



MUSIC AND COLLABORATION IMPLICATIONS FOR FORMERLY OPPRESSED COMMUNITIES AND GROSS DOMESTIC PRODUCT

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Abstract: The point of beginning of economic growth and development is collaboration. Collaboration is essential for rule of law. Rule of law attracts capital and protects democracy. Democracy creates additional pathways that deploy capital optimally to produce goods and services that constitute per capita real gross domestic product (GDP) adjusted for purchasing power parity (GDPppp), otherwise known as standard of living. After depreciation and obsolescence, and consumption, the remainder is a contribution to wealth. The purpose of this paper is to explore the transmogrify in which music education can develop human natural propensity for collaboration. Singapore is evidence of a connection between mandatory music education, high collaboration and very high GDPppp.

Keywords: CDR index; Gross Domestic Product; Capitalism; Democracy; Rule of Law; Entrepreneurship

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INTRODUCTION

The true source of wealth is exogenous human capital ideas of imagination and creativity (see Figure 1). Through collaboration exogenous capital is converted into endogenous capital stock of knowledge, machinery, raw materials, computers, program codes, recordings, etc. Endogenous capital is used to

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produce gross domestic product of goods and services. After depreciation, obsolescence and consumption, the remainder is contribution to wealth. This system of capitalism organizes capital for investment into various industries. Through taxation investments are also made in transportation including roads, bridges, canals, airports and seaports to deliver raw materials and finished products and services, schools that provide opportunities for socialization and education to impart knowledge to future employees, hospitals to deliver healthcare, clean air, and water, police and courts to ensure justice, the common defense, etc., all designed as part of and in support of the capitalist system. These all create economic growth, development, and a high standard of living.

THE CDR ECONOMIC MODEL

The capitalism (C), democracy (D), rule of law (R) (CDR) aggregate economic model combines the degree of C, D and R associated with a country. In prior research by Ridley (2020a, 202b, 2023), the CDR model was computed for cross country relationships. The CDR equation is given below in Figure 2 and plotted in the appendix. C is measured by total market capitalization and includes exogeneous human capital and endogenous capital stock, D is an exogenous catalyst measured by rankings in democracy, and R is an exogenous catalyst measured by rankings in rule of law, taking into account the effect of interactions. The C, D, R coefficients are positive. C contributes 60%, D contributes 5% and R contributes 10% to GDP_{ppp}. The negative interaction effect, 3%, accounts for excessive democracy that delays decision making and excessive rule of law (overregulation) that prevents opportunities. Contrary to commonly held belief, natural resources (N) contribute a mere 6%. The CDR model explains 90% of per capita real gross domestic product (GDP) adjusted for purchasing power parity (GDP_{ppp}) with three policy variables namely C, D and R, and two natural variables namely natural resources (N) and geographical latitude (L). The model is referred to as the CDR model because C, D and R are policy variables that can be changed by policy makers, while N and L are outside the control of policy makers. It is the first to place aggregate economics on a sound scientific basis. The next best and now outdated (Solow, 1956, 1957) growth model explains only 36% of GDP_{ppp}. In any case, Ridley & Ngnepieba (2018) proved that the Solow model is a fallacy of composition.

Rule of law attracts capital and protects democracy. Democracy creates additional pathways that deploy capital optimally to produce goods and services that constitute GDP_{ppp}, otherwise known as standard of living. After

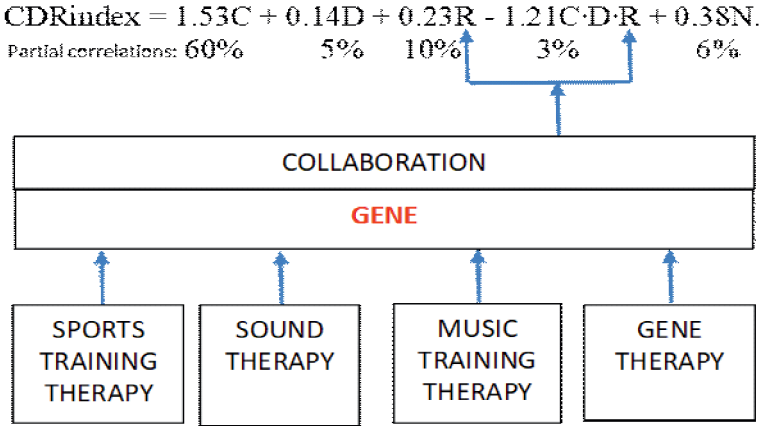


Figure 2: The institutions of capitalism, democracy and rule of law comprise the CDR aggregate economic model where rule of law (R) is enhanced by collaboration skills recovery therapy. Together with natural resources and geography the CDR model explains 90% of GDPppp. $R^2=0.9$

depreciation, obsolescence, and consumption, the remainder is a contribution to wealth. Countries with a low CDR index fare poorly in wealth even when they are rich in natural resources. The objective then is to raise a country's CDR index. But that requires raising R. And raising R requires raising collaboration skills. The Ridley and Nelson (2022a) paradox showed that while self-interest of cooperation is an obstacle to holistic rule of law, the joint interest of collaboration is essential for holistic rule of law. The genesis of rule of law is Magna Carta. Prior to rule of law (Magna Carta) in which no man is above the law, there was rule by law (for example code of Ur-nammu and code of Hammurabi) in which kings and popes were above the law. In addition to permitting rule of law, collaboration is required to create and develop new inventions from human capital. In his free to choose television series Milton Freidman (1980) explains how it takes thousands of people around the world to make a lead pencil with a rubber eraser. The purpose of this paper is to explore the transmogrify in which music training can raise collaboration skills and subsequently rule of law, capital and GDP.

Production Capacity versus Productivity

It is important to recognize the ability of rule of law to attract capital. And the opposite effect of low rule of law is to repel capital through the mendacious perfidy of inimical corrupt dictators. Contrary to commonly held beliefs, all productivity is governed by the natural laws of science such as physics and

chemistry. For that reason, productivity is the same in all countries of the world. What distinguishes countries is the amount of capital that is available for production of goods and services that comprise GDP. Countries with large amounts of capital will prevail in micro economies of scale. Economies of scale will result in low prices of goods and services. The residents of high capital countries will therefore have greater purchasing power and a higher standard of living than that of their low capital counterparts. Therefore, the CDR model adjusts GDP to obtain GDP_{ppp}. That makes it possible to make cross-country comparisons.

SINGAPORE COLLABORATION: SPORTS AND MUSIC

We know from recent research by Ridley, Lee & Nelson (2023) that Singapore has achieved a very high level of GDP_{ppp}. That research identified that Singapore intentionally mandates sports for school children. Sports education results are included in their report card of grades. The outcome has been the world's highest score on international collaboration PISA test (OECD 2015). Concomitant with high collaboration skill is their high GDP_{ppp}. That research, however, did not focus on music education. It turns out that in Singapore music education is compulsory for ages 7 through 14 years old. So, music might have played a significant role, in addition to sports. This paper extends the Ridley, Lee & Nelson (2023) paper to include music training.

Other evidence of Singapore's extraordinary ability to collaborate as a nation is the government leader remuneration system that is based on economic performance. The ministerial salary formula is a function of 1) real median income growth rate of Singaporean citizens; 2) real growth rate of the lowest 20th percentile income of Singaporean citizens; 3) Unemployment rate of Singaporean citizens; and 4) Real GDP growth. Government and citizens intentionally share in national economic performance goals and rewards. This level of collaboration is the highest and broadest known for uniting the efforts of an entire nation. The positive outcome for the economy is that government behavior is like what we expect from the private sector.

It may be fortuitous that in 2017, the USA state of Florida implemented a pilot program of comprehensive music education in kindergarten through second grade. In May 2023, the governor of Florida signed senate bill 478 to convert the pilot program into a permanent program. In passing, we mention that Singaporean school children also score highest in the world in mathematics (Myers, 2024). Although science, technology, engineering, and mathematics

(STEM) education is now known to be on the pathway to high GDP, the point of beginning appears to be collaboration skill. Ridley, Ngnepieba & de Silva (2021) give mathematical proof of how collaboration can combine nonnormal multimodal distributions of low performance educational outcomes to achieve high performance normal unimodal outcomes. In this paper we explore how music training may hold the key (see Figure 4 below).

This paper will explore the efficacy of music training in enhancing collaboration, which flows through the CDR model in providing increased GDP. We shall explore music from two perspectives: the production of music and the consumption of music. It is known that collaboration in music can result in sounds that no single person can produce. For this we can look at a barber shop quartet, which can produce notes that an individual singer cannot attain. We also know that an orchestra can produce a sound which no individual musician is capable of recreating. Hence it is in the production of music, whether by a chorus, barbershop quartet, symphony orchestra or rock band, that collaboration results in enhanced sounds. The production of music is a sociable activity which will enhance collaboration and thus GDP.

It is also shown in various studies that those who are exposed to listening to music receive beneficial results. The Florida law requires exposure to music for one hour per week in elementary schools. It is posited that this should be studied and expanded upon so that collaborative skills are developed during the formative years and continued throughout the educational process. Human beings are the only species that is capable of collaboration (Tomasello & Vaish, 2013, Tomasello, 2023). This is evident in 3-year-old children. Like reading, writing and speaking, collaboration must be developed. Failure to do so can result in atrophy and adult societies with a collaboration deficit. Ridley and Nelson (2022b) argue that environmental stress from forced labor, excessive discrimination and exposure to dangerous chemicals can result in a negative epigenetic transgenerational psycho-sequela of lost collaboration skill. This is especially important in underserved communities and does not necessarily require significant financial commitments to alleviate, since for example, singing only requires a space and a voice coach, who may already have other teaching duties. A band only requires a few instruments, which can be shared.

GENES AND COLLABORATION

We know from Tomasello (2023) that animals cooperate, but they cannot collaborate. Only human beings can collaborate. But Avital, Aga-Mizrachi

& Zubedat (2016) and Avital & Aga-Mizrachi (2022) discovered that genes do affect social cooperation ability of mice. In their experiment where mice negotiated a maze for a tasty reward, it was found that mice cooperated to increase the amount of the award they each received compared to what they received individually. They called this social cooperation because two mice were involved, and sometimes used the term collaboration to describe social cooperation. The activity of the mice can be likened to hunting together, which we recognize as cooperation not collaboration. Cooperation occurs when parties make plans with their own self-interest in mind and, ipso facto, can benefit each other unintentionally. Collaboration occurs when parties intentionally plan their shared goals and mutual benefits. So, we accept that the Avital & Aga-Mizrachi discovery is limited to cooperation. Cooperation is akin to the Adam Smith (1776) invisible hand of unintentional economic gain and results in an expected value of ordinary long-term annual growth rate of $e0.6^t = 1.8\%$ per annum (see Ridley, 2020b, 2023), where e is Napier's constant (Euler's number). Collaboration on the other hand can result in new idea creation and extraordinary growth of more than 1.8%. This can happen when collaboration results in the creation of that which did not exist before.

Avital & Aga-Mizrachi then selected pairs of mice that demonstrated low cooperation skill and bred them. They also selected pairs of mice that demonstrated high cooperation skill and bred them. The result was that the children of high cooperation mice out cooperated the children of the low cooperation mice by earning an even greater amount of award. The transgenerational effects are random in nature. There is a probability distribution of effects. Most high cooperation parents will produce high cooperation children. But a certain percentage, albeit small, of high cooperating pairs will produce low cooperation children. This can occur from an error in the epigenetic instruction regarding what proteins to produce. On the other hand, if low cooperation is caused by the absence of a required gene (or gene turned off), the children will also be missing the gene. Low cooperation parents will not produce any high cooperation children. This would explain why the gap between the grandchildren was even greater, and greater still between the great grandchildren (Figure 3 shows a hypothetical trend). The pattern went on for 10 generations when the experiment ended. This is the closest that they came to showing that genes do affect collaboration. We speculate that if genes affect cooperation ability, then genes will also affect collaboration ability in human beings.

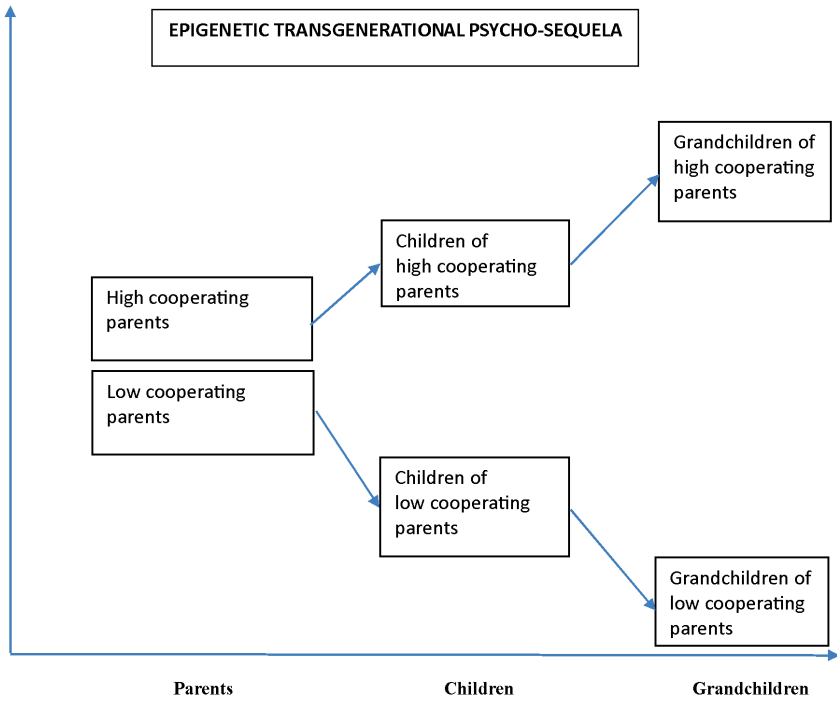


Figure 3. Comparison of children of high and low cooperating mouse parents. The gap between high and low cooperation children increases with each new generation due to an epigenetic transgenerational sequela

We are particularly interested in this connection between genes and collaboration because it appears that formerly oppressed communities of human beings may have suffered a loss of collaboration skill due to environmentally induced stress from forced labor, excessive discrimination, and exposure to dangerous chemicals, resulting in a negative epigenetic transgenerational psycho-sequela (see also Nilsson, et. al., 2022, Beck, et. al., 2021, King & Skinner, 2020, Ben Maamar, et. al., 2018, Skinner, 2014, Skinner, et. al., 2013 & Crews, et. al., 2012). Harlow & Zimmermann (1958) and Harlow, Dodsworth & Harlow (1965) showed that baby rhesus monkeys that were removed from their mother and not allowed to breastfeed and bond with their mother grew up unable to form relationships with their peers. For human beings, this in turn can negatively impact academic learning, job performance, entrepreneurship, and performance in the economy in general. To simply correct and remove the environment that caused low collaboration effects in the first place and hope for the best will be to no avail. A curative intervention is required if collaboration skill is to be recovered.

If it turns out that the gene for collaboration is located in the chromosome range such that it does not affect any other human function, then locating and correcting the gene is a conceptually good approach. If the gene affects other functions, then one could think of those as side effects. Traditional medications also come with side effects. Therefore, biological medical gene therapy would necessarily have to consider the side effects along with the benefits. If the benefit greatly outweighs the side effects, and the side effects are negligible, then biological gene therapy is a favorable candidate for a cure. The side effect of no collaboration skill in formerly oppressed communities is very serious. Learning performance, job performance, entrepreneurship, and general economic performance is severely reduced. In 90 percent of the world's population, GDPppp is very low, poverty is abject, starvation and poverty related illnesses are prevalent. All this results in premature death. So, collaboration skill deficit is not a trivial matter. Avoiding a biological cure for fear of side effects is by far not an obviously favored choice. As shown in the mice experiment in Figure 3, the low cooperation mouse population will never recover from selective breeding of low cooperation mice. The only possibility for a recovery of the normal gene pool would be interbreeding of the two populations. Therefore, one might suspect that human beings might recover similarly if there were an intentional implementation of a worldwide plan to intermarry populations across all continents.

We speculate that therapy could correct the gene responsible for loss of collaboration skill to end the malady. General therapy may take the form of, for paradigmatic example, sports training, sound therapy, or music training. Gene therapy would be biological and medical (see Figure 2). Ridley, Lee and Nelson (2023) already established sports training as the outstanding collaboration skill builder by which Singapore outperforms the world in GDP. They compared numerous factors between Singapore and USA, and mandatory school sports and collaboration score was the outstanding difference. So, we will not study that any further. Medicine is expensive and intrusive. The cheapest, least intrusive, and most accessible potential collaboration skill builders are sound therapy and music training. Therefore, this paper will investigate what is known about music training. Music training also provides a practical skill that can earn someone an income. The consumption of music can be collaborative as well, but first we must focus on music training.

MUSIC TRAINING

Now that we know that there is a gene for collaboration skill, a logical suggestion is to pursue methodologies for therapeutic treatment of this gene. Assessing the

impact of music training presents a unique challenge for researchers who study university students. According to Kraus & Whiteschwoch (2020), the effects of music training on academic mental performance may manifest a year later. Consequently, while continuity of student cohorts is often observed in K-12 schools, such consistency is not typically encountered in university settings, complicating longitudinal studies in this context.

Intragenerational cure

Engaging in sports training has significantly bolstered collaboration skills among individuals in Singapore, with music training potentially offering supplementary benefits. There is speculation that sound therapy could further amplify this effect, suggesting its potential utility. However, it is essential to acknowledge that these treatments entail a considerable investment of time, spanning several years. Moreover, their impact might be limited to the current generation, serving as a remedy exclusively for them. Despite this intragenerational limitation, it is crucial to recognize that deficient collaboration skills could persist and even be inherited by subsequent generations. Nevertheless, these treatments are not redundant and should be used to develop desirable collaboration skills in healthy people, even with no genetic deficiencies.

Transgenerational cure

On the other hand, gene therapy offers a definitive solution by correcting the gene deficiency, ensuring the eradication of the malady for both present and future generations. Epigenetics is how the environment and other factors can change the way that genes are expressed. Epigenetic changes are chemical modifications (methylation) to deoxyribonucleic acid (DNA) or its associated proteins that regulate whether genes are turned on or turned off. Epigenetic changes can affect how the body reads DNA, but it does not alter the DNA sequence. Epigenetic changes can play an important role in development. This revolutionary approach to a cure would not only be highly effective but also remarkably efficient, promising the ultimate results with minimal time investment.

Sensogenomics

Sensogenomics refers to the study of the response of the genome to sensory stimuli. Navarro, Martinon-Torres & Salas (2021) speak to genetics but come up short on collaboration. Playing music is probably what hones collaboration

skill. Just listening to music does not strike one as useful especially since violent music appears to be bad for benevolent collaboration. It has been shown that exposure to music has many positive effects. Levinowiz (1998) shows the importance of exposure to music in early childhood development. Even exposure to music during pregnancy has been shown to enhance child development, as is exposure to preschool age children in learning to discriminate in frequency, melody and stimuli (Bridger, 1961; Trehub et al, 1990). Ridley (2023) previously has shown that collaboration trumps IQ for the creation of GDPpppp. What is essential to determine is whether music training, like sports, enhances collaboration. When we work and play close together, our brain waves can align. This phenomenon is known as interpersonal neural synchronization and suggests that collaboration is biological (Zaraska, 2024). In a study on identical twins, alpha rhythms have been elicited in one of a pair of twins as a result of evoking these rhythms in a conventional manner solely in the other twin (Duane & Behrendt. 1965).

Exposure to music is a necessary but not sufficient condition to build collaboration. The manner in which it is taught and at what age is critical. The earlier children receive music education and are encouraged to produce music collaboratively, the better. The use of music education in Singapore has been extensively studied by Bautista et al. (2018). They found that by teaching young children to produce music collaboratively, collaboration skills are enhanced. So, it is imperative not only that young children be exposed to music through music education but also that it be presented in a manner that promotes collaborative skills.

This paper explores whether exposure to music and music education can lead to standard of living benefits by increasing collaboration. Previously, Ridley & Nelson (2020b) explained that epigenetic changes can be accomplished in underserved communities to enhance collaboration and thus increase economic activity. Likewise, Ridley, Lee & Nelson (2023) have recently published that Singapore, through mandatory sports programs in schools has contributed to enhanced collaboration which leads to greater GDPpppp. It was suggested that this could be replicated in larger economies such as the United States of America (USA). This paper will consider the impact of music exposure as early as possible as a means to increase collaboration. If this leads to any positive change, it will be a manifest benefit, especially to underserved people throughout the world.

Music exposure has been shown to have many positive effects which one would anticipate are likely to enhance collaboration. There are two stimulative

processes: listening to music and the production of it (i.e. a chorus, band, or orchestra). Exposure to music as early as possible, such as during pregnancy, increases the development of the brain and potentially IQ. The sound itself is a positive stimulus although certain sounds can be counterproductive. Exposure to music at an early age, even preschool helps in language development, by imprinting information on young children's brains. As stated by Dr. Kyle Pruitt, a clinical psychiatry professor at Yale School of Medicine, who is also a musician, "language competence is at the root of social competence." Musical experience strengthens the capacity to be verbally competent. Music is endemic to all cultures, as is language. The latter forms the basis for socialization and thus collaboration. Early exposure to music, such as is currently the case in Florida, will enhance language skills and socialization. Creating an environment conducive to collaboration.

Various studies have shown that the production of music confers developmental benefits to school age children. What has yet to be determined is whether the collaboration established by singing, and playing musical instruments can lead to transgenerational increased collaboration. Obviously, there are certain genes which provide a basis for musical abilities. The landmark study by Navarro, Martinon-Torres & Salas (2021) established that sensogenomics explains the role biology plays in musical talent. They posit that musical exposure and training will provide a basis to expect those transgenerational changes in collaboration. Just as the previous paper by Ridley, Lee and Nelson (2023) advocated for mandatory sports training to increase collaboration, it is apparent that mandatory music education per the Singapore experience, will enhance collaboration.

The exposure to music should be at the earliest age possible, even before language skills have developed. From birth until age six children begin to unscramble aural images of music and develop mental representations of music (Holahan, 1987). Like language development, young children develop musically through predictable sequences to basic music competence, which includes singing in tune and marching to a beat (Levinowitz & Gilmartin, 1988). Audiation is critical to all types of musical thinking, because it is a prerequisite to musical development in children.

The ability to practice singing or to play an instrument on one's own is analogous to practicing shooting a basketball. However, to perform as a team, whether in basketball or as a choir or orchestra there must be collaboration. Likewise, collaboration plays a key role not only in the performance of music,

but in writing a song. This form of collaboration is teachable in schools. So, the ultimate goal is to find activities that will promote transgenerational collaboration, in order to encourage entrepreneurship and greater economic activity.

Research suggests that student centric musical teaching, such as has been advocated by Bautista et al. (2018) in a review of Singapore methods, enhances collaboration. Constructivist teaching (Stavrou & Koutselini, 2016) which involves uncertainty and unpredictability promotes critical thinking and allows children to express alternative viewpoints. The Singaporean model allows children to compose music in a manner which promotes collaboration. In addition, it is posited that the consumption of music with discussion, thereafter, will lead to further enhancement of collaboration.

Mandatory vs Optional training

A summary of the mechanism and relationship between music and collaboration and how they impact GDPppp is shown in Figure 4. School music is prevalent in the USA. But it is not mandatory. The outcome is collaboration and high GDPppp. In the case of Singapore, it is mandatory, and the outcome is even higher collaboration and higher GDPppp. It behooves poor countries whether small or large to consider mandatory music training in schools to help overcome and recover from the effect of former oppression that may have led to loss of collaboration skill, in the hope that newfound collaboration will raise their standard of living.

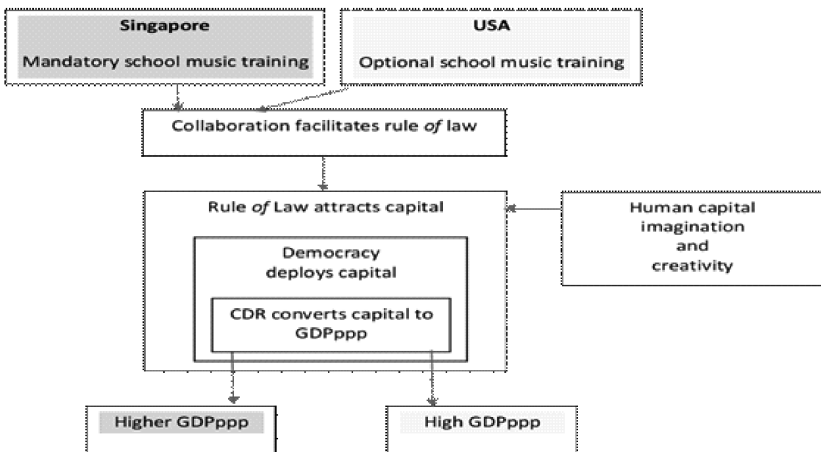


Figure 4: Singapore mandatory and USA optional music training to promote collaboration skills.

CONCLUSIONING REMARKS

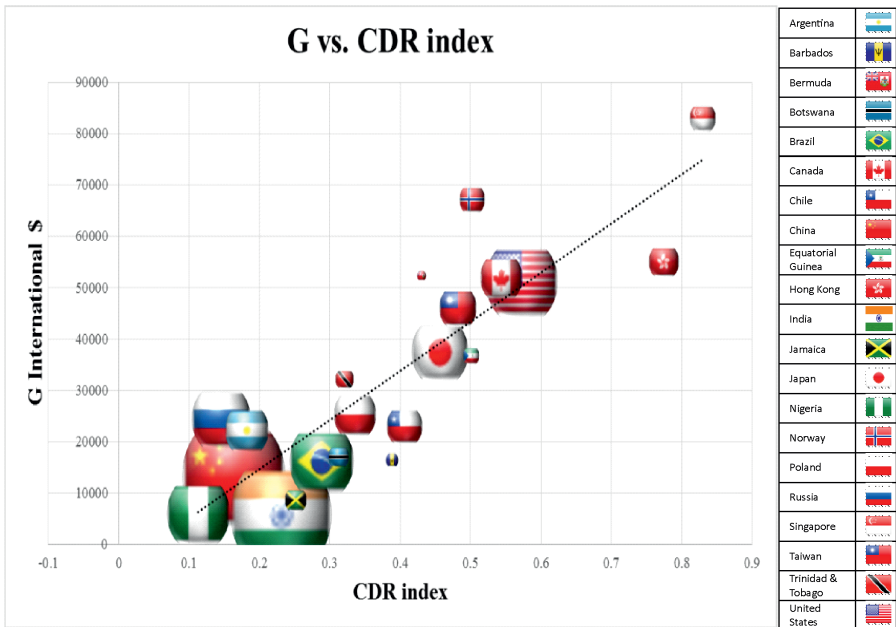
We learned from Avital and Aga-Mizrachi (2022) that there is a gene for cooperation, from which we infer that there is a gene for collaboration. Collaboration permits rule of law that attracts capital and protects democracy that deploys capital optimally for the creation of GDPppp. Ridley, Lee and Nelson (2023) previously compared collaboration and GDPppp of Singapore and the USA. The only difference between the two countries that stood out was mandatory sports. That showed that mandatory sports in Singapore schools is what resulted in higher collaboration and higher GDPppp than in the USA. So, they advocated for mandatory sports in schools in order to attain collaboration. These findings appear to be replicable in the USA in order to raise GDPppp and the standard of living of the least among Americans. Subsequently, we learned that Singapore also had mandatory music education in schools. So, music education may have contributed as much as sports to GDPppp. Studies have shown that music education has multiple benefits and if taught in the proper manner, can enhance collaboration. A longitudinal study among school aged children in Florida, where mandatory music education has been codified into law, is called for. It is hoped that there will be transgenerational benefits through the sensogenomic effect of music education. Poor countries, large and small alike, that were formerly oppressed and suffer from an epigenetic transgenerational psycho-sequela, and collaboration skill deficit, can benefit from mandatory music training for school children to place them on the path to collaboration and a higher standard of living. These benefits may be intragenerational and temporary. They can do no harm and will benefit even high-income populations. But mandatory music education may be necessary to benefit each future generation. Low GDPppp countries should consider mandatory school music training to help recover from the loss of collaboration skill due to ancestral environmental stresses, in the hope that newfound collaboration will raise their standard of living.

It is not unusual for schools to cut certain extracurricular programs when there is a budget shortfall. Typically, music is one such program. We argue that music training contributes to GDPppp via collaboration. That is apart from numerous social benefits obtained from collaboration. Therefore, music training may be the solution to the budget shortfall albeit in the long run.

Suggestions for future research may be the biological search for and location of the gene that is responsible for collaboration. The landmark research by Tan et al. (2014) found that certain genes such as AVPR1A are

implicated in music perception, music memory and music listening. Another gene SLC6A4 is associated with music memory and choir participation. Yet another plays a role in music rhythm. Then they are polymorphisms thereof. Perhaps this will help confirm whether the notion of musical families is actually something that can be established with early childhood musical exposure, allowing transgenerational effects on collaboration. It may be that the gene is responsible only for collaboration and that medication will not have any undesirable effect on any other human functions. Medical biological treatment such as gene splicing may result in a transgenerational cure that is permanent. Making sports training and music training mandatory, and gene therapy available at taxpayer expense may require the creation of new legal frameworks for reparations.

APPENDIX: THE SOURCE AND MECHANISM OF WEALTH



Year 2014 G vs CDR Index for 79 countries (line). Bubble size (21 countries) is the square root of population. This model was re-estimated for years 1995-2016 with similar results. For additional comments on the countries see Ridley (2017a, 2017b). <https://www.youtube.com/watch?v=lf8Gm9m-WIY>

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DR: Design of research, writing, calculations, supervision. LL: Music training discussion.

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