Helping Disadvantaged and Spatially Talented Students Fulfill Their Potential: Related and Neglected National Resources

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Abstract

For at least the last half-century, we have underserved advanced learners, losing countless minds and corresponding innovations. The scientific evidence is clear on educational interventions that are most effective and relatively easy to implement for this population. Despite this, such educational opportunities are not readily available to all students. Whereas financially advantaged students can access opportunities outside of school that develop their talents, financially disadvantaged students cannot, and their talents largely go underdeveloped. Another underserved population is spatially talented learners, who can reason by using well-structured visual images. They are often underidentified and neglected in standardized tests and school systems that emphasize verbal and mathematical skills. Although all advanced learners deserve to have their talents developed to the fullest, a policy focus on the financially disadvantaged and spatially talented would be an actionable and effective strategy to quickly level the playing field. Because spatial reasoning is less correlated with socioeconomic status than are math and verbal reasoning in the population, identifying spatial talent will also identify more students from low-income and disadvantaged backgrounds. A policy focus on helping and challenging such disadvantaged students would contribute to fulfilling their talent and increasing their well-being; it also would increase demographic and intellectual diversity among the ranks of the highest achievers and benefit society. The current K-12 federal educational allocation to advanced learners is currently near zero. Research suggests a small early investment in advanced learners would pay off in intellectual and technological innovations, as well as GDP.

Tweet

Of the $49.8 billion 2015 federal education budget, advanced learners are barely funded, at a ratio of 500,000 to their single dollar.

Key Points

- We underserve advanced learners, losing countless minds and potential innovations, despite having available scientifically supported and easily implemented educational interventions.
- Although financially advantaged students can access opportunities outside of school that develop their talents, financially disadvantaged students cannot.
- Also underserved, spatially talented learners—expert at visual reasoning—are often neglected by standardized tests and school systems that emphasize verbal and mathematical talent.
- Although all advanced learners deserve to develop their talents, a policy focus on those who are both financially disadvantaged and spatially talented could quickly level the playing field.
- Because spatial reasoning is less correlated with socioeconomic status than are math and verbal reasoning in the population, identifying spatial talent will also identify more students from low-income and disadvantaged backgrounds.
- Helping and challenging such disadvantaged students would fulfill their talent and well-being, also increasing demographic and intellectual diversity among the highest achievers, benefiting society.
- The current K-12 federal educational allocation to advanced learners is currently near zero, but small early investments would pay off in intellectual and technological innovations, as well as GDP.

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Introduction

At 16, Albert Einstein wrote his first scientific paper titled, "The Investigation of the State of Aether in Magnetic Fields." This article was the result of his famous *gedanken experiment* in which he visually imagined chasing after a light beam. The insights he gained from this thought experiment eventually led to the development of his theory of special relativity. Einstein was able to perform this thought experiment likely due to his extraordinary spatial talent—"the ability to generate, retain, retrieve, and transform well-structured visual images" (Lohman, 1996, p. 100; see also Lohman, 1994; West, 1997). Spatial reasoning is less correlated with socioeconomic status than are math and verbal reasoning in the population (Lubinski, 2010; Wai, Lubinski, & Benbow, 2009). Thus, identifying spatially talented learners will result in identifying more low-income advanced learners.

Scientific Evidence

Peter Thiel (2015) famously said of the future, "We wanted flying cars, instead we got 140 characters." As innovative as Twitter might be, it pales in comparison with science, technology, engineering, and mathematics (STEM) breakthroughs that could truly transform our future. Many things that were futuristic in the past remain futuristic today, in large part because we have not funded numerous potentially breakthrough technologies. Yet perhaps more fundamentally, we have failed to identify and develop the *minds* that go on to creatively imagine solutions to many of the world's problems and invent things that today are completely unimagined (Subotnik, Olszewski-Kubilius, & Worrell, 2014; Wai, 2015b). Innovations, after all, come from people.

For at Least the Last Half-Century, We've Underserved Advanced Learners, Losing Minds and Innovations

In an article written two decades ago, Benbow and Stanley (1996) reviewed 30 years of evidence revealing that the United States's most advanced learners were performing well beneath their potential, and this was largely due to their not being challenged to develop their academic talents. More recently, a comprehensive review of the gifted literature (Subotnik, Olszewski-Kubilius, & Worrell, 2011) echoed the finding that advanced learners were underperforming. Furthermore, it argued that this underperformance was largely due to a lack of societal focus on and investment in advanced learners who are most likely to go on to create previously unimagined benefits for society. Therefore, for at least the last half-century, we have demonstrably underserved advanced learners, and in the process have likely lost countless minds and their corresponding innovations.

We Know How to Identify Advanced Learners, and Which Educational Interventions Work for Them

What may seem surprising about this neglect of advanced learners is that for decades, the research findings have been clear about both the *educational interventions* (Assouline, Colangelo, VanTassel-Baska, & Lupkowski-Shoplik, 2015) and the *educational dosage* (Wai, Lubinski, Benbow, & Steiger, 2010) that are most effective in developing the talents of such students. Built upon the basic understanding that students each learn at their own individual rates, we know that for academically advanced learners, the key is to provide tailored interventions that challenge such students at the appropriate level. The broad intervention of *educational acceleration*—essentially moving advanced learners through the curriculum at rates faster than typical—has been supported by decades of evidence (Assouline et al., 2015; Wai, 2015a). More broadly, because each student differs, many interventions are effectively interchangeable, as long as they challenge and engage the student intellectually and provide the appropriate dosage or density of educational opportunities (Wai et al., 2010). We have known for decades what works for advanced learners.

Of course, before matching the appropriate educational interventions with individual students to help develop their talents, we have to find appropriate ways to identify them. Identification of advanced learners effectively occurs through multiple avenues, one of which is the talent search model (Olszewski-Kubilius, 1998), essentially testing students to see where they are performing and what educational challenges they can handle.

Innovations Are Linked to Spatial Reasoning

Well over a half-century of research shows that spatial reasoning is linked to STEM innovation, even over and above math and verbal reasoning (Wai et al., 2009). Therefore, we have known for decades that spatial reasoning is important to scientific advances that have a lasting impact on society.

In fact, across the last 15 years, *MIT Technology Review* (2001-2015) has routinely identified breakthrough technologies and scientific advances that will likely transform our future. Many of these advances across the STEM disciplines are clearly spatial in nature. In computing, we have witnessed 3-D transistors; in mathematics, the discovery of a new mathematical tile; in engineering, nano-architecture and agile robots; in chemistry, a self-healing polymer and DNA origami; and in biology and medicine, microscale 3-D printing and implantable electronics. These are just a handful of innovations that have been created by individuals who have relied in large part on their spatial ability and imagination.

Spatially Advanced Learners Are a Neglected Population

Yet, despite the clear connection of spatial reasoning to innovation and even creativity (Kell, Lubinski, Benbow, & Steiger, 2013; Lubinski, 2010; Wai et al., 2009; West, 1997), educational testing from K-12, to college, and even graduate school, largely neglects spatially advanced learners (Wai, 2013b), largely because all these tests do not include spatial measures. Not only do school systems primarily focus on verbal and mathematical aspects in both testing and teaching, spatially advanced learners are less likely to be vocal or speak out (Lohman, 1994). Educators themselves are likely to have higher verbal and math reasoning relative to spatial reasoning, often the inverse pattern of strengths among many spatially advanced learners (higher spatial relative to math and verbal reasoning). Although educators may not intend this, it is often easier to see talent in others that one possesses; therefore, educators may also inadvertently neglect spatially talented students for this reason. All of these considerations converge to suggest that spatial talent is neglected in the current U.S. school system and has been for many decades.

Nearly a century ago, a talent search conducted by Lewis Terman used the highly verbal Stanford–Binet in an attempt to discover the brightest kids in California. This test would miss identifying two kids who would go on to achieve scientific fame, likely because the Stanford–Binet did not include a spatial test: William Shockley and Luis Alvarez, both of whom would go on to become famous physicists and win the Nobel Prize. Fortunately for Shockley and Alvarez, they were able to find ways to develop their spatial and other talents to the fullest. But for many students who are not as fortunate, we have likely let them and their potential to contribute to society fall through the cracks.

Low-Income Advanced Learners Are Another Neglected Population

Another and perhaps more important neglected population of advanced learners are students who come from low-income backgrounds and lack the opportunities that their more financially advantaged peers possess (Callahan, 2005; Loveless, 2014; Olszewski-Kubilius & Clarenbach, 2012; Organisation for Economic Co-Operation and Development [OECD], 2011). Arguably, neglected low-income advanced learners in the United States number in the millions (Wyner, Bridgeland, & DiIulio, 2007). These low-income advanced learners are largely underrepresented in elite schools (Bastedo & Jaquette, 2011; Hoxby & Avery, 2013) and elite occupations (Wai, 2013a, 2014).

Scholars have also pointed out that similar to achievement gaps observed among all students, there are *excellence gaps* among the most advanced learners, in particular between low-income advanced learners and other advanced learners (Hardesty, McWilliams, & Plucker, 2014; Plucker, Giancola, Healey, Arndt, & Wang, 2015). Although the full closing of achievement gaps may not be possible (Ceci & Papierno, 2005), including a focus on excellence gaps can help to reduce educational inequality for these low-income, high-potential learners, given their lower access to adequate educational interventions that have already been shown to be effective (Assouline et al., 2015; Wai et al., 2010). This focus may at the same time contribute to leveling the playing field more generally, by providing academic and occupational role models for low-income students, an outcome that the singular focus on the achievement gap does not do (Hess, 2011). Accelerated and enriched educational opportunities are not readily available to all students. Whereas financially advantaged students can access outside-of-school opportunities that develop their talents, financially disadvantaged students do not have this option, and their talents largely go underdeveloped.

Fully Developed Advanced Learners Improve Intellectual and Technological Innovations and GDP

Research findings from the Study of Mathematically Precocious Youth (SMPY), a U.S. sample of highly select advanced learners (Lubinski & Benbow, 2006) shows that fully developed advanced learners make substantial intellectual and technological contributions, such as earning doctorates and university tenure, publishing fiction and non-fiction, and registering patents at rates *2 to 8 times higher* than the general population (Park, Lubinski, & Benbow, 2007; Wai, Lubinski, & Benbow, 2005). In addition to these contributions, these learners also contribute to society by paying taxes on the substantially higher incomes that they earn. Indeed, fully developed advanced learners around the world have a long-term economic impact, for example, on a country's GDP (OECD, 2010; Rindermann & Thompson, 2011).

Policy Implications

Education Policy Must Account for Individual Differences

In "For Hire: Dedicated Young Man With Down syndrome," a concerned father (Berube, 2014) reflected on his (now grown) son's difficulties in school, which eventually translated into difficulties in finding gainful employment. This piece is an insightful examination on why being sensitive to individual differences in learning rates is important, and why having compassion for people at every level is important and valuable.

Several key psychological findings, backed by decades of research, also contribute important insights. The first is that people differ quite widely throughout the full range of ability

(Benbow & Stanley, 1996; Gottfredson, 1997). Second, these differences are, at least in part, due to genetics (Asbury & Plomin, 2014). Third, and of particular importance, is the fact that the environment has a larger impact on IQ, and, by extension, achievements related to IQ, in lower socioeconomic status populations (Nisbett et al., 2012).

On one end of the spectrum of learning are individuals with extreme learning difficulties and at the other end of the spectrum are the advanced learners. Accounting for these wide individual differences in education policy fundamentally drives how to implement effective educational interventions. Students at every level of the learning rate distribution should have the opportunity to learn something new each day (Stanley, 2000); this includes advanced learners who often do not develop to their full potential.

Helping All Advanced Learners Fulfill Their Potential Is Important for Moral, Humanitarian, and Pragmatic Reasons

Helping all students fulfill their potential is important, and this includes advanced learners, as better serving advanced learners has both individual and societal benefits. There is a frequent bias against helping those who already appear to have such a head start in life, which may understandably be rooted in the concern that inequality will widen rather than shrink. And yet, one of the greatest myths is the idea that advanced learners do not face challenges (Moon, 2009; Subotnik et al., 2011; Worrell, 2010). For example, advanced learners who are not challenged and given the opportunity to learn something new each day can disengage from school, and their joy of learning often fades (Assouline et al., 2015). What this means is that even those who appear to have such a head start in life often will not be able to develop their talents to the fullest and correspondingly may not be personally fulfilled (Subotnik et al., 2011).

Beyond benefits to the individual are the clear societal benefits that can come if advanced learners are provided the help and challenge they need to develop their talents. The research is clear that advanced learners have a large impact on innovation and economic growth. Many scholars have discussed how by not providing support to our most academically advanced students we are shortchanging not only them, but also society, due to their innovation capacity (Augustine, 2005; Finn & Wright, 2015; Gallagher, 2013; Subotnik et al., 2011; Wai, 2012).

We should support the educational and personal development of advanced learners for moral, humanitarian, and pragmatic reasons (Moon & Dixon, 2015, cited in Wai, 2015c). The moral reason is that the first rule of education is to do no harm; by not challenging advanced learners, we may be doing just that, especially for those from disadvantaged backgrounds (Assouline et al., 2015). In this regard, the law applied to students with special education needs mandates a free *appropriate* public education (Education for All Handicapped Children Act of 1975). The humanitarian reason is that the talent-development process takes a long time, and talent development contributes to self-actualization (Lubinski, Benbow, & Kell, 2014; Subotnik et al., 2011). The pragmatic reason is that investing in advanced learners can yield previously unimagined benefits for society (Lubinski & Benbow, 2006; Lubinski et al., 2014; Subotnik et al., 2011; Wai, 2012).

Funding for Advanced Learners Is Currently Near Zero—Even a Small Investment in Advanced Learners Would Result in a Huge Payoff in Intellectual and Technological Innovations and GDP

Advanced learners are not a population that appears, on the face of it, to need assistance. But consider federal funding for advanced learners. According to the National Association for Gifted Children website, the federal government educational allocation for advanced learners is near zero (Callahan, Moon, & Oh, 2014). Of the US$49.8 billion in the federal education budget for 2015, a total of 0.0002% is allocated to gifted and talented education. In other words, money is allocated to everyone else *except* advanced learners at a ratio of 500,000 to 1. This puts advanced learners from low-income backgrounds at a severe disadvantage because they often depend on the educational programming offered by the public school system. With no funding tied to advanced learners in states and districts, it should be no surprise if large numbers of advanced learners are never identified, fail to have their talent developed, and never reach their potential.

Nobel Prize winning economist James Heckman (2000) has shown that investing in students early can have an enormous long-term economic and societal payoff. Consider the data indicating that differences in learning rates among advanced learners translate into significant differences in economic benefits to society (Lubinski & Benbow, 2006; Park et al., 2007; Rindermann & Thompson, 2011; Wai et al., 2005). Heckman illustrated the rate of return to investment in human capital using payoff curves, showing that early investments in *high ability* students in comparison with *low ability* students result in much greater rates of return. Extending this work throughout the wide range of learning rates of advanced learners suggests that even a small investment in advanced learners will result in a huge payoff in intellectual and technological innovations and GDP.

This is one of several reasons why investment in advanced learners is a national competitiveness issue (National Science Board, 2010). In both sports and education, there are below average, average, and advanced individuals. If a coach decided to focus largely on developing the talent of the least competent players, it is doubtful fans would approve—It would reduce the competitiveness of the team. And yet, this is the

current situation in the United States; we focus on low-performing individuals (as we should), but we ignore advanced learners (which we should not). If this strategy is ineffective in the competitive world of sports, it would appear to also be ineffective in a global economy that is becoming increasingly competitive.

Focusing on Financially Disadvantaged and Spatially Talented Advanced Learners Is an Actionable and Effective Strategy to Level the Playing Field

However, even though it is important to help and challenge all advanced learners, there are two neglected populations of advanced learners that deserve significant and immediate attention. These are financially disadvantaged and spatially talented advanced learners. Focusing on these groups would not only result in a huge payoff in terms of intellectual, technological, and socioeconomic capital, but perhaps even more importantly, a focus on these groups would increase demographic and intellectual diversity among the ranks of the highest achievers and leaders and help reduce inequality. Helping these two neglected populations would be an actionable and effective strategy to level the playing field. As Loveless (2014) pointed out, policies that emphasize talent development for high achieving students can actually serve as a tool for greater fairness.

In a representative population level U.S. sample, spatial reasoning is less correlated with socioeconomic status than are math and verbal reasoning (Lubinski, 2010; Wai et al., 2009). This finding suggests that identifying spatially advanced learners will also result in identifying more low-income and other disadvantaged advanced learners because it shows that, at least in some talent domains, socioeconomic status is not as tightly linked to talent and provides an important area to target resources. This does not, of course, negate the need to fully identify and develop the talents of diverse students from all low-income and disadvantaged backgrounds.

By Underserving Advanced Learners, What Innovations Have We Already Lost?

By neglecting advanced learners for at least the last half-century, we have already lost to the quicksand of underachievement an unquantifiable number of brilliant minds and innovations that simply *could have been*. The innovators who have made it through to the pinnacles of achievement have been fortunate enough to gain access to challenging opportunities through a greater access to resources, financial or otherwise. And, from one perspective, if we take a look around our world, we can think about how amazing our innovation currently is. Yet, as comforting as that perspective might be, we can also take the vision of the forward thinker, and consider how much more amazing our innovations might be if

we simply took the time to help all students, including our advanced learners, to reach self-actualization and perhaps in so doing also create things that benefit us all. There were many moments in Einstein's life course, any one of which may have derailed him from creating the theory that we all know today. Similarly, countless others alive today might create something of equal or even greater magnitude. But many of them come from disadvantaged backgrounds or are neglected in schools due to a lack of focus on their strengths, such as spatial talent. Just like all students, they deserve to reach their full potential, and they cannot make it on their own.

References

Asbury, K., & Plomin, R. (2014). *G is for genes: The impact of genetics on education and achievement*. West Sussex, UK: John Wiley.

Assouline, S. G., Colangelo, N., VanTassel-Baska, J., & Lupkowski-Shoplik, A. E. (Eds.). (2015). *A nation empowered: Evidence trumps the excuses that hold back America's brightest students*. Iowa City, IA: The Belin-Blank Center for Gifted and Talented Education.

Augustine, N. (Chair). (2005). *Rising above the gathering storm: Energizing and employing America for a brighter economic future. Committee on prospering in the global economy of the 21st century*. Washington, DC: National Academies Press.

Bastedo, M. N., & Jaquette, O. (2011). Running in place: Low-income students and the dynamics of higher education stratification. *Educational Evaluation and Policy Analysis*, *33*, 318-339.

Benbow, C. P., & Stanley, J. C. (1996). Inequity in equity: How "equity" can lead to inequity for high-potential students. *Psychology, Public Policy, and Law*, *2*, 249-292.

Berube, M. (2014, May). For hire: Dedicated young man with Down syndrome: A father reflects on his son's search for employment. *Al Jazeera America*. Retrieved from http://projects.aljazeera.com/2014/portrait-of-down-syndrome/

Callahan, C. M. (2005). Identifying gifted students from underrepresented populations. *Theory Into Practice*, *44*, 98-104.

Callahan, C. M., Moon, T. R., & Oh, S. (2014). *National surveys of gifted programs: Executive summary*. Charlottesville: National Research Center on the Gifted and Talented, University of Virginia.

Ceci, S. J., & Papierno, P. B. (2005). The rhetoric and reality of gap closing: When the "have-nots" gain but the "haves" gain even more. *American Psychologist*, *60*, 149-160.

Education for All Handicapped Children Act of 1975. Pub L. 94–142 (20 U.S.C. and 34 C.F.R.).

Finn, C. E., Jr., & Wright, B. L. (2015). *Failing our brightest kids: The global challenge of educating high-ability students.* Boston, MA: Harvard Education Press.

Gallagher, J. J. (2013). Educational disarmament, and how to stop it. *Roeper Review, 35,* 197-204.

Gottfredson, L. S. (1997). Why *g* matters: The complexity of everyday life. *Intelligence, 24,* 79-132.

Hardesty, J., McWilliams, J., & Plucker, J. A. (2014). Excellence gaps: What they are, why they are bad, and how smart contexts can address them . . . or make them worse. *High Ability Studies, 25,* 71-80.

Heckman, J. (2000). Policies to foster human capital. *Research in Economics, 54,* 3-56.

Hess, F. M. (2011, Fall). Our achievement gap mania. *National Affairs.* Retrieved from http://www.nationalaffairs.com/publications/detail/our-achievement-gap-mania

Hoxby, C. M., & Avery, C. (2013). The missing "one-offs": The hidden supply of high-achieving, low-income students. *Brookings Papers on Economic Activity, Spring,* 1-65. Retrieved from http://www.brookings.edu/~/media/projects/bpea/spring-2013/2013a_hoxby.pdf

Kell, H. J., Lubinski, D., Benbow, C. P., & Steiger, J. H. (2013). Creativity and technical innovation: Spatial ability's unique role. *Psychological Science, 24,* 1831-1836.

Lohman, D. F. (1994). Spatially gifted, verbally inconvenienced. In N. Colangelo, S. G. Assouline, & D. L. Ambroson (Eds.), *Talent development Volume II: Proceedings from the 1993 Henry B. and Jocelyn Wallace National Research Symposium on Talent Development* (pp. 251-264). Dayton: Ohio Psychology Press.

Lohman, D. F. (1996). Spatial ability and *g.* In I. Dennis & P. Tapsfield (Eds.), *Human abilities: Their nature and assessment* (pp. 97-116). Hillsdale, NJ: Lawrence Erlbaum.

Loveless, T. (2014). *Tracking in middle school: A surprising ally in pursuit of equity?* Thomas B. Fordham Institute's Education for Upward Mobility Conference. Retrieved from http://edex.s3-us-west-2.amazonaws.com/Loveless%20Paper-KLM%20%281%29.pdf

Lubinski, D. (2010). Spatial ability and STEM: A sleeping giant for talent identification and development. *Personality and Individual Differences, 49,* 344-351.

Lubinski, D., & Benbow, C. P. (2006). Study of Mathematically Precocious Youth after 35 years: Uncovering antecedents for the development of math-science expertise. *Perspectives on Psychological Science, 1,* 316-345.

Lubinski, D., Benbow, C. P., & Kell, H. J. (2014). Life paths and accomplishments of mathematically precocious males and females four decades later. *Psychological Science, 25,* 2217-2232.

MIT Technology Review. (2001-2015). *10 breakthrough technologies.* Retrieved from http://www2.technologyreview.com/tr10/?year=2011

Moon, S. M. (2009). Myth 15: High-ability students don't face problems and challenges. *Gifted Child Quarterly, 53,* 274-276.

Moon, S. M., & Dixon, F. (Eds.). (2015). *The handbook of secondary gifted education* (2nd ed.). Waco, TX: Prufrock Press.

National Science Board. (2010). *Preparing the next generation of STEM innovators: Identifying and developing our nation's human capital.* Arlington, VA: National Science Foundation.

Nisbett, R. E., Aronson, J., Blair, C., Dickens, W., Flynn, J., Halpern, D. F., & Turkheimer, E. (2012). Intelligence: New findings and theoretical developments. *American Psychologist, 67,* 130-159.

Olszewski-Kubilius, P. (1998). Talent search: Purposes, rationale, and role in gifted education. *Journal of Secondary Gifted Education, 9,* 106-113.

Olszewski-Kubilius, P., & Clarenbach, J. (2012). *Unlocking emergent talent: Supporting high achievement of low-income, high-ability students.* Washington, DC: National Association for Gifted Children.

Organisation for Economic Co-Operation and Development. (2010). *The high cost of low educational performance: The long-run economic impact of improving PISA outcomes.* Paris, France: Author.

Organisation for Economic Co-Operation and Development. (2011). *Against the odds: Disadvantaged students who succeed in school.* Paris, France: Author.

Park, G., Lubinski, D., & Benbow, C. P. (2007). Contrasting intellectual patterns for creativity in the arts and sciences: Tracking intellectually precocious youth over 25 years. *Psychological Science, 18,* 948-952.

Plucker, J., Giancola, J., Healey, G., Arndt, D., & Wang, C. (2015). *Equal talents, unequal opportunities: A report card on state support for academically talented low-income students.* Landsdowne, VA: Jack Kent Cooke Foundation.

Rindermann, H., & Thompson, J. (2011). Cognitive capitalism: The effect of cognitive ability on wealth, as mediated through scientific achievement and economic freedom. *Psychological Science, 22,* 754-763.

Stanley, J. C. (2000). Helping students learn only what they don't already know. *Psychology, Public Policy, and Law, 6,* 216-222.

Subotnik, R. F., Olszewski-Kubilius, P., & Worrell, F. C. (2011). Rethinking giftedness and gifted education: A proposed direction forward based on psychological science. *Psychological Science in the Public Interest, 12,* 3-54.

Subotnik, R. F., Olszewski-Kubilius, P., & Worrell, F. C. (2014, August). The talent gap. The U.S. is neglecting its most promising science students. *Scientific American,* p. 13. Retrieved from http://www.scientificamerican.com/article/the-u-s-neglects-its-best-science-students/

Thiel, P. (2015). *What happened to the future?* Retrieved from http://foundersfund.com/the-future/

Wai, J. (2012, July). Of brainiacs and billionaires. *Psychology Today, 92,* 78-85.

Wai, J. (2013a). Investigating America's elite: Cognitive ability, education, and sex differences. *Intelligence, 41,* 203-211.

Wai, J. (2013b, July 31). Why we need to value students' spatial creativity. *KQED MindShift.* Retrieved from http://ww2.kqed.org/mindshift/2013/07/31/why-we-need-to-value-spatial-creativity/

Wai, J. (2014). Investigating the world's rich and powerful: Education, cognitive ability, and sex differences. *Intelligence, 46,* 54-72.

Wai, J. (2015a, April 20). As a nation, how can we best empower our gifted kids? What is the impact of educational acceleration? *Psychology Today* [Finding the Next Einstein blog]. Retrieved from https://www.psychologytoday.com/blog/finding-the-next-einstein/201504/nation-how-can-we-best-empower-our-gifted-kids

Wai, J. (2015b, July 8). By neglecting spatial intelligence, how many Elon Musks have we missed? *Quartz.* Retrieved from http://qz.com/447137/by-neglecting-spatial-intelligence-how-many-elon-musks-have-we-missed/

Wai, J. (2015c, March 4). Love the child, not the gift: A conversation with Sidney Moon and Felicia Dixon. *Psychology Today* [Finding the Next Einstein blog]. Retrieved from https://www.psychologytoday.com/blog/finding-the-next-einstein/201503/love-the-child-not-the-gift

Wai, J., Lubinski, D., & Benbow, C. P. (2005). Creativity and occupational accomplishments among intellectually precocious youth: An age 13 to age 33 longitudinal study. *Journal of Educational Psychology*, *97*, 484-492.

Wai, J., Lubinski, D., & Benbow, C. P. (2009). Spatial ability for STEM domains: Aligning over fifty years of cumulative psychological knowledge solidifies its importance. *Journal of Educational Psychology*, *101*, 817-835.

Wai, J., Lubinski, D., Benbow, C. P., & Steiger, J. H. (2010). Accomplishment in science, technology, engineering, and mathematics (STEM) and its relation to STEM educational dose: A 25-year longitudinal study. *Journal of Educational Psychology*, *102*, 860-871.

West, T. G. (1997). *In the mind's eye: Visual thinkers, gifted people with dyslexia and other learning difficulties, computer images and the ironies of creativity*. New York, NY: Prometheus Books.

Worrell, F. C. (2010). Psychosocial stressors in the development of gifted learners with atypical profiles. In J. L. VanTassel-Baska (Ed.), *Patterns and profiles of promising learners from poverty* (pp. 33-58). Waco, TX: Prufrock Press.

Wyner, J. S., Bridgeland, J. M., & DiIulio, J. J. (2007). *Achievement trap: How America is failing millions of high-achieving students from lower-income families*. Landsdowne, VA: Jack Kent Cooke Foundation.