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Amateur hour: Improving knowledge diversity in psychological and behavioral science by harnessing contributions from amateurs

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ABSTRACT

Contemporary psychological and behavioral science suffers from a lack of diversity regarding the key intellectual activities that constitute it, including its theorizing, empirical approaches, and topics studied. We refer to this type of diversity as knowledge diversity. To fix the knowledge diversity problem, scientists have proposed several solutions that would require transforming the field itself—an endeavor that can realistically be realized only in the long term. In this article, we propose that knowledge diversity could also be attained in the short term without transforming the field itself—by harnessing contributions from amateurs who can explore diverse aspects of psychology that are neglected in academia. We identify six such "blind spot" areas within which amateurs could contribute and discuss how this could be practically achieved. We hope that our article will inspire professionals and academic institutions to be more open toward amateur contributions to create a diverse body of knowledge.

Psychological and behavioral science (PBS) suffers from a lack of diversity in its key intellectual and research activities (Krpan, 2020; Medin, Ojalehto, Marin, & Bang, 2017). This low "knowledge diversity" is reflected in numerous aspects of the field—certain research topics (e.g., those that may be easily publishable) are prioritized over other important but less desirable topics (e.g., those that are not heavily cited or easy to publish); some methodologies such as experimentation are widely used whereas less common methods (e.g., self-observation) are neglected; short-term projects with quick gains are prioritized over the long-term ones; some participant populations are understudied (e.g., non-WEIRD samples; i.e., non-western, educated, industrialized, rich and democratic, Henrich, Heine, & Norenzayan, 2010); and theorizing is driven by arbitrary conventions and overly reliant on available research findings while avoiding speculation that could lead to new insights (Krpan, 2020, 2021a; Medin et al., 2017; Stanford, 2019). Although the issue of limited knowledge diversity has not received as much attention within PBS as other problems affecting the field such as the replication crisis (e.g., Maxwell, Lau, & Howard, 2015), it can have equally or even more negative consequences. Crucially, it can hamper the key objective of psychology: to produce knowledge that adequately explains mind and behavior (e.g., Krpan, 2020; Rzhetsky, Foster, Foster, & Evans, 2015; Stanford, 2019).

There are numerous factors that limit knowledge diversity in PBS and other fields. Many of these factors are inherent in the structure of modern science in that they result from the ways in which scientists collaborate, receive funding, publish, and are evaluated for hiring (Akerlof & Michaillat, 2018; Azoulay, Fons-Rosen, & Graff Zivin, 2019; Azoulay, Zivin, & Manso, 2011; Fang & Casadevall, 2015; Foster, Rzhetsky, & Evans, 2015; Gerow, Hu, Boyd-Graber, Blei, & Evans, 2018; Krpan, 2020; Medin et al., 2017; Rzhetsky et al., 2015; Steinhauser et al., 2012). As an example, we may imagine the situation faced by a young researcher (e.g., a post-doc or assistant professor) who wishes to do research that will increase knowledge diversity in PBS, perhaps by studying an uncommon topic or using a rare methodology. This researcher likely knows that their employment and tenure prospects depend on receiving funding and publishing numerous papers in prestigious journals (the so-called "publish or perish'' culture of modern academia) (Nicholas et al., 2017). In this context, it becomes challenging to try an unusual method, pursue a long-term research project with uncertain payoffs, or study uncommon or controversial topics (Kempner, 2008; Lombardo & Emiah, 2014; Väliverronen & Saikkonen, 2020). These issues are, however, not restricted to young researchers. They also apply to mid-career scientists who want to become full professors, or even to full professors who want to continue publishing in top journals

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and remain competitive for funding. Therefore, many psychological scientists may be systematically discouraged from improving knowledge diversity within their discipline.

Several solutions have been proposed to tackle the issue of knowledge diversity in PBS, including increasing the diversity of researchers themselves (e.g., Medin et al., 2017), changing incentives regarding academic career progression and funding (e.g., Avin, 2019; Fang & Casadevall, 2015, 2016; Miguel et al., 2014; Nosek, Spies, & Motyl, 2012), and "disconnecting" psychological scientists from the discipline's current practices (Krpan, 2020). Although these solutions are plausible, they all imply that the issue of knowledge diversity can be improved through large-scale systemic change, something which is difficult to effect and likely to occur only in the long term. We propose a different strategy that is attainable in the short term: harnessing contributions from amateurs who can explore the diverse aspects of psychology that are neglected in academia. We believe this strategy holds great potential to improve PBS and envision a future in which interested and talented amateurs play a vital role in the scientific ecosystem. In the remainder of this article, we first define what an "amateur" is and provide an overview of current amateur involvement in PBS. We then explore how amateurs could contribute to PBS to increase knowledge diversity. Finally, we provide specific suggestions for facilitating amateur participation in PBS.

1. Defining amateurs in science and examining their involvement in PBS

Although various scholars have argued that amateurs throughout history have made significant contributions to science (e.g., Forrest III, 1999; Guillemain & Richard, 2016), the concept of an amateur has rarely been precisely defined, and different sources tend to use the term in different ways. One component that all definitions share is that amateurs are those individuals who pursue science because they are interested in the subject, without financial compensation, and sometimes also use their own money to fund their research (Forrest III, 1999; Watts, 1928). To offer an overarching conceptualization that encompasses how amateurs are discussed in various sources, here we propose a classification of amateurs alongside two dimensions—level of expertise and expertise distance (Fig. 1). Level of expertise refers to how knowledgeable a person is about scientific methodology and practices in one or more fields (Uhlmann et al., 2019), whereas expertise distance refers to the distance between a scientific domain in question and an individual's domain of scientific expertise (Acar & van den Ende, 2016).

These two dimensions can be used to classify different types of amateurs (Fig. 1). For example, the term outsiders typically refers to amateurs who have a high level of expertise in some scientific domain but use that knowledge to answer a question in another domain, an activity which can often result in novel solutions and findings (Acar & van den Ende, 2016). A well-known historical example of an outsider would be Alfred Wegener (1880–1930) (Hallam, 1975). A meteorologist by training, he was the first to propose the continental drift hypothesis and faced significant ridicule for doing so. The hypothesis eventually became widely accepted in the 1950s—over 40 years after it was originally proposed.

In contrast to outsiders, the term independent scientist (Fig. 1) typically refers to an amateur who is knowledgeable in a specific domain and pursues questions within that domain (Dance, 2017), but is not directly compensated for their work or affiliated with a research institution. Most famously, Albert Einstein was an independent scientist when he made some of his most important contributions to physics (Pais, 1982). Although Einstein had a PhD in physics from the University of Zurich, he was a clerk in a Swiss Patent Office in 1905 (his "miracle year") when he published four articles regarding the photoelectric effect that had a major impact on modern physics. He became a professional scientist only in 1908, when he was appointed lecturer at the university of Bern. Robert Boyle, the namesake of the fundamental law that describes the relationship between the pressure and volume of gasses (Hunter, 2009), provides another example of an independent physical scientist who made significant scientific discoveries.

Another category of amateurs includes individuals with low levels of skill and expertise distance (Fig. 1): citizen scientists and undergraduates. Citizen science encompasses individuals who are interested in some domain of science but not highly skilled in it, so they typically pursue certain elements of scientific work, such as data collection, under the guidance of professional scientists or in response to public citizen science projects that have clearly outlined tasks (Bonney et al., 2014). Undergraduate students who assist in scientific research belong to a grey area between amateur and professional scientists, given that they are on the path of receiving a professional training in science and may be paid for their work through a scholarship, but they in many cases also participate in scientific research on a voluntary basis.

The final category of amateurs comprises those who have low to medium skill level and high expertise distance (Fig. 1). For example, the term "quantified self" refers to any individuals who quantify their own behavior, feelings, physiological processes, etc. to answer personal questions (Swan, 2013). This category of amateurs most commonly attracts individuals who are not necessarily highly skilled, but are still capable of gaining insights of relevance to various scientific domains. For example, Sara Riggare tracked daily variations of the effects of her Parkinson's disease medications for one month, which ultimately helped her to improve the effectiveness of her treatment (Wolf & De Groot, 2020).

All the amateurs discussed above can and do make valuable contributions to science. However, the important question for our purposes is to what degree they contribute to the knowledge work of PBS. To our knowledge, there is no systematic data that specifically looks at this question. Nevertheless, indirect evidence, an informal understanding of the PBS landscape, and our independent search indicate that, apart from undergraduate students, amateur involvement in PBS is not common. Here, we overview several indicative examples of amateur contributions to PBS that we could identify.

An example of an outsider in PBS (i.e., an amateur characterized by high expert distance and expert level) would be William T. Powers, an engineer and medical physicist who began developing Perceptual Control Theory in the 1950s (Powers, 1992). His most significant work on the theory, *Behavior: The Control of Perception* (Powers, 1973), has currently been cited almost 4000 times. Another example is Matthieu Ricard, a long-time Buddhist monk with a PhD in molecular biology, who uses his expertise in meditation and background in science to collaborate with professional scientists on research examining meditation from neuroscientific and psychological perspectives (e.g., Dambrun & Ricard, 2011; Lutz et al., 2004). He has also co-authored a popular book *Beyond the Self: Conversations between Buddhism and Neuroscience* (Ricard & Singer, 2017). Finally, Michael Nielsen, a PhD in physics who made important contributions to quantum computing (e.g., Nielsen & Chuang, 2000), and Andy Matuschak, an independent researcher (and former head of R&D at Khan Academy) with expertise in software engineering, are two outsiders who collaborate on developing tools and techniques for transforming human mental capacities (Matuschak & Nielsen, 2019).

An example of an amateur within PBS characterized by low expertise distance and high expertise level (i.e., independent scientist) is Scott Siskind—a psychiatrist who is not affiliated with any academic institution and makes research contributions through his blog Astral Codex Ten[1] (formerly writing under the pseudonym Scott Alexander at SlateStarCodex). In 2016, he began conducting a yearly survey via the blog that includes many detailed psychological and behavioral questions (e.g., the 2020 survey was taken by 8043 people and included 236 questions). The dataset is freely available, and Siskind and other amateur

[1] https://astralcodexten.substack.com/.

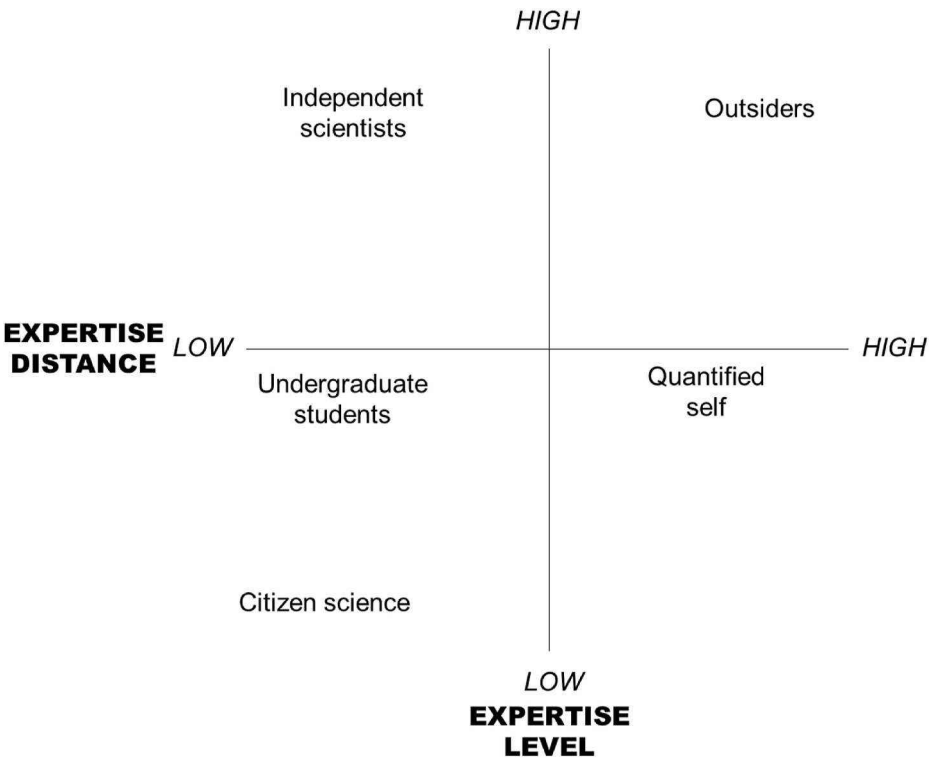

Fig. 1. Classification of amateurs in science as a function of *expertise level* (i.e., how knowledgeable a person is about scientific methodology and practices in one or more fields) and *expertise distance* (i.e., the distance between a scientific domain in question and an individual's domain of scientific expertise).

researchers have used it to replicate previous findings and make novel findings on various topics. For example, it was found that transgender people are significantly less likely to perceive two optical illusions—the hollow mask and the spinning dancer—as illusions (Alexander, 2017), and that rejection-sensitive dysphoria (i.e., being overly sensitive to rejection by important others) does not seem to be a key feature of attention deficit hyperactivity disorder (Alexander, 2018).

Most amateur contributions to PBS come from individuals with low expertise distance and low to medium expertise level. These are usually undergraduate students working on their own research projects or assisting their supervisors. However, these students typically need to focus on achieving grades that allow them to continue their training and/or get job placements, and they may not be willing to take the risks necessary to improve knowledge diversity in PBS that we describe in the next section. Although the vast majority of amateur contributions to science come in the form of citizen science, they are relatively rare in PBS, with more than 80% of citizen science focusing on life and natural sciences (Tauginienė et al., 2020). Moreover, a 2017 analysis found that 99% of citizen science projects are considered contributory rather than a collaborative effort between citizen and professional scientists (Heinisch, 2017).

Lastly, an example of a "quantified-self" amateur who has made valuable contributions in PBS is Alexey Guzey (2020), an independent researcher noted for conducting a self-experiment on the link between sleep and cognitive functioning. Guzey (2019) is also known for performing a rigorous fact-checking of the book *Why We Sleep* (Walker, 2017), which suggests that amateurs can also improve PBS by conducting thorough reviews of popular science books. Both reviews of popular science books and self-experimentation by amateurs can also be commonly found on LessWrong.com, a hub of the rationalist community; for example, one can find posts that detail self-experiments on the effect of chocolate on sleep, metacognitive training (e.g., using heuristics, noticing emotions), the relationship between work output and hours of work, or romantic techniques.[2] Amateur self-experimentation has a long history in PBS, beginning perhaps with Herman Ebbinghaus' ground-breaking work on memory that led to the discovery of the forgetting curve. Though he would eventually gain recognition as an academic psychologist, at the time of his experiments Ebbinghaus was an amateur—he did not have a university position and wanted to advance psychological knowledge by researching himself (Boneau, 1998; Slamecka, 1985; Woodworth, 1909).

Overall, these examples indicate that amateurs can make important contributions to PBS, but apart from undergraduate students, few amateurs are currently involved in PBS. In the next section, we examine the ways in which amateur scientists could make contributions to psychological science that foster knowledge diversity.

2. Exploring the space for contributions

We propose that amateur psychologists can most effectively improve knowledge diversity in PBS if they focus on "blind spots"—topics or endeavors that are generally neglected in academia (e.g., because they are not incentivized, or due to some other constraints) but have a large potential to lead to new insights and discoveries (Table 1).

For example, the "slow scholarship" movement highlights how scholars face a general intensification in the pace of work and an increasing pressure to publish (Harland, 2016; Hartman & Darab, 2012). Research indicates that the average number of publications at time of hiring for science faculty positions has been steadily rising in recent years (Pennycook & Thompson, 2018; Reinero, 2019; Van Dijk, Manor, & Carey, 2014); trends like this may influence researchers, especially early career researchers, away from projects that require dedication over a long period of time. This suggests that long-term research projects are generally a neglected area in academia (i.e., a blind spot), and amateurs

[2] Example 1, Example 2, Example 3, Example 4, and Example 5.

Table 1
Blind spots that are not incentivized in academia and could Be addressed by amateur psychologists to increase knowledge diversity in psychological and behavioral science.

Blind spot	Description
Long-term projects	Projects (e.g., theory development, research pursuit) that require dedication over a long period of time with uncertain payoffs.
Basic observational research	Conducting observational studies that aim to identify new phenomena or characterize the generalizability of already known phenomena.
Speculation	Making speculations that are not limited by current methodological or other practical considerations.
Interdisciplinary projects	Projects that combine diverse areas of psychology (and potentially other disciplines) and do not involve working within a specific area of expertise or topic.
Aimless projects	Projects that do not have pre-determined goals or planned outcomes and evolve in any direction in which pursuing psychology-related ideas takes the person.
Uncommon research areas	Research areas that are neglected by psychological scientists.

could do valuable work by focusing their efforts on research that may take a significant amount of time to yield results (Table 1) (Medin et al., 2017). This may involve spending decades to build rich and multilayered psychological theories, investigating psychological phenomena in greater detail, or conducting long-term observation. One example of an amateur conducting a long-term project in PBS is the post "Seven Years of Spaced Repetition Software in the Classroom" by user tanagrabeast (2015) on LessWrong.com, who investigated how spaced repetition of study material influenced high-school students' academic performance. Although not from PBS, another example of an amateur who did work that took a considerable amount of time is Gregor Mendel—his experiments on pea plants took seven years to complete and took nearly 40 years to be understood as a scientific breakthrough (Henig, 2000; Weiling, 1991).

Given that academic psychology emphasizes experimental research, perhaps to the exclusion of basic observational work (Muthukrishna & Henrich, 2019; Rozin, 2007, 2009), amateurs could make contributions by conducting observational studies that aim to identify new phenomena or characterize the generalizability of already known phenomena (Table 1). Namely, amateurs with access to non-WEIRD populations, niche subcultures, unusual datasets, or unique environments, such as Scott Siskind or Matthieu Ricard, may be able to provide novel observations. These observations could then either guide their own theoretical ideas and independent research, or they could be used to inform academic psychologists about what their work is potentially missing or to inspire new academic research (e.g., Ricard & Singer, 2017). Basic observational research does not involve only observation of other individuals or environments; it also comprises self-observation. Indeed, "self-experimentation" conducted by amateurs such as Guzey (2020), classified under the category "quantified self" (Fig. 1), does not refer to formal controlled randomized experiments. Instead, it involves self-observation and measurement of one's behavior. Ebbinghaus's discovery of the forgetting curve (Boneau, 1998) indicates that important psychological principles can be discovered via basic observational research and then more stringently tested on research participants using formal experimentation.

Another scientific activity which amateurs could focus on is speculation (Table 1), which has played a crucial role in many scientific discoveries (Achinstein, 2018; Currie, 2021; Feyerabend, 1975; Nurse, 2021; Stauffer, 1957). In some cases, scholars were forced to speculate about phenomena that could not yet be empirically investigated due to methodological limitations, and these speculations then guided the research once the methodology became sufficiently advanced (Koyré, 2013). In other cases, speculation beyond the available scientific evidence led to new insights that inspired research and produced novel discoveries (Currie, 2021). For example, Oersted's "discovery of electromagnetism is best understood as arising from a fertile union of speculation and experiment" (Stauffer, 1957, p. 33). However, modern norms within PBS, the current climate of "fake news", and the general focus on experimental research discourage professional psychological scientists from discussing or publishing their speculations (Bunge, 1983; Currie, 2021; Panchin, Tuzhikov, & Panchin, 2014; Stanford, 2019; Starokadomskyy, 2015; Swedberg, 2018). Indeed, it has been argued that, compared to harder sciences such as physics, PBS allows for very little speculation, which has a negative impact on its theorizing and knowledge generation (Krpan, 2021a). For example, while one of the most influential theories in physics, string theory, is to a large degree speculation (Becker, Becker, & Schwarz, 2006), highly speculative theories rarely or never play an important role in contemporary psychology (Krpan, 2021a). Free from the constraints that professionals face, amateurs could work to collect, organize, and publish their own speculations or those of professional collaborators, which could ultimately result in highly novel theories that could potentially enrich psychological knowledge by inspiring novel research endeavors and generating unexpected findings (see Stanford, 2019).

Academic researchers are disincentivized from pursuing interdisciplinary research (Table 1). The disciplinary structure of many universities, funding bodies, journals, and professional organizations makes it more difficult to procure funding, publish, and receive recognition for research that does not neatly fit into one discipline (Bark, Kragt, & Robson, 2016; Bromham, Dinnage, & Hua, 2016; Campbell, 2005; Lamontet al., 2006; Uzzi, Mukherjee, Stringer, & Jones, 2013; Yegros-Yegros, Rafols, & D'este, 2015). Moreover, potential interdisciplinary researchers may face the loss of credibility that comes from not being an expert in one field (the "expert's dilemma") (Yanai & Lercher, 2020). In addition to these career-related barriers, there are also epistemic barriers that may dissuade academics from conducting interdisciplinary research, such as differences in jargon, norms, and conventions between disciplines (Campbell, 2005; Cummings & Kiesler, 2008; MacLeod, 2018; Morse, Nielsen-Pincus, Force, & Wulfhorst, 2007; Siedlok & Hibbert, 2014). Amateurs can more easily overcome both types of barriers. Regarding the career-related barriers, many amateurs (apart from undergraduate students) may not be interested in becoming professional scientists and may thus not be concerned about issues such as procuring funding, publishing, and building expertise in one field. Regarding the epistemic barriers, amateurs such as outsiders (e.g., Ricard, Nielsen, Matuschak) may be better positioned to pursue interdisciplinary research given that they already have a significant expertise in a relevant non-PBS domain (e.g., biology, AI, computer science, meditation). In addition, not having to vigorously pursue a particular expertise for the sake of their careers may allow outsiders to spend more time learning about the differences in jargon, norms, knowledge, and conventions across disciplines.

Academic researchers are also disincentivized from pursuing projects that are more "aimless" in nature (Table 1), which means they do not have planned outcomes or predetermined goals and arise from intrinsically enjoyable activity that is not necessarily goal-oriented (Clark, 2018; Friston et al., 2017). Such projects may involve simply collecting observations and thoughts about human behavior or mental processes out of interest, but these observations and ideas may over time naturally grow into theories, research projects, and other endeavors that can enrich psychological knowledge. Aimless projects may suffer from a "failure to launch" problem in that it will be difficult for academic researchers to justify devoting significant time and resources to projects that do not have a clear focus or "sell" in the very initial stages. On the other hand, amateurs would not face these constraints and therefore would be able to play with different ideas and observations that may take them in unexpected directions. In fact, perhaps the biggest scientific discovery there has ever been—Darwin's theory of evolution—started as an aimless project; Darwin embarked on a voyage on the HMS Beagle with the intent to collect geological specimens and make careful natural

observations, and only gradually began to consider theories of evolution over the course of the years long journey (Bowlby, 1990). Within PBS, Ebbinghaus's self-experiments can also be seen as an initially aimless pursuit that led to fundamental insights about human memory and perception (Slamecka, 1985).

Finally, amateurs can make research contributions by focusing on uncommon research areas (Table 1) that are neglected for some reason, as Scott Siskind does via his Slate Star Codex (SSC) survey.[3] These research areas may be outside the realm of hot topics (Rozin, 2007) that can lead to many citations and therefore advance one's career, they may be taboo or controversial (Kempner, 2008; Lombardo & Emiah, 2014; Väliverronen & Saikkonen, 2020), or they may represent something that is generally not associated with academic psychologists (e.g., religious behavior) (Bloom, 2012; Norenzayan, 2016; Rozin, 2007). There are also some subjects that may be inherently difficult to study because they require considerable domain-specific knowledge (e.g., high-level athletic performance, hunting or survival skills, extensive meditation practice) which a professional researcher is unlikely to have. Collaboration with amateurs (e.g., outsiders such as Matthieu Ricard) who have special knowledge or abilities could provide unique insights into these areas.

Taken together, our discussion of blind spots highlights one overarching direction in "research-space" that may be especially promising: long, aimless, speculative, and interdisciplinary research on uncommon or taboo subjects. Out of all amateur contributions to sciences so far, Darwin's achievements may be the primary exemplar of this type of endeavor. As aforementioned, at the time of his departure on the HMS Beagle in 1831 he was an independent scientist—a 22-year-old Cambridge graduate with no advanced publications who had to pay his own way on the voyage (Bowlby, 1990; Keynes & Darwin, 2001). Darwin's work on evolution certainly took a long time to develop (the Beagle's voyage took 5 years and he did not publish *On the Origin of Species* until 23 years after he returned). It was aimless in the sense that he did not set out from the beginning to develop a theory of evolution. His work was highly interdisciplinary (Darwin drew on numerous fields within the biological sciences in addition to geology and economics), was the culmination of a huge amount of basic observational work, and was not necessarily an experimental contribution (though he did make those as well), but primarily theoretical (and sometimes more speculative) in nature. Darwin's theories were taboo in the sense that they went against the prevailing theological ideas of the time and caused significant controversy (and still do). We speculate that there may one day be a "Charles Darwin of the Mind" who follows a similar path. Indeed, it seems that the state of theorizing in psychology today is at an early stage comparable to evolutionary theorizing at the time of Darwin (Muthukrishna & Henrich, 2019), and the time may be ripe for an equally transformative amateur contribution in PBS. We hope that this paper provides the smallest nudge in this direction.

3. Increasing knowledge diversity in PBS by motivating and facilitating amateur participation

The blind spots we have identified (and further ones that we are not even aware of, the "unknown unknowns") arise from constraints that have both functional and mental aspects. For example, a PBS researcher may be discouraged from pursuing a long, aimless project (perhaps one that deals with a taboo subject) in a functional sense (e.g., they will not get jobs or tenure if they do not publish), but also in the mental sense—being systematically disincentivized to undertake such projects over time may influence them to adopt a mode of thinking that makes it difficult to spontaneously generate ideas for "blind spot" research. The main argument we are making in this article is that amateurs can more easily address the blind spots that hamper knowledge diversity than professionals because they are free from the functional constraints and are therefore also less likely to be hampered by the mental constraints. In that regard, to understand the value of the solution to limited knowledge diversity that we are advocating—increasing amateur participation in PBS—it is important to compare it to other solutions that have been proposed.

One way of increasing knowledge diversity in PBS would be to increase the diversity of researchers themselves (e.g., Medin et al., 2017). Whereas this is a highly important endeavor, achieving it may take one or more generations. Indeed, even if all universities started immediately making perfectly diverse hires, this would increase diversity at the junior levels (e.g., assistant professors), but it would not solve the problem at more senior levels that researchers typically attain after progressing through several ranks (e.g., first becoming assistant and associate professors until they reach full professorship). Moreover, researcher diversity is not a problem of hiring only—it also depends on whether postgraduate education has produced enough diverse PhDs who can be hired for faculty positions.

Another proposed solution to increasing knowledge diversity in PBS has been changing incentives regarding academic career progression and funding (e.g., Avin, 2019; Fang & Casadevall, 2015, 2016; Miguel et al., 2014; Nosek et al., 2012). Whereas this solution is also a highly important endeavor, it will likely require a long-term systemic change given that academic incentives and funding are intertwined with various other factors. For example, professional scientists may be rewarded for publishing in particular journals because publishing in those journals may increase university reputation, which in turn attracts students and funding and makes the universities in question more powerful (e.g., Nosek et al., 2012; Vernon, Balas, & Momani, 2018). Because university reputation and power are interrelated with academic career incentives, individual universities would in many cases need to disadvantage themselves to change the incentives. That is why the change likely needs to be dictated by governmental policies or wider agreements among universities, which are typically gradual and long-term endeavors.

Finally, Krpan (2020) proposed "disconnecting" psychological scientists from the discipline's current practices, norms, and conventions to increase knowledge diversity in PBS. For example, this would involve educating psychological scientists by teaching them about scientific methodology and practices but without conveying them any knowledge generated by psychology as a field, allowing them to develop their own body of work without connecting it to existing research and theorizing in psychology, allowing psychologists to write up their ideas without using specific writing conventions such as APA style, etc. (Krpan, 2020, 2021b). However, his solution also constitutes a long-term systemic change, given that it requires radical transformations regarding how psychological scientists are educated and embedded into the academic system, in a way that allows them to remain "disconnected" (see Krpan, 2021b).

In contrast, the solution we are proposing requires tapping into an already existing resource—amateurs—and encouraging their participation in PBS to harness their intellectual contributions. In this context, it is important to clarify that we do not advocate that amateur participation should replace the more systemic changes described above. Quite to the contrary, we think that amateurs could effectively increase knowledge diversity in PBS while the more systemic changes are on their way, and could in fact even propel these changes. For example, given that amateurs would bring more diverse ideas to academia, it is possible this would in turn make diversity more appealing or acceptable and thus result in more diverse hires. To examine how amateur participation in PBS could work in practice, in the next sections we propose several routes through which amateurs could contribute to PBS that do not require long-term systemic transformations.

[3] See especially page 2 of the survey that includes various questions concerning uncommon research topics in PBS such as sex change, occultism, crime, paranormal experiences and beliefs, etc.

3.1. Non-traditional academic relationships

There are many reasons why someone might not be able or willing to pursue an advanced degree in psychology (e.g., pressing economic needs, feeling creatively restricted, etc.). As it stands, there are few opportunities to participate in academic psychology outside of the standard graduate student-mentor model. We imagine a future in which there is a spectrum of mutually beneficial relationships between amateurs and professionals. One example of such a relationship is that of Dr. Robin Hanson and Kevin Simler that resulted in the book *The Elephant in the Brain* (Simler & Hanson, 2017). Kevin Simler explains the genesis and nature of the relationship:

> When I first approached Robin Hanson (professor of social science at George Mason University and all around fascinating thinker) to see if he wanted to write a book with me, I described it as an "alternative to a PhD." You see, I had already been in grad school once, and knew I didn't want to return for a traditional five-year doctorate. But a book seemed like a comparable project. Both involve intensive research and a long written summary of that research, and both yield a credential of sorts. I'm not going to be "Dr. Simler" at the end of this project, but I'll still have something of substance to put on my byline. (Simler, 2018)

This illustrates a general model for non-traditional partnerships—collaborations that generate a specific product which is of substantial value for the amateur but is also beneficial for the professional. This value can be provided in a variety of ways—for example, authorship of books or papers, gaining of experience or skills, or satisfying a strong personal interest in a subject. One can imagine a psychology lab offering a range of official roles for amateurs—intern advisor, data analysis consultant, scientific literature reviewer, outreach and communications specialist, etc. In the case of this paper, Author Mohlhenrich is motivated by his desire to improve scientific research and add to his C.V. in case he decides to re-join academia in the future.

Long-standing mentorship or partnership from an academic psychologist could be crucial to helping an amateur contribute in one of the blind spots discussed above. In some cases, amateurs will be discouraged from conducting PBS research because it will be difficult for them to know if what they are doing or hope to do is novel or interesting in any way. An amateur may be more likely to conduct a long-term or aimless research project if they have regular encouragement and guidance from an academic psychologist. Academic psychologists will also be able to point amateurs towards uncommon research areas or topics that may fit the amateur's skills and interests. For interdisciplinary projects, it may be easier for amateurs to approach and form relationships with professionals from other disciplines if they already collaborate with an academic psychologist, given that this would add a sense of legitimacy to their work.

3.2. Media and digital platforms

We envision a variety of currently existing and potentially existing media and digital platforms playing a valuable role in facilitating amateur psychology research. Although existing digital platforms (e.g., LessWrong, Twitter, Reddit, ResearchGate, Academia.edu) have some ability to organize amateur research, they are not specifically aimed towards doing so and thus have a limited ability to perform some of the functions that we might want from a potential amateur research hub. It is not hard to imagine a digital platform that facilitates amateur-professional collaboration by allowing amateurs to post information about their interests and skills and professional scientists to post calls for collaborations, ideas on blind spots (e.g., uninvestigated topics), and other relevant content. The platform could also have additional functionalities to foster continued engagement, such as curated working groups and competitions for best amateur contribution. From a technical point of view, launching such a platform would not be difficult, however gaining enough traction for realistic viability would be challenging. Support for the amateur research hub from universities could add a sense of legitimacy that makes all the difference when it comes to garnering sufficient interest from both professionals and amateurs.

In addition, the fan bases of popular psychology media (books, blogs, podcasts, YouTube channels, etc.) can provide a rich source of amateurs interested in collaboration and serve as a basis for more formal organization of amateur research activities. This paper provides an example of how media can help connect amateurs and professionals. Author Mohlhenrich developed his interest in psychology in large part through listening to the Very Bad Wizards, a psychology and philosophy podcast hosted by Cornell psychologist David Pizarro and University of Houston philosopher Tamler Sommers. Very Bad Wizards recommended the Neuroskeptic blog[4] (anonymously authored); a post (Neuroskeptic, 2020) about Krpan (2020) led to an email exchange between the authors and the idea of collaborating on this paper.

3.3. Academic journals

To encourage motivated amateurs to contribute to PBS, journals will also need to play their part by making it easier for them to publish their theoretical, empirical, or other ideas. It is plausible that there are various individuals across the globe who have been working independently on theories, other ideas, or actual research and developed interesting advancements, but they are unable to publish them either because they lack an institution to support them or because they are not familiar with the writing and other academic conventions that are necessary to produce a paper that can be accepted for publication (Budge & Katz, 1995; Madiganet al., 1995).[5] Some amateurs may also be discouraged from developing and writing up their thoughts because they are aware their writings are unlikely to reach the academic or wider community. In that regard, if academic journals are really interested in increasing knowledge diversity, as it is frequently claimed (e.g., Medin et al., 2017), they will need to offer support such as a more robust editing process to help authors bring their writing in line with expectations for scholarly articles. For example, peer reviewers could be instructed to focus primarily on evaluating the merits of a submission's content, and if a submission is accepted, the editors could work collaboratively with the authors to revise the text to ensure that it follows the appropriate academic conventions. There are at least a few journals that already have excellent resources on academic writing and publishing (e.g., PLOS Writing Center, Elsevier Author Tools & Resources, Sage Author Services), and these resources could be more effectively utilized by the editors to help amateurs produce articles that meet the standard desired by the journal.

3.4. Funding and institutions

Ultimately, sustained amateur knowledge work in PBS will greatly benefit from funding, both for specific projects and to support the researchers. It could be argued that providing funding to support amateurs makes them not amateurs, but the nature of the funding matters greatly here. Matuschak and Guzey are funded by crowdsourced donations and small grants that do not have any strings attached (i.e., they are not obligated to do work in PBS), while Nielsen was funded (for a time) by

[4] The blog (now discontinued) can be accessed via www.discovermagazine.com/blog/neuroskeptic.

[5] Out of discussion for this article was born the idea to start a scientific journal that focuses on publishing scientific speculation and makes it easier for amateurs to publish by limiting cumbersome submission requirements and allowing for a diversity of writing styles and formats. Such a journal, *Seeds of Science* (theseedsofscience.org), was recently founded by the authors of this paper.

two fellowships that were "unusually independent" (his own words).[6] With donations, and to a lesser extent fellowships, researchers are still able to maintain their amateurism and therefore work in blind spots. The challenge then is to provide sources of funding that allow amateurs to maintain independence while still providing enough money for significant research projects.

One possibility for addressing this challenge is to create a new organization that can facilitate and coordinate the acquisition of funding on a greater scale than could be done by any individual researcher. The Ronin Institute, an organization dedicated to supporting independent scholars (currently host to 9 researchers in PBS), provides such a model—although they do not provide funding directly, they offer grant management services which can help researchers use their funds more efficiently and can also help match researchers with philanthropists who may be interested in supporting their work.[7] We can imagine an amateur PBS institute that fulfills this function and other valuable services, or perhaps this is folded into the aforementioned digital amateur research hub. Universities could also offer small stipends for amateur researchers and/or alternatively find other ways to offer basic support (e.g., access to libraries, facilities, events).

4. Overcoming skepticism of PBS professionals towards amateurs

Ultimately, if we want to encourage more amateur research and improve the integration of this research into PBS then we need to overcome the skepticism by professional psychological scientists who doubt that amateurs are capable of making serious contributions. Some of this skepticism may be well founded, but some may simply be due to bias against involvement in less prestigious research activities (Roberts, 2010), of which working with amateurs is certainly one. We speculate that much of this skepticism can be overcome by increased exposure to quality amateur research and the development of greater understanding for how amateurs can benefit their own research and PBS as a whole. As it stands, most professional PBS researchers do not regularly encounter examples of amateur work or ideas. One of the authors of this article is an academic psychologist, and before doing extensive research for the purposes of this article, he knew of very few examples of amateur research despite being interested in the topic. Making it easier for amateurs and professionals to find out about each other's work will facilitate collaboration and motivate further interest in PBS research amongst amateurs; something like the proposed digital amateur research hub could help to make significant progress towards this goal. At least one scientist, Karl Friston, the most influential neuroscientist of the modern era (Bohannon, 2016), has found value in amateur collaboration as he has published work with John O. Campbell (Constant, Ramstead, Veissiere, Campbell, & Friston, 2018), an independent researcher investigating how Darwinian evolution can be expressed as a process of Bayesian inference (Campbell, 2016; Campbell & Price, 2019). If such a highly regarded scientist thinks collaboration with an amateur researcher is a worthwhile activity, then we might hope that other scientists would think the same if presented with the right opportunity.

5. Conclusion

Overall, we argue that increasing knowledge diversity in PBS does not necessarily require a large-scale transformation of the field. Increased knowledge diversity could also be achieved by harnessing contributions from amateurs who can explore diverse aspects of psychology that are neglected in academia. We identify six "blind spot" areas that are generally neglected in academia and could be explored by amateur psychologists to generate new insights about human mind and behavior. With this article, we aim to inspire universities and academic journals to create the necessary conditions for amateurs to contribute to PBS, and by doing so propel the development of the discipline.

CRediT authorship contribution statement

Erik Mohlhenrich: Conceptualization, Visualization, Writing – original draft, Writing – review & editing. **Dario Krpan:** Conceptualization, Visualization, Writing – original draft, Writing – review & editing.

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[6] Nielsen's fellowship at the Recurse Center was aimed at "helping us launch a research lab focused on discovering better ways of making software." While not directly focused on PBS, this work (as with Nielsen's other work mentioned in this article) utilized PBS knowledge to create tools that allow us to think and create in new ways.

[7] http://ronininstitute.org/resources/grants-management/.

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