aps ASSOCIATION FOR PSYCHOLOGICAL SCIENCE

Current Directions in Psychological Science
2019, Vol. 28(1) 28–33

DOI: 10.1177/0963721418797300
www.psychologicalscience.org/CDPS
SAGE

Overstating the Role of Environmental Factors in Success: A Cautionary Note

David Moreau[1,2], Brooke N. Macnamara[3], and David Z. Hambrick[4]

[1]School of Psychology, The University of Auckland; [2]Centre for Brain Research, The University of Auckland; [3]Department of Psychological Sciences, Case Western Reserve University; and [4]Department of Psychology, Michigan State University

Abstract

Several currently popular areas of research—brain training, mind-set, grit, deliberate practice, and the bilingual advantage—are premised on the idea that environmental factors are the overwhelming determinants of success in real-world pursuits. Here, we describe the major claims from each of these areas of research and discuss evidence for these claims, particularly focusing on meta-analyses. We suggest that overemphasizing the malleability of abilities and other traits can have negative consequences for individuals, science, and society. We conclude with a call for balanced appraisals of the available evidence concerning this issue, to reflect current scientific discrepancies and thereby enable informed individual decisions and collective policies.

Keywords

abilities, skills, interventions, environment, genetics

> I believe that if one always looked at the skies, one would end up with wings.
>
> —Gustave Flaubert (1915), *Pensées* (p. 50)

The view that a person's environment plays a much greater role in determining success in the world than innate traits has long been a theme of psychological theorizing. Nearly a century ago, John Watson, the founder of behaviorism, articulated this view when he wrote,

> Give me a dozen healthy infants, well-formed, and my own specified world to bring them up in and I'll guarantee to take any one at random and train him to become any type of specialist I might select—doctor, lawyer, artist, merchant-chief and, yes, even beggar-man and thief, regardless of his talents. (Watson, 1930, p. 104)

The appealing implication of this view is that anyone can be become highly successful, whether it be in school, at work, or at a hobby.

Although few, if any, contemporary scientists would endorse Watson's extreme view, the idea that individuals' capabilities are highly malleable, and thus that environmental factors are the overwhelming determinants of accomplishment in real-world pursuits, remains a powerful undercurrent in psychological research. This view is currently emphasized in five popular areas of research: brain training, mind-set, grit, deliberate practice, and the bilingual advantage. Thousands of scientific articles have been published on these topics, which have also captured the popular imagination through books such as *Smarter: The New Science of Building Brain Power* (Hurley, 2014), *Mindset: The New Psychology of Success* (Dweck, 2006), *Grit: The Power of Passion and Perseverance* (Duckworth, 2016), and *Peak: Secrets From the New Science of Expertise* (Ericsson & Pool, 2016). Some of these areas of research have also spawned lucrative commercial ventures. Brain training is a multibillion-dollar industry, and commercial mind-set interventions are used in schools around the world.

Nevertheless, the central claims of each of these areas of research have been increasingly called into question in the scientific literature. Here, we briefly summarize evidence from each area of research,

Corresponding Author:
David Moreau, The University of Auckland, Centre for Brain Research, Science Centre, 23 Symonds St., Office 227, Auckland 1010, New Zealand
E-mail: d.moreau@auckland.ac.nz

focusing on large-scale studies and meta-analyses. Our intent is not to criticize individual theorists—misleading statements can find their way into the media and popular beliefs despite caution expressed by the theorists (see, e.g., Duckworth, 2016). Rather, our goal is to present current evidence for the claims central to each area of research. We conclude that caution is warranted when considering both future research on these topics and translations of this research to real-world applications.

Brain Training

The premise of brain training is that the brain is like a muscle that can be strengthened through cognitive exercise. More specifically, the idea is that training in tasks that target core cognitive functions, such as working memory, attention, and spatial ability, generalizes to real-world situations that call on these functions. This claim of *far transfer* has been at least implicit in advertising claims by brain-training companies (see Simons et al., 2016). Scientists have made similar claims, arguing that working memory training improves fluid intelligence (Jaeggi, Buschkuehl, Jonides, & Perrig, 2008) and that video-game playing enhances visuospatial abilities (Green & Bavelier, 2003).

Nevertheless, after more than a decade of intensive research on brain training, it is clear that far transfer is elusive. Several meta-analyses have demonstrated that the benefits of brain training are limited to the trained task or to very similar tasks (*near transfer*). For example, in a meta-analysis, Melby-Lervåg and Hulme (2013) found "no convincing evidence of the generalization of working memory training to other skills" (p. 270). They also noted that studies of working memory training are often plagued by major methodological problems, including the use of research designs without appropriate control groups. More recently, Simons and colleagues (2016) conducted an exhaustive review of the available evidence of the benefits of brain training and concluded that "the evidence that training with commercial brain-training software can enhance cognition outside the laboratory is limited and inconsistent" (p. 173). Finally, in a meta-analysis examining brain training in the form of playing video games, Sala, Tatlidil, and Gobet (2017) "found no evidence of a causal relationship between playing video games and enhanced cognitive ability" (p. 111).

Mind-Set

Whereas the idea of brain training is to directly strengthen cognitive abilities, the aim of mind-set interventions is to increase people's beliefs that they can be strengthened. Dweck (2000) has argued that people who hold a *growth mind-set* believe that intelligence (and other traits) can be improved with effort and thus will persist to overcome obstacles and work hard; by contrast, people with a *fixed mind-set* believe intelligence is relatively stable and are "devastated by setbacks" (Dweck, 2008, para. 2). In a typical mind-set intervention, participants are told that the brain is like a muscle and can grow with effort. As Dweck (2007) explained, students learn about "how they can make their brains work better and grow smarter" (p. 38). These brief interventions are touted for "striking effects on educational achievement" (Yeager & Walton, 2011, p. 268; see also Boaler, 2013; Dweck, 2008).

Mind-set interventions are used in schools around the world. However, evidence for the impact of mind-set on real-world outcomes is equivocal. Large-sample research has failed to replicate findings of beneficial effects of mind-set interventions. As a case in point, across three studies with a total sample of more than 600 participants, Li and Bates (2017) found "no support for mindset-effects on cognitive ability, response to challenge, or educational progress" (p. 2). Furthermore, in a recent meta-analysis, Sisk, Burgoyne, Sun, Butler, and Macnamara (2018) examined the effectiveness of growth-mind-set interventions on academic achievement and identified a number of methodological shortcomings among mind-set studies, such as many instances of manipulation checks either not being successful or not being reported. Sisk et al. (2018) found that the effectiveness of mind-set interventions on academic achievement was very weak overall, with almost all analyses yielding small or null effects. They concluded that "those seeking more than modest effects or effects for all students are unlikely to find them" (p. 568).

Grit

Grit refers to perseverance and passion for long-term goals (Duckworth & Eskreis-Winkler, 2013; Duckworth, Peterson, Matthews, & Kelly, 2007). Gritty people maintain "effort and interest over years despite failure, adversity, and plateaus in progress" (Duckworth et al., 2007, p. 1088), whereas less gritty people are easily discouraged (Duckworth & Eskreis-Winkler, 2013). Duckworth (2016) argued that "you *can* grow your grit" (p. 269, emphasis added), and Duckworth and Gross (2014) stated they were "optimistic that a better understanding of the psychological processes underlying self-control and grit could, in fact, lead to high-impact, cost-effective interventions" (p. 323).

However, in a study of 4,642 twins, Rimfeld, Kovas, Dale, and Plomin (2016) found that grit was substantially heritable but found no evidence for a shared environmental influence on grit. They explained that "the most limiting finding, for any possible intervention, is that shared environmental influence is negligible" (p. 786). In other words, current environmental factors such as how parents raise their children or approaches schools take to teaching do not appear to influence grit. They also noted that, despite a lack of evidence that grit can be trained, training grit has been established as a priority by the U.S. Department of Education (see http://pgbovine.net/OET-Draft-Grit-Report-2-17-13.pdf) and the U.K. Department of Education (see https://www.gov.uk/government/news/england-to-become-a-global-leader-of-teaching-character). Rimfeld et al. (2016) caution that "the effectiveness of training programs should be rigorously researched before they are rolled out widely" (p. 781).

Evidence further suggests that, even if grit is found to be trainable, it may have no impact on academic achievement above and beyond other personality factors. For example, Rimfeld et al. (2016) stated that "grit adds little phenotypically or genetically to the prediction of academic achievement beyond traditional personality factors, especially conscientiousness" (p. 780). Similarly, Credé, Tynan, and Harms (2017) conducted a meta-analysis investigating the influence of grit and other traits on academic achievement and found that whereas conscientiousness explained variance in academic achievement after controlling for grit, "overall grit explains no variance in either overall academic performance or high school GPA after controlling for conscientiousness" (p. 501).

Deliberate Practice

The concept of deliberate practice emphasizes the importance of environmental factors in the context of acquiring expertise in a specific domain. The deliberate-practice view claims that "individual differences in ultimate performance can largely be accounted for by differential amounts of past and current levels of practice" (Ericsson, Krampe, & Tesch-Römer, 1993, p. 392). More generally, Ericsson (2007) claimed that "it is possible to account for the development of elite performance among healthy children without recourse to unique talent (genetic endowment)—excepting the innate determinants of body size" (p. 4). A further claim in this view is that "it is impossible for an individual with less accumulated practice at some age to catch up with the best individuals, who have started earlier and maintain maximal levels of deliberate practice not leading to exhaustion" (Ericsson et al., 1993, p. 393).

There is no question that deliberate practice can lead to major improvements in performance within an individual. The controversial claim is that deliberate practice can largely explain differences in performance across individuals. This claim is not supported by empirical evidence. In a recent meta-analysis, Macnamara, Hambrick, and Oswald (2014) found that deliberate practice leaves the majority of variance in performance across individuals unexplained and potentially explainable by other factors (see also Platz, Kopiez, Lehmann, & Wolf, 2014). In another meta-analysis, Macnamara, Moreau, and Hambrick (2016) found that deliberate practice accounted for a nonsignificant 1% of the variance in performance among elite-level athletes, inconsistent with Ericsson and colleagues' (1993) claim that "individual differences, even among elite performers, are closely related to assessed amounts of deliberate practice" (p. 363). Furthermore, Macnamara et al. (2016) found that higher-level athletes were no more likely to have begun practicing their sport at a younger age than their lower-level counterparts. Together, this evidence indicates that deliberate practice is not the only important contributor to individual differences in expertise.

Bilingual Advantage

Finally, there is currently a great deal of scientific interest in the benefits of bilingualism for cognitive functioning—the so-called bilingual advantage (Bialystok, 1999). The idea behind the bilingual advantage is that prolonged experience maintaining multiple languages in working memory and inhibiting the inactive languages improves executive functioning. As Bialystok (2009) explained, "The effect of bilingualism on cognitive functioning as evidenced by lexical access, executive control, and working memory, is part of a growing body of research demonstrating the powerful role of experience on cognitive function and cognitive organization" (p. 9).

However, multiple researchers have pointed out that the literature on the bilingual advantage suffers from a high degree of publication bias, favoring statistically significant, positive effects (de Bruin, Treccani, & Della Sala, 2015). Indeed, a recent large-scale meta-analysis showed no evidence for the bilingual advantage in any executive-function domain after correcting for publication bias (Lehtonen et al., 2018). Similarly, in a detailed critique of the literature, Paap, Johnson, and Sawi (2015) pointed out that over 80% of the tests assessing the bilingual advantage since 2011 yielded null findings.

What's the Harm?

The evidence that we have just reviewed notwithstanding, one might argue that there is no harm in people believing in the overwhelming importance of environmental factors in success. What, for example, is the harm in leading the elderly to believe that "brain games" will have broad benefits for cognitive functioning, even if that is unlikely given the available evidence? Or what is the harm in enrolling children in mind-set interventions (touted as relatively inexpensive), even if the available evidence casts serious doubt on the effectiveness of these interventions?

We think there is potential harm in the form of opportunity costs. Some of these opportunity costs affect society. For example, time that students spend completing ineffective interventions could be spent on learning mathematics, science, language, arts, and other school subjects. Similarly, money spent on brain training or mind-set programs for a school—even if the program is cheaper than other interventions—could be spent on more effective interventions or on needs such as hiring additional teachers. Other opportunity costs affect science. For example, at the cost of pursuing other areas of research, young scientists excited about these topics might dedicate their formative training years to pursuing effects that they are unlikely to find. Likewise, researchers spending time and effort attempting to reproduce, validate, or meta-analyze these claims do so at the expense of pursuing other research endeavors. Finally, funding dedicated to these areas could go to more promising areas.

We further argue that overemphasizing the role of environmental factors in success may lead to failure being stigmatized, despite the fact that individual differences in many real-world endeavors may in part reflect factors that are not under people's control. That is, by overemphasizing the influence of environmental factors, we may unintentionally hold individuals accountable for conditions, events, or outcomes beyond their control, including learning disabilities and neurological disorders. If, for example, the brain is like a muscle and cognitive functions can be dramatically increased through brain training, then why should any child suffer from learning disabilities or attention-deficit/hyperactivity disorder? Likewise, if deliberate practice is the overwhelming determinant of expertise, why should anyone who devotes thousands of hours of practice to a given sport not become an Olympic gold medalist? In short, we argue that overemphasizing malleability while minimizing the role of stable traits in success may burden individuals and families with responsibilities that are largely not theirs to bear.

Conclusion

There is no doubt that environmental factors play an important role in determining success in real-world domains. At the same time, it now seems clear that environmental factors have a more limited impact on individual differences in success than some theories suggest. Views that emphasize malleability over the influence of stable traits on success are appealing, particularly in modern democratic societies, which place great emphasis on equal opportunities across individuals. However, acknowledging the role of factors that are difficult to change is important because it enables the allocation of resources where they can have a real impact, taking into account individual needs, to allow meaningful improvements.

In our view, continuing to accept claims that are unsupported by evidence hinders scientific progress and prevents evidence-based policies. The scientific community should therefore consider current evidence and direct research toward endeavors that provide insight on the complex and interacting factors that contribute to individual differences in success in real-world domains. Ultimately, recognizing and understanding individual differences, rather than denying or undermining their importance, leads to politics of equity—providing individuals with the means to thrive—rather than equality—treating everyone uniformly regardless of their specific needs.

Recommended Reading

Credé, M., Tynan, M. C., & Harms, P. D. (2017). (See References). Presents a meta-analytic synthesis of the grit literature, with a particular focus on the relation between grit, cognitive ability, and performance.

Paap, K. R., & Greenberg, Z. I. (2013). There is no coherent evidence for a bilingual advantage in executive processing. *Cognitive Psychology, 66*, 232–258. Reviews the evidence for a bilingual advantage in executive processing and describes three experimental studies investigating the effect via a comparison of bilingual and monolingual populations.

Simons, D. J., Boot, W. R., Charness, N., Gathercole, S. E., Chabris, C. F., Hambrick, D. Z., & Stine-Morrow, E. A. L. (2016). (See References). Reviews evidence for the efficacy of brain-training programs and provides a set of guidelines and best practices for the design and reporting of interventions.

Sisk, V., Burgoyne, A. P., Sun, J., Butler, J. L., & Macnamara, B. N. (2018). (See References). Reports on two meta-analyses exploring the relationship between mind-set and academic achievement as well as the efficacy of growth-mind-set interventions in schools.

Ullén, F., Hambrick, D. Z., & Mosing, M. A. (2016). Rethinking expertise: A multifactorial gene–environment interaction

model of expert performance. *Psychological Bulletin, 142*, 427–446. doi:10.1037/bul0000033. Proposes a multifactorial gene–environment interaction model of expertise as an alternative to the deliberate-practice framework.

Action Editor

Randall W. Engle served as action editor for this article.

Declaration of Conflicting Interests

The author(s) declared that there were no conflicts of interest with respect to the authorship or the publication of this article.

References

Bialystok, E. (1999). Cognitive complexity and attentional control in the bilingual mind. *Child Development*, *70*, 636–644. doi:10.1111/1467-8624.00046

Bialystok, E. (2009). Bilingualism: The good, the bad, and the indifferent. *Bilingualism: Language and Cognition*, *12*, 3–11. doi:10.1017/S1366728908003477

Boaler, J. (2013). Ability and mathematics: The mindset revolution that is reshaping education. *Forum*, *55*, 143–152.

Credé, M., Tynan, M. C., & Harms, P. D. (2017). Much ado about grit: A meta-analytic synthesis of the grit literature. *Journal of Personality and Social Psychology*, *113*, 492–511. doi:10.1037/pspp0000102

de Bruin, A., Treccani, B., & Della Sala, S. (2015). Cognitive advantage in bilingualism. *Psychological Science*, *26*, 99–107. doi:10.1177/0956797614557866

Duckworth, A. (2016). *Grit: The power of passion and perseverance*. New York, NY: Scribner.

Duckworth, A. L., & Eskreis-Winkler, L. (2013). True grit. *Observer*. Retrieved from https://www.psychologicalscience.org/observer/true-grit

Duckworth, A. L., & Gross, J. J. (2014). Self-control and grit: Related but separable determinants of success. *Current Directions in Psychological Science*, *23*, 319–325. doi:10.1177/0963721414541462

Duckworth, A. L., Peterson, C., Matthews, M. D., & Kelly, D. R. (2007). Grit: Perseverance and passion for long-term goals. *Journal of Personality and Social Psychology*, *92*, 1087–1101. doi:10.1037/0022-3514.92.6.1087

Dweck, C. S. (2000). *Self-theories: Their role in motivation, personality, and development*. East Sussex, England: Psychology Press.

Dweck, C. S. (2006). *Mindset: The new psychology of success*. New York, NY: Random House.

Dweck, C. S. (2007). The perils and promises of praise. *Educational Leadership*, *65*(2), 34–39.

Dweck, C. S. (2008). Brainology: Transforming students' motivation to learn. *Independent School*. Retrieved from http://www.stns.org/downloads/NAISBrainology.CarolDweck.pdf

Ericsson, K. A. (2007). Deliberate practice and the modifiability of body and mind: Toward a science of the structure and acquisition of expert and elite performance. *International Journal of Sport Psychology*, *38*, 4–34.

Ericsson, K. A., Krampe, R. T., & Tesch-Römer, C. (1993). The role of deliberate practice in the acquisition of expert performance. *Psychological Review*, *100*, 363–406.

Ericsson, K. A., & Pool, R. (2016). *Peak: Secrets from the new science of expertise*. Boston, MA: Houghton Mifflin Harcourt.

Flaubert, G. (1915). *Pensées*. Paris, France: Louis Conard.

Green, C. S., & Bavelier, D. (2003). Action video game modifies visual selective attention. *Nature*, *423*, 534–537. doi:10.1038/nature01647

Hurley, D. (2014). *Smarter: The new science of building brain power*. London, England: Penguin Books.

Jaeggi, S. M., Buschkuehl, M., Jonides, J., & Perrig, W. J. (2008). Improving fluid intelligence with training on working memory. *Proceedings of the National Academy of Sciences, USA*, *105*, 6829–6833. doi:10.1073/pnas.0801268105

Lehtonen, M., Soveri, A., Laine, A., Järvenpää, J., de Bruin, A., & Antfolk, J. (2018). Is bilingualism associated with enhanced executive functioning in adults? A meta-analytic review. *Psychological Bulletin*, *144*, 394–425. doi:10.1037/bul0000142

Li, Y., & Bates, T. (2017). *Does growth mindset improve children's IQ, educational attainment or response to setbacks? Active-control interventions and data on children's own mindsets*. Retrieved from SocArXiv: https://osf.io/preprints/socarxiv/tsdwy/

Macnamara, B. N., Hambrick, D. Z., & Oswald, F. L. (2014). Deliberate practice and performance in music, games, sports, education, and professions: A meta-analysis. *Psychological Science*, *25*, 1608–1618. doi:10.1177/0956797614535810

Macnamara, B. N., Moreau, D., & Hambrick, D. Z. (2016). The relationship between deliberate practice and performance in sports: A meta-analysis. *Perspectives on Psychological Science*, *11*, 333–350. doi:10.1177/1745691616635591

Melby-Lervåg, M., & Hulme, C. (2013). Is working memory training effective? A meta-analytic review. *Developmental Psychology*, *49*, 270–291. doi:10.1037/a0028228

Paap, K. R., Johnson, H. A., & Sawi, O. (2015). Bilingual advantages in executive functioning either do not exist or are restricted to very specific and undetermined circumstances. *Cortex*, *69*, 265–278. doi:10.1016/j.cortex.2015.04.014

Platz, F., Kopiez, R., Lehmann, A. C., & Wolf, A. (2014). The influence of deliberate practice on musical achievement: A meta-analysis. *Frontiers in Psychology*, *5*, Article 646. doi:10.3389/fpsyg.2014.00646

Rimfeld, K., Kovas, Y., Dale, P. S., & Plomin, R. (2016). True grit and genetics: Predicting academic achievement from personality. *Journal of Personality and Social Psychology*, *111*, 780–789. doi:10.1037/pspp0000089

Sala, G., Tatlidil, K. S., & Gobet, F. (2017). Video game training does not enhance cognitive ability: A comprehensive meta-analytic investigation. *Psychological Bulletin*, *144*, 111–139. doi:10.1037/bul0000139

Simons, D. J., Boot, W. R., Charness, N., Gathercole, S. E., Chabris, C. F., Hambrick, D. Z., & Stine-Morrow, E. A. L. (2016). Do "brain-training" programs work? *Psychological Science in the Public Interest*, *17*, 103–186. doi:10.1177/1529100616661983

Sisk, V., Burgoyne, A. P., Sun, J., Butler, J. L., & Macnamara, B. N. (2018). To what extent and under which circumstances are growth mind-sets important to academic achievement? Two meta-analyses. *Psychological Science*, *29*, 549–571.

Watson, J. B. (1930). *Behaviorism* (Rev. ed.). Chicago, IL: University of Chicago Press.

Yeager, D. S., & Walton, G. M. (2011). Social-psychological interventions in education. *Review of Educational Research*, *81*, 267–301.