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Interdisciplinary Insights That Reveal Contextual Influences on the Development of Giftedness and Talent

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Abstract: There are powerful, hidden contextual influences that strengthen, weaken, or distort the discovery of aspirations and the development of talents in gifted individuals. These influences can be hidden from gifted individuals and their teachers and mentors because they are not sufficiently addressed in the gifted education research literature. This analysis highlights and describes examples of contextual influences that emerge from phenomena studied by scholars in a wide variety of fields. After these examples are presented and clarified, recommendations for educators and scholars of the gifted are provided.

Keywords: gifted; talent; education; interdisciplinary; ethics; transformational giftedness

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1. Overview of Interdisciplinary Creative Intelligence Explorations

For a very long time, scholars in most academic disciplines have focused intently on phenomena within their own fields. They seldom consider theories and research findings from beyond their own domains [1–3]. In one example, over 20 eminent researchers came together to unify theories of creative intelligence. This was an interdisciplinary group including an economist, a philosopher, a theoretical physicist, psychologists, and gifted education specialists, among others. This posed a problem because the participants did not know the knowledge bases and terminology their colleagues brought into the forum. Consequently, the author of this article was brought in to serve as an interdisciplinary translator who would read the works of all of the participants and turn their major insights into visual metaphors [4]. These were drawings and paintings in which the imagery metaphorically captured the ideas from the research. Each visual metaphor was accompanied by a brief story explaining how the symbolism in the imagery conveyed the theories and research findings. They were set up around the conference rooms as if in an art museum and during breaks, the participants could wander around, look at the images, read the accompanying text, and familiarize themselves with the knowledge bases from the fields represented in the project. This helped them communicate with one another.

When interdisciplinary teams are not involved, individual scholars still can carry out far-ranging interdisciplinary explorations that can add concepts and theories to the knowledge base in gifted education. For example, one project involved the cross-referencing of 87 theories and research findings from 29 academic disciplines and professional fields to create insights about creative intelligence [5]. This exploration enabled the discovery of cross-disciplinary influences. For example, ideas about leadership from indigenous studies [6] were connected with insights from feminist standpoint theory [7]. There were intriguing similarities. Both bodies of work showed how those who align with them tend to embrace multiple perspectives when carrying out complex decision making. Authoritarian leadership tends to be absent from the more inclusive processes magnified by indigenous studies and feminist explorations. These ideas also were connected with phenomena in critical thinking because they aligned well with intellectual humility, which signifies the critical thinking ability of decision makers that helps them avoid falling prey to their own dogmatic rigidity [8].

These interdisciplinary explorations have made my conception of giftedness expand and diversify throughout the years. I still recognize the value of traditional conceptions that include advanced cognitive abilities; exceptional scholastic achievement; prodigious accomplishment in an area of endeavor; and outstanding creative, artistic, or leadership capacities (see [9]). There also are some useful modifications and refinements in the field, such as a strong emphasis on the emergence of giftedness through long-range talent development [10]. But the interdisciplinary discoveries forced me to recognize that these conceptions cannot be held rigidly, and must be augmented with other capacities and dispositions, which are discussed in the sections to come.

Due to the interdisciplinary nature of this article, it is a conceptual piece instead of an empirical analysis. It is conceptual because it involves the importation and syntheses of a wide variety of research findings and theories from many fields. The interdisciplinary exploration in this article is not as broad as the aforementioned large-scale projects, but it does include constructs from fields including economics, ethical philosophy, political philosophy, psychology, evolutionary biology, primatology, sociology, social epidemiology, neuroscience, history, the complexity sciences, various STEM fields, and gifted education.

This article is one more step on an interdisciplinary journey that has been taking place for more than three decades. Throughout the journey, I have been exploring the literature in multiple disciplines to discover theories, empirical research findings, and phenomena that can refine, clarify, and expand our knowledge of giftedness, talent development, and creativity. I have also been collaborating with scores of scholars from these various fields so they can contemplate some ways in which their work can apply to high ability. In essence, this and the other interdisciplinary projects tend to generate conceptual syntheses that produce insights conducive to additional theorizing and empirical work in gifted education.

Interdisciplinary work is needed because gifted education is a fragmented, porous, contested field [11]. Consequently, giftedness is a complex, ill-defined construct because there is no dominant theory as there would be if the field was unified, insular, and firmly policed [11,12]. An example of a unified field is neoclassical economics, which revolves around the dominant rational actor theory. The ideas for gifted education that are inspired by constructs from many disciplines are very diverse, including revisions of conceptions of giftedness, motivational dynamics, underachievement, and productive ways to solve problems in complex environments, among others. The following sections provide some examples of interdisciplinary connection making with high ability.

2. Transformational Giftedness versus Predators

Questions arise about the extent to which giftedness is used for beneficial or harmful purposes. Sternberg [13–15] draws distinctions between transactional and transformational giftedness. Individuals who are transactionally gifted use their impressive intelligence and talents to benefit themselves, often at the expense of others. In contrast, those who are transformationally gifted use these abilities to inject compassion and altruism into their innovative proclivities so they can make the world a better place. Sternberg recommends that the field of gifted education pay more attention to the ethical dimensions of high ability so bright, talented individuals will be more likely to move toward transformational manifestations of giftedness when they become adults. He also points out that only some transactionally gifted individuals do truly harmful things that might be considered similar to the damage caused by talented psychopaths (see [16]). Many of the transactionally gifted do not mean to do harm, but they can do it when they are only thinking about themselves.

Contextual pressures in societies can push the gifted toward either transactional or transformational inclinations as they develop toward adulthood. Many of the most powerful of these pressures come from the ways in which societies run their economies, which range from communist government control to vigorously deregulated, free market capitalism, with prudently regulated capitalism in between. For several decades, many developed nations have strongly favored deregulated capitalism [17] so individuals can

have maximal freedom as they develop their aspirations and talents and produce innovative enterprises. Deregulation minimizes government control over the economy so attempts by political agents to set up protections against unethical predation are weakened and discouraged. In contrast, nations that strongly favor the regulation of capitalist enterprises impose protections against economic predation, but they can diminish the freedom that makes high-level economic innovation easier [17–19]. Due to the shift of developed nations toward deregulated capitalism, this section of the article focuses on the effects of this economic system on gifted individuals.

Striking a balance between regulation and deregulation tends to make the economy vibrant and inclusive. It does not marginalize large portions of the population in a society but it still creates considerable wealth. But going too far in one direction or the other harms the economy and the lives of most citizens. The field of economics has been dominated by neoclassical theory, which portrays human agents in the economy as *rational actors* who are perfectly rational, make decisions on the basis of nearly complete information sets, and carry out these actions for entirely selfish purposes [18,20–22]. According to this theory, millions of selfish individuals engaging in economic actions make the economy strong and beneficial for all. But leading economists who dissent from rational actor theory argue that the economies of most nations around the world have become too deregulated and pour most of the wealth up into the pockets of a very small percentage of the population while leaving most others exploited and deprived [17,18,22,23]. Mulgan [24] used an insect metaphor to effectively convey the essence of this huge economic problem:

> If you want to make money, you can choose between two fundamentally different strategies. One is to create genuinely new value by bringing resources together in ways that serve people's wants and needs. The other is to seize value through predation, taking resources, money, or time from others, whether they like it or not. Your choice, in short, is whether to be a bee, or a locust. (p. 52)

Clearly, the most intelligent and talented human locusts in a society are transactional and enrich themselves without caring about the effects on others. In contrast, the gifted human bees in a society are transformational and try to ensure that their enterprises help others by going beyond selfishly stuffing their own pockets. This enormous, powerful contextual pressure on the ethical development of the gifted needs to be addressed by professionals in the field of gifted education, as recommended by Sternberg [13–15], Tirri [25], and Ambrose and Cross [26]. They need to become more aware of the locust–bee economic phenomenon and establish gifted programs that encourage students to aspire to become transformationally gifted bees instead of selfish, exploitative locusts.

3. Are We by Nature Vicious Competitors?

In scholarship related to the locust–bee metaphor, Charles Darwin's [27] insights about natural selection have fueled the popular notion that nature is red in tooth and claw, which means highly competitive and somewhat vicious. Compassion and cooperation seem not to fit well into this portrayal. Consequently, the notion that humans should be very aggressive and competitive has prevailed in a number of fields including economics, which portrays people as selfish rational actors (for details, see the prior section on transformational giftedness).

But some scientists have been arguing that the red in tooth and claw perspective is shortsighted. Ryan [28] argues that cooperation has played a much bigger role in evolutionary processes, and that human societies largely develop through cooperative inclinations. Similarly, primatologist Frans de Waal [29–31] has shown how cooperation and empathy are very evident in animal behavior. Observations in this field have revealed widespread empathetic actions within species, but surprisingly, the empathy can extend even further when creatures from different species interact and help one another.

The implications for gifted education are intriguing. Competition dominates the selection processes for identifying students for gifted programs because these processes are dominated by supposedly precise, mechanistic measurements of intelligence and academic

achievement (see [14,32]). Scholars and other professionals in gifted education have been developing and implementing more holistic, "less competitive" identification processes for a long time [32] but at the local level, mechanistic measures are magnified because they are somewhat resistant to arguments against their accuracy and inclusiveness, so they stand out as tools for selection of the gifted.

If professionals in the field were to heed the advice of prominent scholars who challenge long-term suppositions about intelligence, and step away from assumptions about nature being red in tooth and claw, they might align themselves more with the insights provided by the biologists and primatologists who have discovered and magnified the importance of cooperation and compassion. This could incline them to broaden their conceptions of giftedness while being more cautious about the accuracy of precise measurements (more on this precision in a later section). They also might focus less on promoting individualism and create more opportunities for the gifted to experience collaborative work aimed at helping others who are not in their identity group (see more on identity dynamics in the next section).

4. Particularist versus Universalist Morality

Many of the most serious problems in societies arise from the extent to which individuals favor those who are in their identity group while marginalizing or harming those who are not. Political philosopher Kristin Renwick Monroe [33–36] and ethical philosopher Alan Gewirth [37] illustrated some ways in which individuals can fit into two different moral–ethical camps. Those who align with *particularist morality* can be kind, generous, and compassionate toward those who are within their identity group. These "insiders" tend to be favored by particularist individuals because they are of the same ethnicity, race, religion, or other important identifiers. But particularists can denigrate, marginalize, or even do considerable harm to "outsiders" who do not fit their identity. This harm can be minor, but it also can extend all the way up to slavery and genocide. In contrast, those who align with universalist morality tend to extend their kindness, generosity, and compassion to all of humanity, including those who are very different from them.

When particularists come to dominate a society, conditions can become dire. Nazi Germany was a frightening example. Adolf Hitler and his supporters motivated the masses to follow the Nazi cause by selecting groups of outsiders and labeling them as subhuman and evil (see [38,39]), thus giving their followers enemies. This strongly encouraged the followers to adopt and firmly embrace their Nazi identities so the leaders could exploit them for political gain. Consequently, Jewish people and some other marginalized groups suffered miserably. The Nazis exterminated millions while engaging in a world war.

Along similar lines, unethical leaders in some developed nations today are identifying groups to be targeted for the same reasons that Hitler chose. These leaders promote and fuel the rise of authoritarian populism because they want large numbers of dogmatic followers who will obey and support them [40]. They distract their followers from the unethical exploitation they impose on them by denigrating certain racial and ethnic groups. This drives the followers into a frenzy that can turn violent at any time. The result is strong polarization in the population that undermines democracy [2,41].

These conditions provide gifted individuals with major problems to overcome and significant opportunities for leadership. All of this aligns with the aforementioned concept of transformational giftedness [12–14]. If some ethical individuals who are transformationally gifted (intent on making the world a better place) become interested in the power dynamics of sociopolitical systems, they will use their impressive intellectual capacities and talents to promote the growth of universalist morality throughout their societies while preventing the growth of harmful particularist versions of morality. They will find ways to suppress the deceptive messaging that encourages the masses to fall for toxic authoritarian populism. In contrast, some of those who are transactionally gifted (using extraordinary abilities for selfish purposes) will aspire to become powerful leaders in the sociopolitical system, and they will creatively design communication processes to promote and strengthen the un-

ethical messaging that fuels the growth of toxic forms of particularism. Given the harmful trends toward the undermining of democracy in the 21st century [2,41–43] it is extremely important to help gifted individuals become transformational universalists instead of transactional particularists.

5. Chronic Stress Emerging from Severe Inequality

Socioeconomic inequality grows and recedes over the long term. In some locations and eras, it is rather mild, while in others, it becomes extremely severe. The more inequality grows, the more chronic stress it forces onto the population, with the deprived suffering more than those who have significant wealth [44–46]. However, even those who are very well off suffer from the chronic stress caused by social comparison. Affluent individuals can feel this stress when they compare their assets or incomes with the wealth of others and find themselves losing the comparisons.

Sapolsky [47], a prominent neuroscientist, showed how the chronic stress suppresses and distorts cognitive development and processing. He describes how the "biological grind" caused by this long-term stress in highly unequal societies causes inflammation, chromosomal damage, and distorted brain functioning. Here are some of the suppressions and distortions of the brain–mind system:

- prefrontal cortex impaired (lowered executive function diminishes planning, decision making, and impulse control)
- hippocampus reduced (learning and memory weakened)
- amygdala distortions (fear and anxiety heightened)
- mesolimbic dopamine system (crucial for motivation; disruption leads to depression and addiction)
- retracting connections between neurons and suppressing the birth of new neurons (diminishes thought capacities)

Here is how Sapolsky [47] describes the essence of the inequality problem: "We know enough to prompt moral outrage at the situation. It is outrageous that if children are born into the wrong family, they will be predisposed toward poor health by the time they start to learn the alphabet".

Social epidemiologists Wilkinson and Pickett [45,46] show how the chronic stress from inequality also aggravates societal problems, which include elevations in mental illness and drug and alcohol addiction, lower levels of trust, suppressed social mobility (the chances that a child will become more successful than her/his parents), higher levels of violence and incarceration, and suppression of educational achievement, among others. They show how the social problems in more egalitarian nations (e.g., Japan, Finland, Sweden, Norway, etc.) are much less brutal than they are in nations with far more extreme inequality. The United States is by far the most unequal of the developed nations, and has the most acute social problems.

One other phenomenon embedded in the severe inequality we are experiencing in the 21st century is the difference in treatment between street criminals and corporate criminals [48,49]. Those who come from deprivation can commit very small crimes but end up incarcerated for decades in the horrific conditions of maximum security prisons [50]. Politicians, who like to portray themselves as "tough on crime", have promoted the growth of the "carceral state", a term Gottschalk uses to show how widespread, unfair, and toxic the crime–punishment system has become in the United States.

How can educators of the gifted and their students benefit from more knowledge about the effects of inequality on gifted students? First, they can recognize the ways in which their aspirations and talents might point them toward becoming either bees or locusts in adulthood, and strive to become the former instead of the latter. And while "becoming bees", they will be injecting their impressive aspirations and abilities with the ethical awareness that encourages them to become transformationally gifted (making the world a better place) as opposed to selfish and transactionally gifted (see the prior section on transformational giftedness for details).

Second, they can recognize that students' educational achievement and mental health are being suppressed and damaged if they live in a highly unequal nation. Such awareness can help them realize that any underachievement they are experiencing is at least partially due to the chronic stress produced by their nation's inegalitarian economic system. While this awareness can produce frustration, even disgust, it can be somewhat liberating because these individuals can recognize that they have impressive, hidden abilities that have not been allowed to emerge due to economic circumstances. They will be motivated to discover and develop these abilities to the full extent possible. When they become adults, they also might be inclined to make the world a better place by pushing the ideological and economic systems in their nation toward the bee metaphor as opposed to the locust one.

Intriguing, powerful examples of individuals transforming from locusts into bees come from the "Lost Prizes" program at the University of Winnipeg in Canada [51,52]. The professionals who designed and operate this program look for deprived individuals who have gone astray and then help them discover their aspirations and talents so they can establish new, more productive, ethical life trajectories. In one example, they helped an incarcerated young man regain his freedom and develop his abilities to the point where he is currently a practicing physician. Along with other recovered lost prizes, he is now doing positive, ethical work instead of destroying himself and others on the violent inner-city streets.

In addition to the Lost Prizes initiative, some professionals in the field of gifted education have been revealing the effects of severe inequality on the gifted while recommending ways to address this large-scale problem. For example, a group of scholars analyzed the effects of inequality on the gifted in a Special Issue of the *Roeper Review* [53]. Taken together, the contributions showed how severe inequality suppresses and distorts the aspirations and talent development of deprived, gifted individuals while diminishing their chances for admission to gifted programs. Some other scholars illustrate the ways in which gifted programs do not sufficiently address the effects of implicit bias against the educational prospects for Black, Hispanic, and Indigenous students (e.g., [54,55]). Essentially, all stakeholders in gifted education should be aware of the effects of socioeconomic inequality on the gifted and talented. Educators and parents need to address these effects to the full extent possible in terms of guiding, mentoring, and strengthening the motivation and achievements of the deprived students. Gifted, impoverished students must recognize that their impressive abilities could be hidden by the socioeconomic pressures they face.

6. Colossal Disasters and Creative Constraints

Most people logically assume that creative thought and action cannot take place effectively when there are significant barriers. It seems likely that individuals and groups confronting economic difficulties, environmental problems, large-scale conflicts, and other high-pressure issues will be too busy trying to survive and they will not be able to come up with innovations. But counterintuitively, research in the field of creativity studies shows that constraints can actually fuel impressive creativity [56–58]. Rather than completely blocking progress, when problem solvers remain somewhat flexible, the constraints imposed by the barriers can enable them to contemplate unusual solutions and select and implement the best of them. The results can be highly creative, impressive problem solutions or innovations.

One interesting example of creativity becoming vibrant in the face of constraints comes from what was arguably the world's worst pandemic, the Black Death that began in 1346 [59]. This plague exterminated half of the population in many regions and caused enormous suffering. It is hard to imagine a more daunting constraint than this. But because of this massive devastation, the shrinking of populations left more assets in the hands of survivors. Demand for various goods grew, and the European economy expanded. This new economic vibrancy jumpstarted the creation of new technologies such as blast furnaces, water power, wind power, and new weaponry.

Similar creative processes emerged in response to the constraints imposed by the COVID-19 pandemic [60]. Transport and trade disruption caused by this horrific global problem prompted the creative development of new agricultural innovations, including new forms of automation in food production.

When confronted with intimidating barriers while trying to carry out their work, gifted individuals can freeze up and stop trying because persisting seems futile. But if they know about the ways in which creative constraints can spark the emergence of creative insights, they might find themselves being more optimistic about the conditions in which they find themselves. They might be more willing to try various options and fail multiple times because they know that one or more creative solutions is hidden within the contextual turbulence that currently confines their thoughts and actions. Gifted perfectionists (see [61]) might benefit the most from this because knowledge of the creativity embedded in constraints can make problem solvers more accepting of their own failures.

7. Riding Hope to Prevent an Impending Apocalypse

Primatologist Jane Goodall has studied animal behavior, as well as trends and issues in the 21st century (see [62]). In her far-reaching investigations, she has contemplated ways for humanity to grapple with the large-scale macroproblems that are discussed elsewhere in this analysis (see [63,64]). In recognition that the combination of these problems produces the next essential crisis, she and her colleagues have investigated the phenomenon of hope that might help us survive and perhaps thrive in the decades to come.

She identifies four reasons to be hopeful. First, there is the recognition that nature is surprisingly resilient when environmental disasters strike. Climate change and pollution might destroy plants and animals on a large scale, but nature has a tendency to evolve and produce survivors that can deal with new conditions. Second, the human intellect is surprisingly effective because it can adjust to deal with rapidly changing conditions. This is in spite of the fact that these intellectual capacities also have been creating and fueling many of today's most serious problems. Third, the indomitable human spirit enables populations to grapple with problems while pondering the efficacy of possible solutions. Fourth, the power of young people to recognize and deal with the problems caused by prior generations has been impressive throughout human history. Taken together, these four reasons for hope represent a metaphorical lifeboat on a sinking 21st-century Titanic that has slammed into a gigantic iceberg comprised of 21st-century macroproblems. This lifeboat might be able to bring humanity to safety and prosperity on a nearby metaphorical island.

How can this magnification of hope benefit gifted young people? Young people growing up in today's turbulent world cannot see much reason for hope because the news outlets and social media platforms surrounding them tend not to produce any optimism about the large-scale problems [65]. But if they learn about Goodall's four reasons for hope, they might be able to replace their pessimism with some degree of optimism. Moreover, if they engage in authentic learning and inquiry projects that connect with some of the macroproblems, they can do practical work that fuels optimistic attitudes.

8. Finding the Zone of Complexity

Some gifted individuals can be scatterbrained at times. They also can lock themselves inside rigid, dogmatic conceptual boxes [66]. Fortunately, many gifted individuals can also effectively deal with problems and create highly complex, flexible, productive ideas and processes. These very different actions can fit into a simple framework drawn from the interdisciplinary field of complexity science. According to research in this field, complex adaptive systems tend to oscillate along a continuum from excessive order to excessive chaos, with a highly productive, desirable space in between these extremes [67–70] (see Figure 1). Complex, adaptive systems can take a very diverse array of forms. Examples include animal populations in ecosystems, chemical reactions in a laboratory, traffic pat-

terns in cities, individual brain–mind systems, groups of minds operating in teams, and many more.

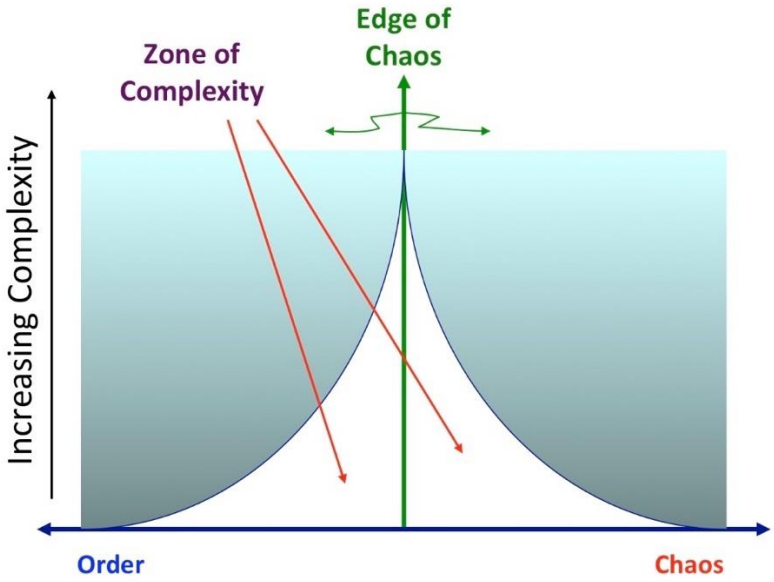

Figure 1. The chaos–order continuum (derived from [71]).

The inclination for complex, adaptive systems to oscillate along that continuum means they will move from rigid order through the zone of complexity at the *edge of chaos* (an opportunity space for the development of productive complexity) and toward excessive disorder at the other extreme. And then they swing back to the other side. Occasionally, they can become trapped at either end of the continuum, with some becoming excessively ordered and others becoming too chaotic.

Examples come from the operations of the human mind. Those who have inflexible cognitive inclinations can be trapped in rigid, dogmatic order. The minds of those who are trapped at this end of the continuum tend to produce any blend of narrowminded, shortsighted, superficial, rigid thinking. In contrast, those who suffer from schizophrenia can find themselves trapped in the excessive chaos end because their thought processes are too fragmented, disordered, and unpredictable [71]. Fortunately, those who can avoid entrapment at either end of the continuum can frequently find themselves in the *zone of complexity* in the center of the continuum, where a dynamic tension between chaos and order helps them create highly complex thoughts and actions. In this zone, they can come up with impressive innovations that can be either beneficial, or harmful, or both.

Some implications of the tendency for gifted minds to oscillate on this continuum include the need for professionals in the gifted education field to ensure that they are aware of chaos–complexity–order dynamics, and that their students become aware of them as well. With such awareness, they can avoid contributing to the world's biggest problem, which is dogmatism, because it fuels the growth of gigantic 21st-century problems [72,73]. These macroproblems are enormous issues in the world that can cause widespread, severe harm to populations around the globe [63,64]. They are so complex because they are international (cannot be solved from within the borders of a single nation), interdisciplinary (cannot be solved from within a single academic discipline or professional field), and long-term (took decades or centuries to emerge, and can take long time periods to solve). In contrast, those who learn about the zone of complexity at the edge of chaos will be more able to participate in the production of 21st-century macro-opportunities, which are enormous international chances for creating and spreading innovations that will improve the prospects for humanity. Some phenomena in the world are hybrids because they blend macro-opportunities with macroproblems. Here are three examples of these massive, 21st-century situations. For obvious reasons, climate change is a macroproblem and the emergence of green energy is a macro-opportunity. The development and growth of

artificial intelligence (AI) is a hybrid because it can produce innovations that are very positive, or very harmful, or both.

9. 21st-Century Technological Innovation

The artificial intelligence mentioned in the prior section could produce new, highly beneficial modifications to socioeconomic systems, but it also could enable widespread totalitarian systems to arise throughout the world, devastating the lives of billions. With artificial intelligence developing the capacities to take over a lot of jobs in the economy, market leaders could turn this trend into a huge benefit for most of humanity because it could lead to far more rapid, efficient production of goods and services. This could expand wealth considerably and spread it broadly throughout the population while diminishing the need for employees to work long hours. However, it also could lead to just a few oligarchs controlling these new systems of technology for their own benefit while marginalizing and impoverishing most others. An especially interesting possibility is that advancements in AI could produce a *singleton*, which would be a concentration of power that could generate a global totalitarian regime (see [74,75]). The singleton could take the form of a few massively wealthy individuals who commandeer and retain the levers of power while destroying individual, personal autonomy and democracies. It could turn the masses into billions of "objects" to be controlled or marginalized by the technology. Another form of singleton could be artificial intelligence itself taking power away from humanity and controlling the lives of virtually everyone on Earth. Clearly, artificial intelligence increasingly represents a 21st-century macro-opportunity–macroproblem hybrid because it could produce enormous benefits or devastating harm, or both.

Another important form of 21st-century technological innovation is the production and dissemination of green energy systems that diminish the need for petrochemicals that are pushing climate change into very dangerous territory (see [76,77]). There are many forms of green energy systems. Here are a few examples: wind-powered turbines, solar power, hydropower, geothermal energy, and biofuels. If humanity is to prevent the devastating effects of climate change, green energy will have to advance and spread around the world quickly.

The implications for gifted education are intriguing. Some scholars in the field have been emphasizing the need for more effective learning about STEM (science, technology, engineering, and mathematics) innovation and its implications (e.g., [78]). Due to the powerful negative and positive effects of innovations in artificial intelligence, green energy, and other technologies, the importance of STEM learning in gifted education is even more evident. Moreover, this STEM learning needs to be combined with more emphasis on *panoramic scanning*, which is the ability to contemplate very long-range issues and broad-scope, interdisciplinary insights that can contribute to the expansion of knowledge about those issues [79]. Those who are effective panoramic scanners can discover and understand the long-range implications of technological innovations and the phenomena they produce while avoiding entrapment within shortsighted, narrow perceptions of knowledge that is confined within their own fields. If gifted young people can develop this long-range, broad-scope awareness, they will be less likely to generate unforeseen, harmful effects when they become adult innovators in STEM fields.

10. The Tyranny of Sterile Metrics

Excessive faith in the accuracy of precise measurement seems to plague many academic fields and professions. Here are some examples. Many economists portray gross domestic product (GDP) as a supposedly precise measurement of economic health and growth in a nation, but it ignores and distorts a lot of important economic phenomena [80]. A nation can have a high GDP even though its ideology and political policies severely undermine the life chances of a large percentage of the population. Similarly, IQ and standardized test scores are assumed to be precise indicators of giftedness even though they ignore a lot of very important abilities [32].

In a long-range, far-reaching interdisciplinary exploration, the author of this article has so far discovered 47 prominent scholars from 21 academic disciplines who are pointing at the same problem of excessive faith in quantitative precision and calling it different names. Here are just a few examples:

- pseudo-quantitative precision—Robert J. Sternberg, psychologist;
- sterile certainty—William Byers, mathematician;
- weapons of math destruction—Cathy O'Neil, mathematician;
- the tyranny of metrics—Jerry Muller, historian;
- the flight from reality in the human sciences—Ian Shapiro, political scientist;
- reductive megalomania; shift a muck heap with a teaspoon—Mary Midgley, moral philosopher;
- silly reductionism—Gerald Edelman, neuroscientist.

If a large number of eminent scholars from a wide variety of domains are concerned about the same problem, that problem can cause considerable harm throughout the world.

So what can be done about this widespread situation? It is important that professionals in the gifted education field become more aware of the problems caused by sterile certainty and work to overcome these problems. For example, they can strive to enlighten themselves about the need for an expansion of the methods for identifying the gifted and talented [32]. Too often, the identification processes are dominated by the precision of mechanistic measurements because this form of identification is more difficult to challenge than more complex processes that bring into play cognitive and social–emotional abilities that are very difficult to measure, such as the highly complex visual–metaphorical thought that Einstein used to develop the theory of relativity [81]. Educators of the gifted also should ensure that students understand that some of their abilities might be hidden by the sterility of the mechanistic assessments they undergo in the regular curriculum, and in gifted identification processes. If they understand that their measured achievement, which may not be as strong as they anticipated, did not include some powerful, hidden abilities, they might become more confident, even if they are not selected for gifted programs.

11. Insights from Outside Disciplines That Reveal Some Aspects of Hidden Giftedness

When giftedness is identified through the use of "sterile certain" quantitative measures, some of the most talented individuals are not selected because their abilities are largely or completely ignored by the testing. Some of these individuals are dual-exceptional (2e) because they have weaknesses in aspects of academic skills and knowledge that are focused on in the testing, but they have a strength in an area that is not. In essence, these individuals can have brilliance far beyond the norm, but that brilliance is hidden by a weakness such as a learning disability, ADD, ADHD, autism spectrum disorder, and other conditions [82,83]. Consequently, they might appear average or even below average to the teachers with whom they work.

There is a strong connection between visual–spatial thinking and STEM giftedness [84]. Neuroscientific research also shows this connection [85,86]. For example, O'Boyle showed how those who are gifted in mathematics tend to have brain-based processes that develop strong visual–spatial thought capacities. The visual–spatial thinking–STEM connection also appears in the history and philosophy of science literature. [81,87]. For example, "Scientists strongly prefer the visual mode of thought in their research" ([81], p. 281). Building more awareness of dual exceptionality and the power of visual–spatial thinking in the gifted could help educators and the 2e students they work with appreciate and develop these hidden abilities.

12. Concluding Thoughts

Gifted education is a complex field with a diverse group of stakeholders (students, teachers, counselors, parents, policymakers). What are the implications of the interdisciplinary phenomena explored in this article for the thoughts and actions of these various

stakeholders? These phenomena tend to highlight the need to resist falling prey to dogmatism, and to think in big-picture ways that lead to positive ethical results. All of the stakeholders need to know about the impact of these phenomena and the need for strengthening ethical awareness in gifted students. In order to build that knowledge and awareness, the adult stakeholders in the field need injections of panoramic scanning capabilities [1] so they can contemplate the implications of their future actions for the gifted young people they know and help them infuse their growing talents and aspirations with empathy. Gifted students need to know about these concepts from diverse disciplines so they will understand how contextual pressures and constraints influence the development of their abilities and motivational and social–emotional dynamics.

Those who trap themselves within the thick walls of their specialized academic domain can do good work within that silo. However, they usually do not have the interdisciplinary knowledge necessary to contemplate the ways in which powerful contextual pressures can strongly shape, distort, or suppress the phenomena they study [3,79]. The best way to ensure that gifted education can escape its silo is to import relevant insights from diverse fields and explore how these insights connect with the research literature addressing giftedness and talent development. This analysis carried out some of that exploration by considering the nature and nuances of economic activities, evolutionary processes in nature, various forms of moral development, the impact of socioeconomic inequality, the influence of constraints on creative thoughts and actions, the importance of hope in a complex world, the balance between chaos and order in complex adaptive systems, various forms of technological innovation, some problems that occur when excessive faith in precise measurement prevails, and some aspects of dual exceptionality. A lot of ideas about giftedness and talent emerged from these analyses, but this is only a small exploration of very broad, complex, interdisciplinary conceptual territory. More of this exploration is needed to align gifted education with trends and issues in the 21st century.

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