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The Road to Uncreative Science Is Paved With Good Intentions: Ideas, Implementations, and Uneasy Balances

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Abstract
How does the current replication crisis, along with other recent psychological trends, affect scientific creativity? To answer this question, we consider current debates regarding replication through the lenses of creativity research and theory. Both scientific work and creativity require striking a balance between ideation and implementation and between freedom and constraints. However, current debates about replication and some of the emerging guidelines stemming from them threaten this balance and run the risk of stifling innovation. Although we recognize the importance of doing rigorous science, we argue that any "one size fits all" research guidelines being proposed or enforced will do more harm than good for scientific creativity.

Keywords
creativity, innovation, ideation, implementation, science, replication crisis

Ideas and implementations are very different. Think about these two statements: (a) Teachers should not be allowed to screen pornography to students, and (b) colleges should not endorse racism. These concepts sound like common sense to most people.

Consider, however, two specific incidents that made headlines near the end of 2017. A teacher in Utah was accused of showing pornography to her high school students after she screened the musical *Oklahoma!*, starring Hugh Jackman (Wood, 2017). The musical had been aired multiple times on public television; the scene in question featured a brief and blurred glimpse at a racy photo held by a character.

The second incident concerned a well-known Brandeis alumnus, Oscar-nominated screenwriter and playwright Michael Weller. He decided to let the university theater department premiere his newest play, a political satire titled *Buyer Beware*. The piece's main character was a modern student comedian, similar to the late Lenny Bruce, whose inflammatory style raises both administrator and student ire (Arsenault, 2017). In the plot, students misinterpret the comedian's intentions—to rob racist words of their meaning—and rally on Facebook to protest. It is not surprising that, given the controversial topic and language, there was student discussion and debate at Brandeis about the merits and characters of the play. However, an alumna who specifically said that she had never read the play began a Facebook protest to shut down the production (Spencer & Spitzer, 2017). She was able to rally so much support from alumni that, combined with student backlash, the university decided to avoid controversy and canceled the play.

The two controversies represent opposite sides of the political spectrum, yet they share much in common. Sensible positions were interpreted in extreme ways, resulting in misguided actions with potentially far-reaching consequences. How likely is it that a future teacher in that district will show any challenging material to students? What are the odds that a playwright would think to offer Brandeis a controversial new work to premiere? The differences between ideas and implementation are profound and, we argue, at the heart of the question of how the replication crisis affects creativity. Moreover, the notion of balance is important for our

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argument here. In both cases, one side of an argument dominated the issue. We believe an equilibrium should be reached between freedom and constraints in scientific research; this same kind of balance is required, as we will see, for creativity to flourish.

The Replication Crisis: Ideas and Implementations

Throughout this article, we will use the broad term *replication crisis* to refer to a wide set of identified problems, policy suggestions, and research trends. These concepts emerged from a number of disturbing incidents, primarily in the fields of social and cognitive psychology. The most egregious involved outright deceit, such as falsifying or fudging data or plagiarism. More recently, authors have created fake names and e-mail addresses so that they can review their own articles (Ferguson, Marcus, & Oransky, 2014). Such practices have occurred since the birth of science; many believe that Gregor Mendel faked or fudged his data (Pligrim, 1984), and controversy continues to exist about the extent to which intelligence researcher Cyril Burt falsified his data and made up nonexistent coauthors (Mackintosh, 1995). However, the past decade saw a striking peak in their discovery. Partly in response, there has been a push for science to be more open with sharing data and methodology (Nosek & Bar-Anan, 2012; Simonsohn, 2013).

Another issue is a growing awareness of what Lilienfeld (2017) called questionable research practices. These can include *p*-hacking (checking for statistical significance at multiple times during data collection; Szucs, 2016), dropping variables that were not significant to increase power (Simmons, Nelson, & Simonsohn, 2011), or changing a hypothesis after completing data analysis (Bastardi, Uhlmann, & Ross, 2011). One possible solution to these issues is to have scientists preregister their methods and hypotheses before conducting the study (Lindsay, Simons, & Lilienfeld, 2016).

Finally, the results of classic and recent studies often fail to be replicated (Open Science Collaboration, 2015). Although some researchers note that a study's results may not be replicated because not all findings generalize across time or conditions (Stroebe & Strack, 2014), others argue that these failures indicate a replication crisis that requires science to partake in major reforms (Pashler & Harris, 2012). Other scholars advocate even more strongly for an ideographic science, focused on the unique elements of individual phenomena (Salvatore & Valsiner, 2010). Going further, some argue that even successful replications have limited value because the people who are conducting the replication may make the same mistakes as the original scientist (Rotello, Heit, & Dubé, 2015).

The replication crisis arose because of legitimate problems in the system. The early leaders in this movement are to be commended for their efforts to highlight the problems and outline what is needed for science to reverse course and stay both honest and relevant. The past decade has seen psychological science in a transitional state of recognizing these issues, offering possible solutions, and determining how, where, and the extent to which these suggestions can be placed into action.

It is important to separate ideas from implementation, because the best intentions lead to often unintended consequences. Upton Sinclair's (1906) novel *The Jungle* was written as an exposé of the terrible treatment of poor and immigrant workers. Because the story was set in a meat-packing plant, public attention focused on the need for food reform. The effect that *The Jungle* had on society was not so much to help the cause of the poor but instead to institute laws to regulate slaughterhouses. These laws were important and made it much safer to consume meat. However, they overlooked what Sinclair regarded as a much larger issue: how society treats workers. Ideas can grow and be put into action in quite disparate ways.

Consider the many different suggestions already posed to address the replication crisis. Some are general tips on how to conduct high-quality replications, which include (a) establishing credibility by clearly summarizing the research to be replicated; (b) demonstrating the need for the replication study; (c) following the original research design as closely as possible, identifying and justifying any deviations; and (d) developing explanations for why results are sometimes consistent and sometimes inconsistent with those of the original study (Toncar & Munch, 2010).

Some researchers have focused in this context on how scientists are rewarded, arguing that the underlying causes of the replication crisis would be mitigated, at least to some degree, if promotions, grants, and other desirable academic outcomes were not as closely tied to positive and hence publishable results (Lilienfeld, 2017; Nosek, Spies, & Motyl, 2012; Simonsohn, Nelson, & Simmons, 2014). It is hard to argue with this sentiment. However, with funding agencies and universities facing budget cuts, it is also hard to see how such widespread changes will happen without the necessary resources.

There are many proposed solutions, and in most cases, the scholars have their hearts in the right place. However, many solutions may contain key flaws. Everett and Earp (2015), for example, suggested that a well-executed replication should be required for graduate students to obtain a PhD. Such a policy might advance the field, but would it benefit the student? If the goal is to teach proper methodology, students could conduct

a carefully supervised study that is based on their own ideas. If the goal is to use cheap labor to strengthen the field, then it could easily end up with students being exploited.

One area in which implementations are actively taking place is journal policies. Drotar (2010) called for increased submissions of replication studies to the *Journal of Pediatric Psychology* and also urged authors to include supplemental material that would allow future replicators to be more accurate. Other journals, such as *Advances in Methods and Practices in Psychological Science* and the *Journal of Experimental Psychology: General*, strongly encourage a study's rationale, methods, and predictions to be preregistered in a data-stamped, open source such as the Open Science Framework. As of now, these steps are required for replications; they are only suggestions for other studies. It is possible that the implementations at the journal level will stay at the "best practices" level and thus remain optional procedures (perhaps rewarded with a badge or other public acknowledgment). It is also possible, however, that they will shift toward becoming standard protocol. LeBel et al. (2013), for example, argued that all journals should require potential authors to disclose full methodological information (such as listing every measure used as part of the study and specifying how the sample size was determined).

Proponents of these guidelines argue that they would benefit psychological science and make it more accurate and trustworthy. By building a stronger empirical base, the story goes, we will be able to detect true advancements and move the field forward. In other words, stricter procedures will, in the long term, increase scientific creativity by giving research more solid foundations. Pointing to the distinction between ideas and their implementation, however, we argue that such logic reflects wishful thinking more than reality, particularly under a scenario in which the guidelines above are taken to the extreme and become mandatory in all branches of psychology. Instead, we point to the need for balance. We argue that as suggestions become rules, we move away from this balance. The same distinctions between ideas and implementation and the need for balance that are true for the replication crisis are also true for creativity. Another important concept in creativity that is applicable to the current debate is the benefit of differing views and concepts joining together.

Creativity: Ideas and Implementations

The word *creativity* is often used interchangeably with the word *innovation*, yet there are important nuances. Creativity is a broad term that can include a wide scope of products, from imaginative thoughts to brilliant works of genius. Someone may be potentially creative in science and have many interesting ideas, yet never produce a manuscript. In contrast, innovation requires these scientific ideas to be applied and fully realized (Anderson, Potocnik, & Zhou, 2014). When we discuss how the replication crisis will affect scientific creativity, it is important to be careful with terms and definitions. To understand the continuum between creativity and innovation, consider the creative growth that takes place across a career and where the replication crisis may have the most potential effect.

One theory in creativity, the four-C model, offers a developmental trajectory that suggests different levels of accomplishment (Beghetto & Kaufman, 2007; J. C. Kaufman & Beghetto, 2009). When someone learns and discovers a new topic, he or she may have ideas that are new and personally meaningful (even if others do not agree). At this mini-c level, for example, a student may be introduced to classic science experiments and conjure her own mental representations in her head (e.g., Ward, 1994). Her insights may be no more advanced than those of any other engaged student, but they are her own (Beghetto, 2016). As she shares her ideas, she will sift through feedback and gain insights into her creative strengths and weaknesses (J. C. Kaufman & Beghetto, 2013). At this level of everyday creativity, or little-c, she can produce work that others recognize as being creative. Examples of little-c may include a strong entry in a local science fair. With practice and acquired expertise, she may reach professional creativity, or Pro-c. At this level, she is actively contributing to a field with manuscripts of publishable quality. Some Pro-c scholars continue to strive and move toward Big-C achievements when their accomplishments survive them. They may even be considered creative geniuses; it is ultimately up to future generations to decide the retrospective strength of a creator's legacy (e.g., Csikszentmihalyi, 1999).

Each advancement toward the next C in the progression is a step toward turning ideas into implementations. This transition may be in the form of an unspoken thought becoming articulated (a possible move from mini-c to little-c) or connecting a body of research into a larger theory, finding, or discovery that changes the world (a possible move from Pro-c to Big-C). Furthermore, it is important to note that each C is not necessarily a sudden switch; mini-c, little-c, Pro-c, and Big-C are intended to simply be labels and not categories (Beghetto & Kaufman, 2015). Like the actual process of being creative, it is not a straight line; there are cycles and reversals and unexpected directions. A Pro-c creator will have mini-c moments of insight that may become little-c and then Pro-c, and this entire process may take a few minutes (Beghetto & Kaufman, 2013).

There may be countless cycles of ideas to implementations within the smallest gradient of a C, in addition to the broader prospective of how one develops and evolves creativity across a life span.

If the four Cs take a person-oriented approach, the propulsion model of creative contributions (Sternberg, 1999; Sternberg & Kaufman, 2012; Sternberg, Kaufman, & Pretz, 2004) focuses on the creative product. As with the four Cs, consider which types of creative work in science are most important for the field and how the issues of the replication crisis may differentially affect them. The propulsion model is concerned with how a creative work affects the field. Some types of contributions stay within the existing paradigm. *Replications*,[1] at the most basic level, aim to reproduce or recreate a past successful creation, whereas *redefinitions* take a new perspective on existing work. Forward or advance forward *incrementations* push the field ahead slightly or a great deal, respectively. Forward incrementations anticipate where the field is heading and are often quite successful, whereas advance forward incrementations may be ahead of their time and may be recognized only retrospectively. These categories stay within the existing paradigm; others push the boundaries. *Redirections*, for example, try to change the way a field is moving and take it in a new direction. *Integrations* aim to merge two fields, whereas *reinitiation* contributions seek to entirely reinvent what constitutes the field. Most of these categories exist in the Pro-c or Big-C level. All involve finished products and thus would be considered not only creative but also innovative.

When we discuss the effect of the replication crisis on scientific creativity, such as in this symposium, what implicit assumptions are we making? Do we care more about ideas or implementations? Given that no articles in this issue are exploring possible ramifications for sixth-grade science fairs, these are not hard questions to answer. The debate is not about the full spectrum of creativity; it is focused on the Pro-c expressions that would also be called innovation. Likewise, when we engage in these discussions, we are thinking of the future of our field. The replications and incrementations help shape present conceptions, but science progresses as the paradigm itself is expanded or changed. The philosophy behind current calls for replication and the guidelines that are starting to be formulated around them are concerned with the "correctness" of implementations. Existing ideas need to be verified and not taken at face value (Nosek et al., 2012), and precautions should exist to prevent questionable research practices (Lindsay et al., 2016). The danger is that this value system may come at the expense of new ideas.

We want to again emphasize that we are not against scholars using these techniques; indeed, we support their use. If and when suggestions become requirements for all, they will add significantly more time and resources for each study and, probably, an additional hurdle of bureaucracy. An organization supports creativity by ensuring that adequate time and resources are set aside for creative work (Amabile & Gryskiewicz, 1989). If these new practices result in additional time and resources spent on each manuscript, they take away the time and resources needed for creative work. In doing so, they ignore the balance that is needed in science between free ideation and constrained implementation. It is precisely this kind of dynamic equilibrium that defines creative work.

Creativity and the Replication Crisis: Ideas, Implementations, and Balance

The core ideas that inspired the replication crisis are legitimate and even noble. Falsified data, findings that turn out to be based on chance or error, and dishonest or questionable research practices (e.g., Lilienfeld, 2017) are not good for science. Ideas on how best to avoid such occurrences would be unlikely to diminish creativity, given that the standard definition of creativity is making a contribution that is both novel and valuable (Hennessey & Amabile, 2010; J. C. Kaufman, 2016). Science does not need to be ultimately "right" to be creative; most eminent scientists (from Newton to Galileo to Einstein) turned out to be incorrect in at least some of their work. Indeed, the natural progression of science includes such mistakes and accidents. However, a study rooted in duplicity (such as falsified data) or in extremely questionable research practices does not hold any value for science. Therefore, it cannot be considered creative (Makel & Plucker, 2014a, 2014b, 2015). Consider Cyril Burt, mentioned earlier. Soon after his death, claims of falsified data and other unethical behavior emerged and nearly all of his research was considered invalid. There was eventually extensive pushback on the accusations, with many scholars arguing that he was innocent of wrongdoing (see essays in Mackintosh, 1995). Yet today he is mostly remembered for the controversy surrounding his work. Any lasting effect that Burt's research may have had is mostly gone.

As we transition from the expression of these ideas to their implementation, there is a certain balance to consider. What is best for science? Many of the leaders of the replication crisis movement have framed their goals as seeking scientific truth. Indeed, Nosek et al. (2012) have discussed the merits of valuing new ideas versus truth. Yet there is a false dichotomy proposed here. Few people would argue that scientific truth is not a worthy pursuit; the question is about the best way to seek such truth. Most scholars who value scientific

creativity see it as a pathway to truth, not an obfuscation of it. These scholars are ready to accept—even encourage—partial or incorrect implementations as part of creativity in science (and other domains; see Glăveanu et al., 2013), because we have not (at least not yet) reached any ultimate truth.

The question of balance in science extends to much more than the opposing concepts of free ideation versus rigorous implementation. In fact, we argue that the same balance among competing ideas that are essential to creativity is also needed for science. Let us first examine how the combination and integration of opposites are an integral part of creativity. The core definition discussed earlier of novelty and value itself combines attributes that are not always aligned. The most valuable offerings are not necessarily the most original ones. If you have a clogged toilet, the first step would be to grab a plunger. Unraveling a wire hanger and attaching it to a flurry of pipe cleaners may (eventually) accomplish the same goal, but the plunger is more immediately useful and a better first choice. The new ideas become valuable (and, hence, creative) when they improve in some way on what is already existing and at hand.

There are many more such contradictions in the creative literature. As noted by Csikszentmihalyi (1996), creators often have seemingly discrepant personalities. They may be energetic yet well rested, playful yet responsible, or intelligent yet naive. Two of the core elements of the creative process are divergent thinking, or idea generation, and convergent thinking, or idea evaluation (Finke, Ward, & Smith, 1992; Guilford, 1950). Being able to produce many different new ideas is different from being able to select the best idea out of many ideas. Simonton's (2011) blind variation, selective retention model uses this same two-part concept at a macro level. New ideas are developed blindly, with little planning or vision of long-term success, and then over generations, the best ones are selectively retained.

In sociocultural approaches to creativity (see Glăveanu, Gillespie, & Valsiner, 2015), the interplay between agency and constraints comes to the fore. Creative products and processes manage, in a surprising manner, to combine sameness (conventionality) and difference (uniqueness) by exploiting the tension between them. There is, in fact, a dynamic movement between these two seemingly opposed poles. Creative ideas build on what is known or conventional but do so precisely by modifying existing knowledge; in turn, when new concepts and ideas are integrated into what we know, they become part of the new conventional wisdom. This cycle can persist as a continuous process (Glăveanu, 2011), not necessarily dialectical in the Hegelian sense—because new ideas do not always make a synthesis of the old—but dialogical, where the new and the old are kept in productive tension with each other (see Bakhtin, 1981).

The issue of constraints may be the most relevant to the replication crisis. There is a common assumption that creativity is "thinking outside the box," yet one must also be able to think inside the box. Real life has limited resources, and the ability to create within constraints is equally (if not more) important. People are often more creative when there are constraints in place, whether solving problems or creating art (Haught, 2015; Stokes, 2007, 2014). Complete freedom may lead people to be overwhelmed and to gravitate toward more obvious or easy responses (Haught-Tromp, 2017). Yet if there are too many constraints, creativity is also limited (Medeiros, Partlow, & Mumford, 2014). In addition, timing is crucial. Constraints in the early stages of the creative process can be beneficial, whereas constraints later in the process typically are not (Medeiros, Steele, Watts, & Mumford, 2017).

The ideas underlying the replication crisis, as we have discussed, are important. Yet many of the current or suggested implementations implicitly if not explicitly value convergent over divergent thinking. Supporting, refining, and perfecting existing work are seen as linchpins of scientific truth. Undoubtedly, such practices play an important role in scientific creativity (Cropley, 2006). Ideas must be properly evaluated and verified before they become innovative contributions. The risk, as we see it, is that the more that convergent practices are emphasized, the less that divergent, original, and exploratory work will be valued (e.g., Cropley, 2017). Another risk is that the use of qualitative methods will be discouraged because qualitative studies cannot possibly be evaluated using the standards set by supporters of replication (for a discussion of accountability in qualitative research, see Gaskell & Bauer, 2000). Nosek et al. (2012) argued that novelty is related to an article's being more likely to be published, whereas the continued study and verification of a new idea are related to the pursuit of scientific truth. We see an alternative view.

Science is complex and filled with components that can seem in opposition to each other. Empirical and theoretical advances have a chicken-and-egg relationship of propelling each other forward. Theoretical construction is linked to the more speculative (or generative) side of scholarship (Beghetto, 2014). To those who value theory, explorative ideation is prized and implementation becomes a second, convergent step. Current guidelines for replication studies reverse this relationship: The implementation is preexisting and needs to be repeated with as little novelty as possible. What we should remember is that moving too far toward either side of pure theory or empiricism is rarely desirable

(Gopnik, 2009). At the extreme, the development of theory in the absence of empirical support can only fall apart, but hard empiricism driven by method rather than theory is equally empty.

Another dichotomy is between a promotion focus and a prevention focus (Higgins, 1998). Those with a promotion focus are eager, pursuing discovery even at the risk of errors. In contrast, a prevention focus entails a vigilant approach that places a greater emphasis on caution and reducing mistakes. As Finkel, Eastwick, and Reis (2015) noted, a scientist's focus affects goals and practice. The eager approach leads one to pursue opportunities and to include and integrate as much potentially relevant information as possible. Neither extreme is ideal. People who advocate extensive regulations to address the replication crisis can legitimately argue that a lack of attention to details and accuracy (also consistent with promotion focus) played a substantial part in establishing conditions that allowed questionable research practices. But we return to the question of balance.

We accept that the pendulum of science may have been edging more toward the novelty end of scientific innovation than toward that of value. The replication crisis has raised important issues. There has already been a growing movement for journals to be more encouraging of replications or to recognize preregistered hypotheses and methods. We believe, to the extent that these standards remain suggestions and options, that we have reached a balanced position. This equilibrium at the moment, however, is increasingly fragile. The older guard, particularly researchers whose studies have not been reproduced successfully, have lashed back. In one prominent example, an established scholar described the supporters of the replication crisis as being guilty of "methodological terrorism" (Letzter, 2016). It is reasonable to assume that the suggested implementations are actively opposed by some scholars. Conversely, people who strongly support such implementations are eager to turn their views of science into policy. If the implementations lean toward the more extreme proposals and become mandates, however, then we argue that the pendulum will swing too far away from novelty and toward confirmation. Science will become the land of convergence, prevention, and too many constraints. Scholars who might have become Big-C or paradigm-shifting creators may end up being confined to little-c ideation and paradigm-confirming implementation. Change is not always good. It can lead to errors that take us backward; appropriate caution and care are important. But we, as creativity researchers, believe that the absence of any change is most definitely bad.

We should remember that many of the initial ideas for new scientific guidelines came in response to issues in social psychology (Klein, 2014; Open Science Collaboration, 2015). Research and theory articles regarding beliefs about the replication crisis, unsurprisingly, tend to focus on social psychologists (e.g., Reis & Lee, 2016; Stürmer, Oeberst, Trötschel, & Decker, 2017). As a result, most of the suggested implementations take the perspective and values of social psychology. One risk is that these implementations may be embraced by the journals not exclusively (or even primarily) devoted to social psychology. Requirements for replicability, preregistration, and open data have a different implication for studies that are purely exploratory, aim to develop a new assessment, or focus on difficult populations (from infants to well-known creators). The danger associated with some of the more extreme implementation proposals is that they establish a certain standardization of the entire field. With this new landscape, scholars working across disciplines or those who use qualitative methods will see their options constrained and have fewer choices for publishing in high-quality outlets. These circumstances could lead to a culture shift that would be applauded by some but result in a loss of autonomy and initiative for many others. Extreme implementations of some of the ideas resulting from the replication crisis could potentially ruin the benefit of the core ideas.

As important as it is to move science away from the dangers of errors and poor research practices, we see it as equally if not more important to not hold back scientific innovation. We are at a time when science has little currency in the public eye. Antiscience attitudes flourish in what many warn is a posttruth era (Glăveanu, 2017), whereas other groups embrace pseudoscience (A. B. Kaufman & Kaufman, 2017). Indeed, science has gone from being seen as a miraculous cure for humanity to a threat to civilization to something that political interests dismiss easily when it seems inconvenient (Hecht, 2015; Oreskes & Conway, 2010). Yet, more than ever, the world needs solutions for a growing list of seemingly insurmountable problems. It is not enough for science to be intelligent and ensure that we are not led astray by false or irreproducible findings (e.g., Sternberg, 2014). It is important to consistently check that established ideas are correct, to know where we are, but this step is not sufficient. We also need to hold on to our scientific creativity and think of where we want to be.

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Note

1. *Replication* is a term used in the theory and not a specific reference to the replication crisis.

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