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Laboratory Notes From Behavioral Pharmacologists and Trainees: Considerations for the Discipline

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Laboratory Notes From Behavioral Pharmacologists and Trainees: Considerations for the Discipline

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Abstract

In several laboratory meetings, we discussed the challenges that face trainees in behavioral pharmacology. Major concerns, such as a difficult funding climate and limited academic job prospects were discussed at first. However, we decided to concentrate on ways to meet these challenges; versus focusing on negatives and listing gripes. Within this more constructive framework, we identified the importance of broadening training to aligned areas to enhance the capacity of behavioral pharmacologists to collaborate in multidisciplinary teams. With increased breadth of training comes the concern for a balance that does not cheat trainees out of the depth of training also needed for success. We believe that behavioral pharmacologists trained in this manner will be ideally positioned to be leaders of these translational research teams. Related to the breadth and depth of training is the recent concerns over replicability and reproducibility of published research. Behavioral pharmacologists, with the rigors of training in behavioral analysis and experimental design, can be at the forefront of this conversation. This will be especially true if current training is reinforced with additional experience in the use of cutting-edge statistical tools that address the complex experimental designs and large data sets that emerge from modern multidisciplinary collaborations. Finally, communicating the import and potential societal impact of our research to legislators, other scientists, educators, school children, neighbors, and acquaintances is needed to ensure that our field thrives. In closing, the process of explicitly discussing the challenges and potential solutions with current trainees will enhance their mentoring and training.

Evolving Conversations

The request from Dr. Alan Poling for contributions to this special section asked for reflections on “the defining features of behavioral pharmacology, its current status, and its probable future, including if possible consideration of areas where growth is possible.” I (Bevins) brought this suggestion to my laboratory crew and this sparked a thoughtful series of evolving conversations on a range of topics. The first conversation or two occurred at the closure of a laboratory meeting with 10 or 15 minutes left. Interestingly, in this brief time, the tone of the topics went quite negative. For example, and perhaps not surprising, one topic that recurred was the continuing poor budget outlook for the National Institutes of Health (NIH). What does this budget situation mean for early career investigators trying to establish

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independent programs of research? Will this funding environment be cyclic or is this a new normal? If the latter, what does this mean for current and future trainees. Does the limited or lack of a science education received by most of our legislature, and the public in general, contribute to this situation? Perhaps related, there seems to be a dwindling number of job prospects, relative to the number of behavioral pharmacologists currently being trained. Although there are notable strongholds for academically-oriented behavioral pharmacologists within certain universities and medical centers, more often than not, our impression was that these positions were lost or reallocated to fields of neuroscience with a more molecular focus and often with little to no consideration of behavioral processes.

Rather than 15 minutes of a laboratory meeting here and 10 minutes there, we eventually decided to sit down and dedicate several lengthy discussions to this topic. We also decided to avoid negativity and frame the conversation in a more positive and constructive light. For example, instead of complaining about the reallocation of jobs, we should talk about how we compete successfully for those jobs, while maintaining our core identity as a behavioral pharmacologists. Similarly, how can we position ourselves to be more successful at competing for the limited grant dollars from NIH or other extramural funding agencies? The narrative that follows reflects a winnowed version of these conversations[1].

Laboratory Notes

Breadth of training

By definition, behavioral pharmacology, since its inception, has been a multidisciplinary field. Today, the study of the effects of drugs on the brain and behavior can include such disciplines as psychology, pharmacology, neuroscience, chemistry, genetics, economics, evolutionary biology, sociology, computer science, and biomedical engineering. As the field of behavioral pharmacology moves forward, and as our understanding of the varied mechanisms of behavior expands, the need for individual researchers to become better versed in a wide range of theoretical and methodological approaches also expands. To meet these challenges and to remain competitive, the training for future (and current) behavioral pharmacologists ought to increase the breadth of topics to which trainees are exposed. Such training may equip individuals with the skills increasingly requisite for reviewing and conducting rigorous and informative science. Indeed, investigators who are versed in a wider array of applicable topics may be better positioned to help tackle complex scientific questions traditionally, and perhaps not traditionally, in the purview of behavior pharmacology. Such researchers are a boon on grant review panels, and as members of a research team. They are able to integrate a wider array of pertinent knowledge from an expanse of disciplinary approaches to ensure that our field continues to conduct science with the highest rigor, innovation, and application.

[1]To better understand the conversation, we thought it would be helpful if the reader knew where each author was in their training. Rick Bevins, as the PI of the Behavioral Neuropharmacology Laboratory (BNL), published his first behavioral pharmacology paper in 1994. He has been on the faculty at the University of Nebraska-Lincoln (UNL) since 1996. Scott Barrett received his Bachelor's degree at Utah State University working in the laboratory of Dr. Amy Odum. He completed his Ph.D. in 2015 at UNL and is now a post-doctoral scholar in the laboratory. Steven Pittenger received his Bachelor's degree at Kansas State University working in the laboratory of Dr. Mary Cain. He is finishing his dissertation and will be starting a post-doctoral position with Dr. Marina Picciotto at Yale in August 2016. Brady Thompson finished his Bachelor's degree at Nebraska Wesleyan University last year and is now a technician and manager in the BNL and an incoming graduate student.

Depth versus breadth

With the need to expand training in an increasingly broad range of research fields also comes a need to ensure and to protect depth of training. Herein lies the challenge for trainees, mentors, and graduate programs: ensuring an increased breadth of training, while simultaneously maintaining quality and depth of training that has been the hallmark of behavior pharmacology. Meeting this challenge will not be easy and it will require constant vigilance to avoid training that produces behavioral pharmacologists that are “jack-of-all-trades, masters-of-none.” On the other end of the continuum, we must avoid such narrow training that the individual is trapped in the ivory tower of the academy and unable to work on a research team addressing pressing scientific questions outside the comfortable boundaries of traditional training. If the balance is struck and we are successful, then the field of behavioral pharmacology will thrive. Indeed, to the extent that research in the field increasingly employs multidisciplinary approaches to a host of important societal issues, then institutional research teams, grant review committees, and editorial boards require individuals who are well-versed in a wide arrange of topics, but also highly knowledgeable in the area of their specialty.

Research teams

The idea that an individual could achieve expert status across all fields potentially interested in the discoveries of behavioral pharmacology research is by most standards, an unreasonable, if not impossible, expectation. This fact alone calls for a cohesive plan by experts to collaborate in a meaningful manner to solve complex societal questions. We have referred to scientific teams several times in these notes. However, to address the most complex and vexing problems facing society today will require an approach where scientific questions and answers move seamlessly across the disciplines and are addressed at each level in a manner communicable, useful, and informative to the other levels. For many health-related questions (e.g., drug abuse, obesity, schizophrenia, etc.), a behavioral pharmacologist trained in the manner we have been discussing would likely serve as a linchpin team member. Take as an example substance abuse with its estimated societal cost of $600 billion dollars a year (NIH, 2013). A behavioral pharmacologist could be ideally positioned to gather researchers that span public policy, intervention and prevention development, community-based participatory research, neuroimaging, behavioral pharmacology, neurobiology, genetic, and medicinal chemistry to answer an integrated set of questions central to the etiology of substance abuse. This approach is not novel per se, as there are a number of centers and program projects of this nature funded by the National Institute on Drug Abuse (NIDA). However, what we are suggesting is that behavioral pharmacologists seek training that will place them as leaders of such efforts.

Replication and reproducibility

Trainees in the field will continue to require rigorous instruction in the scientific method and hypothesis testing to ensure that future research in behavioral pharmacology persists as innovative, illuminating, and informative. Recently reported issues regarding scientific rigor and reproducibility highlight the need for current and future researchers to be trained in sound scientific design and state-of-the-art analytical approaches (Prinz et al., 2011;

"Trouble at the Lab," 2013). Experimental analysis of behavior must be a key component of that training. However, an exclusive focus on this area will not be enough. For example, imagine a self-administration study that combines testing the effectiveness of a potential medication to prevent reinstatement with a proteomic approach to begin identifying potential neural mechanisms of the drug's action. The very nature of this hypothetical study (i.e., very large data set from the gene assay), combined with the desire to ensure the continued reproducibility and reliability of our work, prompts the need to use statistical procedures that appropriately account for errors in hypothesis testing. Further, leveraging recent advances and up-to-date statistical methods such as multilevel regression modeling and robust estimation will keep the field on the cutting-edge and aid in achieving our goals.

Greater emphasis needs to be placed on the detailed reporting of methodological practices. Publications in some of our most highly-regarded periodicals are often severely lacking in detail, making the results difficult to evaluate or reproduce. There is enough blame to go around. The journals put significant restrictions on manuscript length and word count, thus forcing authors to make compromises to meet those requirements. In an era of online publishing, DOIs, and PDFs, this practice seems antiquated and makes little sense. Of course, investigators could make better use of supplemental section when available in a journal. Additionally, we should take care to write the methods section from the perspective of someone in a different laboratory that wants to replicate and extend the study. Sometimes small details that are routine in a laboratory, and could be easily overlooked, may matter for replication. For example, a small detail in our intravenous drug self-administration protocol is that we start each session with a priming infusion that fills the internal volume of the indwelling jugular catheter (Charntikov et al., 2015). This step has the effect of more closely equating the volume of drug delivered into the vein on the first earned infusion with the volume of later infusions. Not only do we believe it is good scientific practice to control such factors when possible, we also believe that it matters and may affect behavioral or neuropharmacological outcomes.

Better communication

One of the major recurring themes of our discussions for this commentary was the critical need for behavioral pharmacologists to openly engage in scientific communication at multiple levels. The NIH budget has stagnated over the past decade. Not only has funding not adjusted for inflation ($28.1 billion in 2004 to $30.1 billion in 2014), but it has actually decreased in real dollars ($31 billion in 2010) over the past five years (NIH, 2015). It is imperative that we communicate with our congressional delegations the benefits of a well-funded scientific community and highlight the importance of basic scientific research to the long-term health and well-being of society, as well as the economic impact of these advances. Notably, some allied professional societies (e.g., American Psychological Association [APA], American Society for Pharmacology and Experimental Therapeutics [ASPET], Society for Neuroscience [SfN]), provide fellowships and/or workshops that inform scientists on best practices for more effectively communicating with legislators.

As behavioral pharmacologists, we will also need to actively convey the importance of our field to scientific colleagues in other disciplines when given the opportunity. A deeper

appreciation of behavioral pharmacology may serve us well when these colleagues are serving on Center for Scientific Review (CSR) Study Sections for NIH. Finally, scientific communication with our local community is a necessity. The measles outbreak in December 2014 – January 2015 sourced to Disney theme parks in Orange County, California, and spread largely by unvaccinated individuals, provides an alarming example of how scientific repudiation is a grave public health concern (Zipprich et al., 2015). Community outreach in the form of public forums, guest teaching in our local science classrooms, as well as informal discussions with our friends and family will help educate the public on the scientific process and instill trust in science and its outcomes. The Society for Neuroscience has Brain Awareness Week and, as an example, provides many supports for how to engage children and teachers in public schools about the benefits of neuroscience research. Perhaps we can steal a page from their playbook and encourage the leaders of our scientific organizations (e.g., Division 28 [Psychopharmacology and Substance Abuse] of the APA or the Behavioral Pharmacology Society) to coordinate such efforts. Interaction with members of our community may also come in the form of outreach through social media. Behavioral pharmacologists publishing books targeted at non-scientist may also increase accessibility and appreciation of our field. A well-informed public may even aid in the expansion of government funded scientific research. The bottom line here is that communication at all levels, local to federal, is paramount to the success of the field of behavioral pharmacology, and science in general.

Closing Reflections

I (Bevins) recommend that every laboratory PI prompt this conversation every so often. We frequently have informal conversations about the current status and the future of behavioral pharmacology, but there is something different about formalizing the discussion. It was illuminating to hear what topics and concerns were on the minds of my trainees. The positive framing for solutions was constructive. Perhaps some of the issues were predictable and stand the test of time (e.g., availability of jobs). However, each trainee differs and the potential constructive solutions or actions for that future behavioral pharmacologist may differ from past trainees. Regardless, these types of conversations can inform mentoring and recommendations for training in an ever evolving field. Finally, thanks to Dr. Poling for prompting these conversations; they were eye opening.

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