2017/ https://www.beds.ac.uk/cst/hackathon) and education (e.g., http://educationhack.nl/). You can benefit from Hackathons in multiple ways, e.g. by:

- developing your leadership skills by converting a part of your main project into a Hackathon project and delegating it, or proposing a small standalone project
- developing your research and networking skills by joining another project in the area of your interest in order to learn and to obtain new collaborations
- in some cases, also developing your writing skills by authoring a brief proceedings publication

6.6 Keep in touch

It is a good habit to reach out to former contacts from your studies, summer schools or graduate school from time to time. Academia has a very fluid structure; people often jump between similar subfields, and it is likely that your former colleague is now working on a topic relevant to your current project and may be willing to start a collaboration.

Also, be proactive and do not be afraid to organize a lunch or coffee with valuable people with whom you have constructive discussions. Do not hesitate to ask questions about their personal success—chances are that they will be happy to share. Also, remember that values such as ‘influence’, or ‘being well connected’ are not built overnight. While Twitter is a great way to snowball initial ties, progress toward network building is incremental and needs care and attention over the scope of years.

6.7 Fill a niche and become the ‘go-to’ person

Work to develop at least one skill which will allow you to stand out in your research community and to become a ‘go-to' person. This skill can be almost anything: detailed knowledge of a particular model or experimental tool, high fluency in a programming language, an ability to create good graphics, a knack for teaching or organizing communities, an ability to write particular types of texts (e.g. essays or motivational letters). It is important to discover early on what your strengths are and to communicate this to your community in order to build personal branding around that skillset.

Hone your reputation as a go-to person by communicating with collaborators in a timely manner. We live in a culture of sharing, yet it is often the case that researchers take weeks or even months to answer an email. Instead, consider allocating time in your daily schedule to respond to emails and inquiries. Doing so can eliminate these distractions during the work day and ensure that they do not detract from your dedicated research time.

7 Share your ideas with others

One constructive way of converting a frustrating situation into something positive is sharing your thoughts and solutions about the issues you have encountered with your research community. For example, blogs are a good way to share your ideas and point of view. Blog posts can also have a high impact on the research community (as demonstrated in the reference list on this manuscript).

Also, try to increase your visibility online, for example, by setting up a personal website. Even if you have not yet established a thick research portfolio, a personal website can be supplied with blog posts or updates on your career activities, and not only with a publication list. Also, sharing your work with the public (e.g. through services such as www.github.com or https://www.researchgate.net/), can also help you gain more academic contacts.

8 Mentoring is key

8.1 Join or create a peer coaching program

A common misunderstanding is that mentorship is just another aspect of day-to-day interactions with your supervisor. Creating a network of mentors can be beneficial as they can become valuable learning resources. There are multiple possibilities for finding mentors. Most institutes and graduate schools offer some form of mentorship - typically with a more senior researcher, with whom you can schedule meetings on a regular basis. However, it is also a good idea to reach out to external mentors, especially if their expertise is different from yours, as having exposure to experts of other disciplines has long-lasting benefits (Liénard, Achakulvisut, Acuna, & David, 2018).

Peer-mentoring is a particular form of mentorship, in which mentors and mentees at similar career stages cooperate in pairs for a period of time. In such a mentoring scheme, mentors and mentees usually self-manage their relationship, including the schedule, and can discuss any aspect of their careers. Peer mentoring is possible in person or with the use of online conference tools, e.g. Skype (Payne, 2018) and has a long-term positive influence on mentees (Leidenfrost, Strassnig, Schütz, Carbon, & Schabmann, 2014, Fox & Stevenson, 2007).

A newer form of peer mentoring are coaching groups. A coaching group is a group consisting of researchers at a similar career stage, who support each other during a series of meetings in person (e.g., a peer coaching program at the Donders Institute, Nijmegen, the Netherlands http://www.ru.nl/donders/peercoaching). Such meetings are typically assisted by a trained session moderator or a facilitator. Experiments conducted on groups of PhD students demonstrated that such peer coaching group activities can efficiently complement traditional mentoring (Williams, Thakore, & McGee, 2016). If there is no peer coaching group available at your institution, you might consider creating one with your fellow ECRs.

An alternative option is joining online mentoring programmes, which are growing in popularity nowadays (Payne, 2018). In such programmes, mentees are offered mentorship from more experienced researchers who might be geographically distant. For example, the Organization for Human Brain Mapping offers an International Online Mentoring Programme (Bielczyk et al., 2018) in which mentors are coupled with mentees on the basis of years of experience in active research and mutual expectations. Another example of an online mentoring programme is run by the Institute of Electrical and Electronics Engineers (IEEE). This programme allows mentees to apply for a particular mentor: https://www.ieee.org/membership/mentoring.html.

Mentoring is a complex interaction (Straus, Johnson, Marquez, & Feldman, 2013, Gewin, 2005), and there are a wide variety of online resources that can assist both mentees and mentors in making the process run more smoothly. For example, this Early Faculty Online Training program offers a range of training information for mentors to develop their mentorship skill-set, and can be useful for scientists at many stages of their career: https://ctsc.health.unm.edu/apps/brep/. Stanford University has compiled a range of resources and written materials providing additional training for mentees and mentors alike (https://biosciences.stanford.edu/current-students/advising-and-mentoring/how-to-get-the-mentoring-you-need/). In order to have a fruitful mentoring relationship, prepare for the meeting with your mentor by thinking about your personal needs for advice, summarise the progress since your last meeting and prepare a set of questions (Iversen, Eady, & Wessely, 2014). You may also consider explicitly formulating written mutual expectations for the mentor-mentee relationship (Masters & Kreeger, 2017).

Bear in mind that research systematically shows that there is no common way of becoming successful in academia and career trajectories vary greatly (Sinatra et al., 2016, Clauset, Larremore, & Sinatra, 2017, Way, Morgan, Clauset, & Larremore, 2017, Bielczyk, 2018). Therefore, unlike the traditional mentor-protege model (Fig. 2A), you should aim for creating a network of mentors at different career stages rather than relying on advice from one particular person (Fig. 2B).

8.2 Become a mentor to others

It is often the case that one can only distance themselves from daily problems when taking a new perspective. Counterintuitively, dedicating time to mentor other ECRs may be helpful for inspiring new motivation at one's job (Fig. 2B). Mentoring researchers who are at earlier stages than you can make you realize how much about academia you already know. Furthermore, you might understand your own supervisors' point of view better. It was also found that mentoring others is beneficial for mental health and reduces levels of stress and anxiety (Gill, Roulet, & Kerridge, 2018). An ability to mentor others is also a desired competence at advanced career stages in almost every profession that requires teamwork and managing people. Furthermore, by mentoring others, you can also express gratitude and give back to the community.

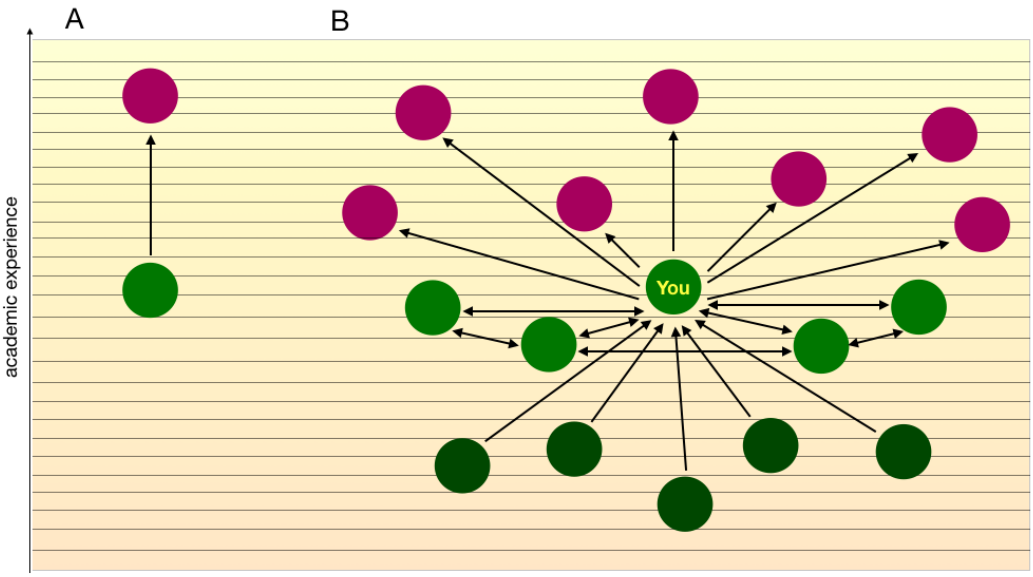

Figure 2 Models of mentoring. **A:** the traditional view at the mentor-protege relationship. It is a strictly hierarchical relation; the mentee follows mentor's advice and builds a career under the mentor's direct supervision. **B:** the modern, multilayered model of mentoring. In this model, the mentee becomes a centre of their own little 'galaxy'. Firstly, the mentee reaches out to multiple mentors at different career stages (magenta). Secondly, the mentee peer-coaches other ECRs at similar career stage (light green). Thirdly, the mentee mentors more junior ECRs (dark green).

9 Consider your career options and never stop searching for new solutions

If at some point in your career, you get a desire to try something else than academic research, do not be afraid to try. Changing course from academia to another profession is a personal development, and should not be considered a failure (Kruger, 2018). Also, a decision to try a position in industry is not a definite decision, as there are also multiple success stories of transitioning back into academia (Gramlich & Bodewits, 2016).

Once you are still in academia, it is always good to keep your options open by extending your research CV by a diverse portfolio of logistical skills: mediation, negotiation, communication, organization, scheduling, management, mentoring, coaching, journalism. While long research experience might hamper your chances of landing a good position in industry in certain circumstances (Woolston, 2018b), all of these skills can make you competitive on the job market, both in academia and beyond (Woolston, 2018a). Attending Hackathons (see section 6.5), blogging and taking active part in ECR associations might strengthen these skills over time.

If you are looking for ideas for your new career path, it could be worth considering the popular belief that whatever you are naturally drawn to when you are procrastinating is what you should do for a living. Think about how you are spending your time and reflect on what you are passionate about, as many ECRs have never held positions outside of academia and are yet to discover other natural talents. It might also be helpful to browse through current open positions and create your profile on career platforms, e.g. LinkedIn (https://www.linkedin.com/) which is widely used by headhunters. You may be surprised at how many jobs are out there that nicely fit your profile that you had actually never heard of! Moreover, you might be surprised how many careers have a substantial research component to them.

If you decide to apply for a position in industry, there are online services dedicated to help you adjust your CV to the industry standards and find your first job in industry, e.g. the Cheeky Scientist association (https://cheekyscientist.com/). Keep in mind that while holding a PhD can sometimes overqualify individuals for certain jobs, for the most part holding a PhD is a valuable asset for many companies. For example, large companies with strong Research & Development departments (e.g.,

Google or Amazon) and IT startups often welcome candidates with a PhD as they are innovative and independent (Hankel, 2019). There are also companies (e.g., Roche), which offer full PhD and Postdoc programs, so that you can gain both research career advance and industry experience at the same time.

In Supplementary Material 2, we list exemplary professions in which a PhD title is typically an asset rather than a liability. However, it is important to understand that in industry, communication and management skills typically matter more than an ability to produce publishable research (Powell, 2018). Therefore, you should revise your CV before applying for jobs outside academia (Woolston, 2018a). It is also essential to get familiar with a working culture within the company you are applying for (Fiske, 2016).

It is a good idea to start actively looking for opportunities at least a few months before your current contract expires as finding a suitable position takes time. However, if you are a PhD candidate with your thesis defence still pending, employers may unfortunately be reluctant to hire you. The best method at this stage may be to tap into your professional network of colleagues who work outside of academia about possibilities in their environment.

Furthermore, academia is a dynamic organization and together with the development of internet services and social media, new professions around academia are continuously being created. This trend is present across the job marketplace. For example, ten years ago, professions such as a YouTuber or a vlogger did not exist, while now, these are the dream jobs for over 50% of children in the UK (Daily Mail Reporter, 2017). Similarly, new trends in science oriented at science journalism and communication between research teams and industry are rapidly developing.

Together with the development of open databases, open-access preprint servers and open communication platforms, science will likely become more decentralized and open to freelance researchers. In 2007, Tim Ferriss published a best selling book The 4-four Hour Working Week (Ferriss, 2007), in which he presented his lifestyle of a nomadic freelancer. Namely, Tim developed a working style in which, due to outsourcing and efficient self-management strategies, he only needs to spend a few hours per week on deep work, and he is able to travel and enjoy life otherwise. If you have dreamed about marrying your research life with personal freedom in this spirit, you might soon have a chance if you keep yourself open minded and flexible. As Steve Jobs famously said, ‘stay hungry, stay foolish’ - and, you never know when the time will come to connect all the dots.

Conclusion

Researchers are usually talented and versatile. In her well-received TED talk (Wapnick, 2016) and recent book (Wapnick, 2017), Emilie Wapnick characterized multipotentialites: individuals with multiple talents and passions. Science is one of the multidisciplinary fields where multipotentialites often look for one job that covers all aspects of their interests. However, it is logistically difficult to develop an optimal working pattern as a multipotentialite. Here, we have discussed some key points for ECRs that may help steer their careers, and we hope that the ECRs can pick and adapt the recommendations to fit their personal situation. The essence of this set of guidelines is that, in order to move forward in academia, one should (1) be mindful and understand themselves; (2) reach out to people and (3) never stop searching for new opportunities. Career building always needs patience and persistence (Sinek, 2016) and we hope that the presented guidelines can help you discover and adopt some habits that will help your build your own career.

As mentioned in the Introduction, research on optimal conditions and strategies for career development, and achieving a general life happiness is scarce. Given that yearly sales of self-motivation and self-development materials (e.g., books, CDs, seminars etc.) is worth over $10 billion USD in the US alone (Marketdata, 2017) and most of the statements published in these materials are not backed up by science, more attention should be dedicated to systematic research on predictors of

professional success, and to developing optimal strategies for career development. We would like to also draw attention to the fact that conducting systematic research in this domain would have a high societal impact and benefit employees in multiple sectors of the marketplace.

The team of researchers who contributed to this article come from cognitive and computational neuroscience backgrounds. However, we believe that the working culture developed in neuroscience can represent natural sciences in a broader sense. Through working together in a very complex network of mutual dependencies, self-development as a neuroscientist enforces a necessity for self management on many levels. We hope that the advice provided here can help ECRs in any discipline in developing an internal sense of control, which could contribute towards a satisfying and successful career.

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SUPPLEMENTARY MATERIALS

Supplementary Material 1: A summary of online resources for ECRs

Table 1 A list of online resources for ECRs

Category	Name	Remarks
Grant opportunities	*International Brain Research Organization (IBRO)*	An organization that provides international grants for Research Fellowship, travel grants in brain research
Time management	*Time Out*	A break time reminder app that gently remind you to take a break on a regular basis

	Stretchly	A break time reminder app that reminds you to take breaks when working with computer
Grow network	*Twitter*	A social platform that allows you to disseminate and advertise your own work, get first-hand information, have a voice in your community
Open peer review	*biorxiv*	A preprint server for biology
	psyarxiv	A free preprint service for the psychological sciences
	F1000Research	A preprint server that publishes all your findings including null results, data notes and more.
	Peeriodicals	A lightweight virtual journal with you as the Editor-in-chief, giving you complete freedom in setting editorial policy to select the most interesting and useful manuscripts for your readers
Joining Hackathons	*Brainhack organization*	A unique conference that convenes researchers from across the globe and myriad disciplines to work together on innovative projects related to neuroscience
Sharing ideas	*GitHub*	Online service to share your work
	ResearchGate	Online service to share your work and make your work visible
Peer coach programmes	*Donders Institute, Nijmegen*	A peer coaching program
	Institute of Electrical and Electronics Engineers (IEEE)	An online mentoring program that allows mentees to apply for a particular mentorAn online mentoring program that allows mentees to apply for a particular mentor
Developing mentorship skills	*Early Faculty Online Training program*	A program that offers a range of training information for mentors to develop their mentorship skill-set
	Stanford Biosciences	A range of resources and written materials providing additional training for mentees and mentors
Career	*LinkedIn*	A social network specifically designed for career and business professionals to connect
	Cheeky Scientist association	The world's largest PhD-only job search training platform specifically for helping PhDs transition into industry careers

bigger pharmaceutical or biotechnology companies (e.g., Roche)	Companies that offer full PhD and Postdoc programmes, which can allow one to gain both research career advance and industry experience at the same time.

Supplementary Material 2: A list of potential alternative careers to consider for holders of a PhD title in natural sciences

Below, we list a number of ideas for alternative career options after your PhD.

Data Analyst/Data Scientist

Data scientists are experts in data analysis. They collect, visualize and analyze large amounts of data (SAS, 2018). Data scientists are typically trained in math, statistics, computer science, information science, finance or economics. Data scientists must have high technical and analytical skills, and should be adept at using a variety of statistical programming languages such as R, SAS or Python. Data scientists often use complex analytical techniques, such as machine learning and deep learning. They can freelance through online platforms such as Upwork or find jobs in IT and business-related fields. If you hold a PhD title, you can apply for senior data analyst positions, which partially resemble research life in the sense that you will be given more junior data analysts to supervise.

Software Developer

Software developers build, design, and test software for consumers. They should have high technical expertise to write, test, and maintain code, and have strong analytical skills and be capable of long periods of extreme concentration. They can work in a variety of industries, and are currently in high demand. PhD candidates in natural sciences often need to write and run scripts over the course of their PhDs, however, becoming a software developer often requires some amount of additional training. To hear more about experience of a PhD who transitioned to software development, see (Soapbox Science, 2012).

Research Scientist

Research scientists set up and conduct projects and experiments in a specific scientific area, much like they would in an academic institution. They can work in a wide range of areas, including industry (i.e., tech companies, pharmaceutical producers etc.), government laboratories, environmental organizations, large hospitals, and other specialist research organizations. Day-to-day work could entail gathering, analyzing, and interpreting data, as well as designing projects and putting together research proposals. Research scientists should have strong written and verbal communication skills, as they may be expected to work in diverse teams and liaise with other staff.

Medical Science Liaison

Medical Science Liaisons (MSLs) are excellent communicators who liaise between physicians, clinicians and researchers. They must be able to tailor complicated information to their target audience in a clear and concise way, as they help ensure health-related products are utilized effectively. They can be found in the pharmaceutical, biotechnology, medical device, and other health-care industries or contract research organizations. Since science communication is a compulsory competence to obtain such a position, it may be helpful for those interested in MSL positions to use social media, such as tweeting and blogging, as a platform to market themselves and practice writing for a non-scientific audience.

Market Research Analyst

A market research analyst's primary role is to conduct research to analyze the key advantages / disadvantages of the company's technologies/products and ideas in order to assess their commercial value. Market research analysts often work in innovation-based sectors: biotechnology, electronics, and IT (although market research analyst roles exist in most industries). They must have excellent oral and written communication skills and strong analytical thinking with a knack for business.

Healthcare Information Technology Specialist

Health IT specialists manage technical aspects of handling patient health data. They may support or build electronic health record systems, may be involved in data analytics and be a part of interdisciplinary teams to facilitate improved healthcare outcomes. Health IT specialists must have basic knowledge of the Microsoft Office software, as well as medical terminology, database management and document imaging software.

Scientific Editor

The role of a scientific editor is to ensure that the peer review process of a journal is fair and efficient, and to carry out production of journal articles after they are accepted for a publication. Scientific editors work for specific journals and must be excellent at critical reading of scientific literature, including literature in unfamiliar topics. Scientific editors must also be strong writers, as they may be asked to write news pieces or blog posts summarizing newly published papers. To learn more, see https://cheekyscientist.com/an-insider-guide-for-how-phds-can-get-science-editor-jobs-in-industry/

Science Communication Officer

The role of a science communication officer is to communicate recent scientific output of an institution such as a research institute, to the general public. Science communication officers create the content in collaboration with the authors of the scientific work. This job is a form of journalism, which additionally requires an understanding of science and technology, as well as having strong communication skills.

Project Manager in public institutions (e. g., in the Ministry of Education)

Public institutions such as the Ministry of Education usually have separate units dedicated to creating infrastructure around science: developing new directions in science education, working on behalf of gender and ethnicity diversity, or building open-source databases or computing clouds. As a Project Manager, you can develop large projects on behalf of science.

Business Developer

Business development requires a profound understanding of the relevant market sector. A pure education in business management might not be sufficient to let a highly specialized project survive on the market. Therefore, if you have a general interest in developing projects, you can become competitive on the market by gaining additional competence in business management and finding a job as a business developer specialized in the sector of the market close to your former PhD topic.

Academic / High school teacher

If teaching students was your favorite part of a PhD, you might consider pursuing a further career in teaching, either at the university or in high school education.

Freelance Writer / Content Writer / Copywriter

If writing was your favorite part of the PhD programme, you might consider freelance writing. This job allows you to choose the scope of topics and select your preferred forms of text from a broad range of possibilities: from blog posts, through essays and articles, to white papers and grant proposals.

For more ideas, please check: https://cheekyscientist.com/top-10-list-of-alternative-careers-for-phd-science-graduates/
http://curiousaboutscience.net/phd-job-options/