Legacy High School

The Art and Science of Learning Music

and anything else

Gregg Goodhart

The Learning Coach

ggoodhart.com

learningcoach@ggoodhart.com

The Learning Coach

@Gregg_Goodhart

© 2015 Gregg Goodhart

". . .learning how to learn is the ultimate survival tool."

-Drs. Bjork and Bjork

THE CAMBRIDGE HANDBOOK OF EXPERTISE AND EXPERT PERFORMANCE

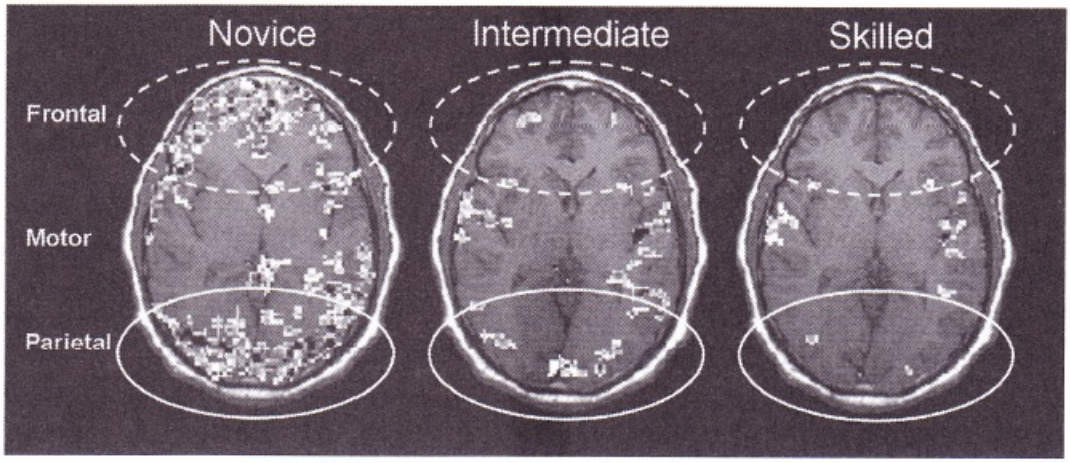


Figure 37.1. Activation of the brain, as a function of practice, in three periods of learning a motor tracking task. This is a maximum projection image, with white areas showing the activation of any cortical area either above or below the illustrated brain slice. The image is an axial (aerial) view of the head, where the top of the image corresponds to the front (nose) of the head and the bottom corresponds to the back of the head. The frontal areas (dashed ellipse) and parietal attention control areas (solid ellipse) show dramatic reductions in activation. The motor areas (middle of images) shares fairly preserved activation.

"Use learning to chase content, not content to chase learning."

© 2015 Gregg Goodhart

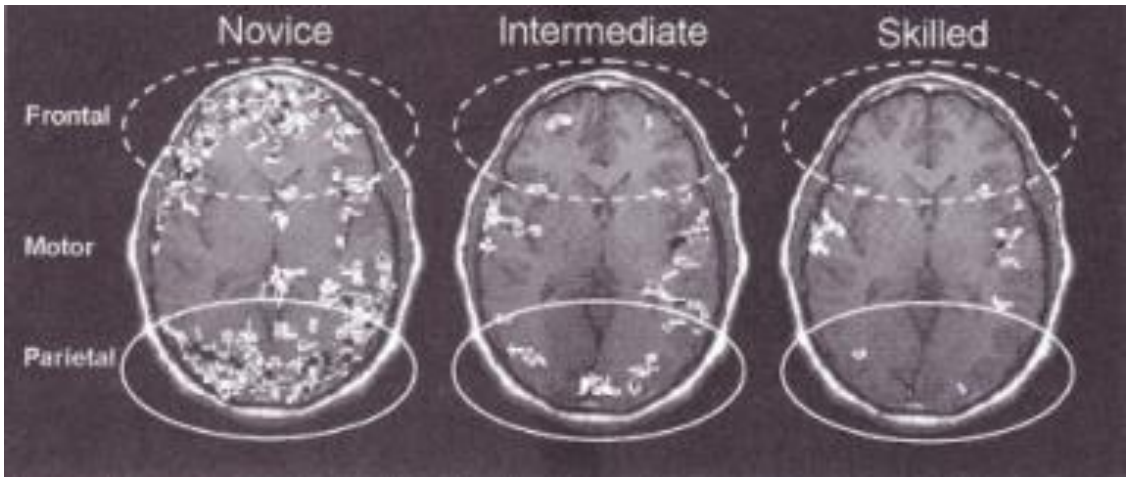
Talent is Overrated

- Whatever that is.
- Consider how important, or not, this concept is to you.
- It is the subject of an excellent book that delves into the complex issues surrounding skill development. In *Talent is Overrated* Geoff Colvin writes, "If it turns out that we're all wrong about talent, and I will offer a lot more evidence that we are, that's a big problem. If we believe that people without a particular natural talent for some activity will never be very good at it, or at least will never be competitive with those who possess that talent, then we'll direct them away from that activity. We'll tell them they shouldn't even think about it. We'll steer our kids away from particular studies whether they're art, tennis, economics or Chinese because we think we've seen signs that they have no talent in those realms . . . most insidiously, in our own lives, we will try something new, and finding that it isn't easy for us conclude that we have no talent for it, and so we never pursue it. Thus, our views about talent, which are extremely deeply held, are extraordinarily important for the future of our lives, our children's lives, our companies and the people in them. Understanding the reality of talent is worth a great deal."
- The Role of Practice in the Development of Performing Musicians (Sloboda et al.)
    - A sample of 257 young people aged between eight and 18 who had undertaken individual instrumental tuition were interviewed in depth about their performing history from the start of playing. A subset of 94 of these individuals also kept a practice diary for a 42-week period. The data collected allowed estimates to be calculated of the amount of time devoted to various types of practice and other activities. The sample was selected in order to encompass a wide range of levels of musical achievement, from pupils at a highly selective specialist music school through to individuals who had abandoned instrumental study after less than a year of formal instruction. Data about formal examination successes confirmed the very wide range of achievement in the sample. It was discovered that there was a strong relationship between musical achievement and the amount of formal practice undertaken. Weaker relationships were discovered between achievement and amount of informal playing. There was no evidence that high achievers were able to gain a given level of examination success on less practice than low achievers. High achievers tended to be more consistent in their pattern of practice from week to week, and tended to concentrate technical practice in the mornings. These data lend strong support to the theory that formal effortful practice is a principal determinant of musical achievement.
- Mozart and Tiger Woods explained (Colvin 25-30).
    - Children of motivated master teachers.
    - Put in thousands of hours of guided practice starting at a very early age.
    - The Rochlitz letter
    - There is no magic here other than the unusually young age they started focused, guided, serious work with excellent coaching.
- James Flynn and his population IQ research. IQ , short of developmental disability, does not seem to matter, and you can build it.
- Are kids encouraged because they are talented or talented because they are encouraged?
- It can even be detrimental to believe in talent. (Dweck)
    - The Dangers of Believing That Talent Is Innate (Gopnik)
- So then, how does the process really work?

© 2015 Gregg Goodhart

Learning Happens in Your Brain

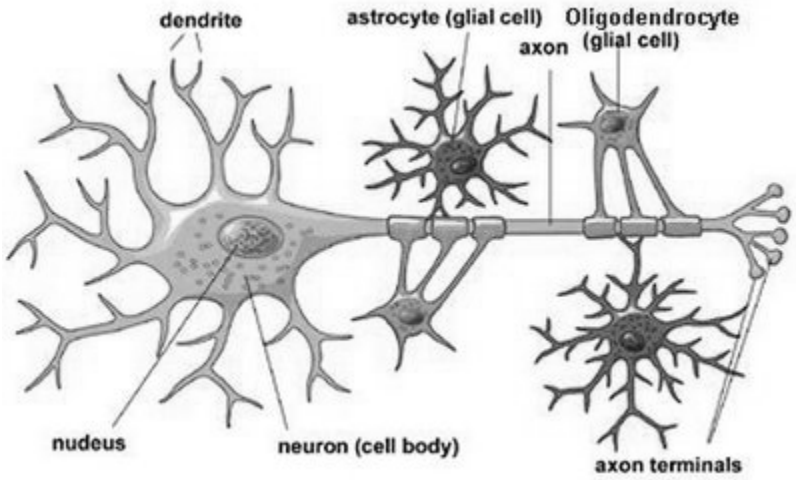
- Neuroscience has improved dramatically over the last 30 years. The advent, and more importantly improvement, of fMRI (Functional Magnetic Resonance Imaging) as well as other diagnostic tools have pushed the field forward at an astonishing rate.
- Everybody has some of this, the great teachers have most of it, but few know the terms and how these concepts are organized as part of a larger model. This is because the research has only recently been disseminated and those of us who teach are, understandably, very far removed from the field of cognitive and behavioral psychology and neuroscience.
- Neuromyth
    - "The popularization of neuroscientific ideas about learning – sometimes legitimate, sometimes merely commercial – poses a real challenge for classroom teachers who want to understand how children learn. Until teacher preparation programs are reconceived to incorporate relevant research from the nuro and cognitive sciences, teachers need translation.. . . Meanwhile, the success of our schools will continue to be narrowly defined by achievement standards that ignore knowledge of the neural and cognitive processes of learning. . .these naïve misinterpretations of science have spread throughout the folk psychology of educators in recent years. . .The problems facing scientists and teachers are only exacerbated by the popular media, particularly those who sensationalize the, "Bold new findings," of scientists and exaggerate their immediate impact on society. . .An exchange of knowledge between neruo- and cognitive scientists and educators will help generate a better understanding of how learning takes place in real-world contexts." (Hardiman et al 1, 3)
    - "The need for translators and for greater collaboration between educators and neuro- and cognitive scientists has been previously described by a number of researchers [Ansari and Coch, Fischer et al., Hinton and Fischer, Kuriloff et al., Ronstadt and Yellin]." "These translators, trained in multidisciplinary programs tied to school of education, can return to schools and school districts with sufficient background in the neuro- and cognitive sciences to provide perspective and transmit knowledge to their colleagues." (ibid 3)
- Do we really only use 10% of our brains?
- Process Efficiency Change – less is more



© 2015 Gregg Goodhart

- During this process the brain is working through confusion to find the perfect efficiency point for that task. (See the fMRI images on page 2). This occurrence has been called a process efficiency change. (Hill and Schneider)
- At first the brain it is lit up like a Christmas tree. Most notably the pre-frontal cortex, responsible for executive function, is very involved. As the task is learned more and more regions drop out as the brain finds the perfect efficiency point for the desired ability. Here the skill can be reliably executed. This process involves difficulty and frustration as the brain is trying to figure out how to best deal with it.

- Just as we can lift weights in order to change and strengthen our muscles so too can we engage in exercises that physically and/or functionally change the brain. (Doidge)
  - Violinists left hand representations, London cab drivers Hippocampi. On and on.
- This is the idea of neuroplasticity. A concept that some still find hard to believe.
  - The book, *The Brain That Changes Itself*, follows the transition from the old thinking of specialization in the brain to our current understanding of how we can change it by the choices we make. (Doidge).
  - The old ideas that the brain is done evolving after childhood have been totally debunked. The brain is plastic for life.
- Training your brain - Everything we do or think is a neural representation in the brain. Neurons talking to other neurons. We have an estimated 100 billion neurons (give or take a few billion) that create more than 100 trillion connections.
  - Such communications are neural networks.
  - Synapses are gaps between neurons across which action potentials (electrochemical nerve impulses) travel.
  - Action potentials travel down an axon which is punctuated by little gaps called the nodes of Ranvier.
  - Just as with the electricity we use, if the conduit is not insulated then the action potential leaks out and the signal is not as powerful (does not travel as fast). The more insulated the axon the faster it travels.
    - There are cells attached to axons called oligodendrocytes. Each time an action potential travels through an axon oligodendrocytes are activated to produce an insulating substance called myelin which forms a covering known as the myelin sheath (Araque and Navarrete 1588; Wake, Lee, and Fields 1649-1651).



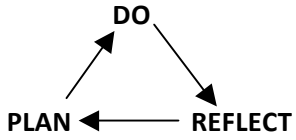
© 2015 Gregg Goodhart

- The more insulated the axon the faster the action potential travels (i.e. faster cognition, finger movements, etc.). That is why thoughtful repetition over and over creates solid technical foundation and speed *in all domains*.
- Learning; slow accurate movements/thoughts create accurate neural representations ready for myelination.
- Eventually (it takes some time) enough myelin accumulates for a process called saltatory conduction to take place. This change between the processes has been called the "Lillie Transition" (Young, Castelfranco, and Hartline 533-546). In this process the action potential leaps across the axon at far greater speeds. Specifically it originates on both ends of the axon and meets in the middle instead of linear conduction from one end to the other.
    - Interestingly during the onset of the "Lillie Transition" action potential velocity decreases before the significant increase of saltatory conduction. This may explain plateaus in learning and why sometimes after working a lot on something we can seem to regress.

- We control our brains, how much we use them and how we use them.
- 10 years 10,000 hours to become world class in any complex domain, and that number is rising.
- The point is not to do 10 years 10,000, but to take the same steps as one would if one were to follow that process however many hours they may work to improve.
- And that process is. . .

Deliberate Practice

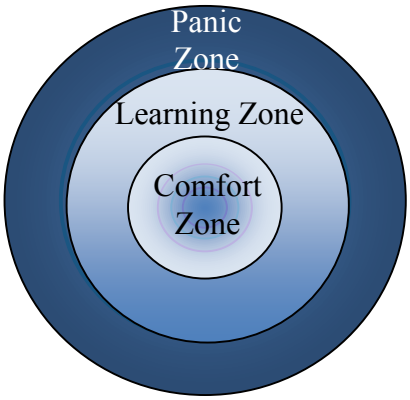
- Effortful activity generating constant feedback that guides the refinement of that activity over and over and over.
- The term was first coined in the 1993 paper, "The Role of Deliberate Practice in the Acquisition of Expert Performance," published in *Psychological Review* by the leading researcher in skill development K. Anders Ericsson and some of his colleagues and (Ericsson, Krampke, and Tesch-Romer).
    - He refined and updated this in, "The Influence of Experience and Deliberate Practice on the Development of Superior Expert Performance." (Ericsson 2006)



- Cognitive researchers have developed an inclusive model for the Plan-Do-Reflect model calling the three phases Forethought-Performance-Self Reflection, as well as addressing other environmental and psychological factors surrounding the paradigm of skill development (Zimmerman 707-715, 705-719).
- One characteristic of deliberate practice is that it is not that it is not inherently enjoyable. (Ericsson, Krampke, and Tesch-Romer 368).
    - It is work. Whereas physical work is taxing on the body, this type of intellectual work is taxing on the brain.

© 2015 Gregg Goodhart

- This state of difficulty is the 'sweet spot of learning'. I, half-jokingly, have called this the 'burn of learning' or the blearn – Feel the Blearn! Of course I later found it has a real name. Two UCLA researchers have described this condition as, "Desirable Difficulty," (Bjork and Bjork 58). Writing about the current state of education professor Bjork states, "optimizing instruction will require unintuitive innovations in how the conditions of instruction are structured (ibid 56)." Or to put it colloquially – learning is not what many people think that it is.
- Vygotsky and the Zone of Proximal Development



- ". . .deliberate practice requires that one identify certain sharply defined elements of performance that need to be improved and then work intently on them. Examples are everywhere. . .Tiger Woods has been seen to drop golf balls into a sand trap and step on them, then practice shots from that near impossible lie. The great performers isolate remarkably specific aspects of what they do and focus on just those things until they are improved; then it's on to the next aspect." (Colvin 68)
- How most kids do homework is not deliberate practice. No wonder classes seem hard. Kids who do all the assignments *as assigned when assigned* in their homework do not need to study for tests to get A's (rich mental model). I have known plenty of honors students who do this and it has everything to do with how they prepare not 'giftedness'.
- Might that knowledge benefit your students? If they are convinced of their own efficacy then how smart they are is entirely up to them.
- Recovery periods and sleep.
  - Studies show that high achievers take more naps (Ericsson, Krampke, and Tesch-Romer 376-377).
    - Memory is consolidated.
    - Recently it has been discovered that a 'sanitation system' called Metabolite Clearance that is not active during waking hours flushes out waste in the brain during sleep (Xie et al.).
      - Practice before school, first thing in morning on weekends and nap.
  - Recovery Periods.
    - Engaging in deliberate practice is intellectually taxing (mental fatigue) and breaks need to be taken when serious confusion occurs.

© 2015 Gregg Goodhart

        - Current research shows that world class experts cannot engage in more than 4-5 hours of deliberate practice daily (Ericsson 699). 90 continuous minutes of deliberate practice at a time seems to be the limit. Consider this if you want to introduce your students to this concept. Generally 45 minutes on and 15 minutes off works for high level study. For beginners start with five minutes. This is far better than 15 minutes of unfocused practice.
        - When true mental confusion occurs, however long that takes, a recovery period is necessary.
        - Leisure activity (Ericsson, Krampke, and Tesch-Romer 377).
        - Plan recovery periods.
    - Focus is like a muscle. Those new to this type of intense concentration will only be able to lift a little intellectual weight until exhaustion. Start with little bits at a time, it will grow, but do not push through genuine mental fatigue. Take a break and do something that takes little intellectual investment.
- Repetition – I can't stress enough the importance of massive amounts of thoughtful repetition (did I do it right? If not how do I fix it? If I don't know ask my teacher, etc.) tens of thousands of times in the pursuit of effortless expert performance. Performing is fun, practicing is work; the more work you'll do the more fun you'll have. The good news is we've got about 12 years of schooling to do this a little bit at a time.
    - 100 rep scheme.
    - Getting something 'right' is on only the *first* step. Then repetition can begin with an eye for anything that can be improved for each subsequent repetition. This process can take days, weeks, or months depending on the challenge.
    - It is fine to make mistakes. It is not fine to not recognize and correct them. Pay attention.
- Interestingly there is a way to supercharge the brain's learning potential when doing reps. . .

Strategy Changes

- The Power Law of Practice (Newell, Allen, and Rosenbloom)
    - What many of us call the '80/20 rule'. Most progress is made during the initial stages then progress slows, sometime to a halt (plateau) for a while and the last stages take a long time.
- "The Strategy Specific Nature of Improvement: The Power Law Applies by Strategy in Task," Delaney et al.
    - The power law can be reset so that initial fast gains occur again by working on the same material in new ways.
    - Take Ben Franklin and writing. He learned to be a great man of letters through an ingeniously designed set of strategy changes.
    - This is present in all high efficiency/high level teaching and coaching.
- Don't just try these once or twice. Don't give up on new ideas too soon. Some of these will work better than others in certain situations. After you begin using them for a while that you will be able to identify the strategy needed for specific circumstances when necessary. In any case, doing any of this will work much better than doing none.
- Daniel Coyle, *The Little Book of Talent*.
    - Great ideas for the practical application of strategy changes applicable to any domain.

© 2015 Gregg Goodhart

For a detailed step by step instructions on how to begin implementing the following and enjoy significant improvement pretty quickly download, "Practical Ways to Play Better Now, Right Now, 'mon, go do it," here http://www.ggoodhart.com/wp-content/uploads/2014/06/goodhart-feel-the-blearn.pdf

Three of Many

Dots and Reverse Dots (with and without metronome): If this is not obvious to you see the musical examples herein. Reverse dot is a term I made up until someone brought to my attention that it is a Scotch snap. I should have paid more attention when studying Lully overtures in grad school!

Note Grouping: Playing a set number of notes then stopping and holding the last note for at least twice the value you had been previously playing. I've found groups of 3's (dots are twos) through 7's are enough. For an added challenge start your repetition with 1 or 2 or however many less notes than your target grouping. Now the gaps will be in different places challenging you. For example; after doing some reps with groups of 3 try playing the first note, hold that longer, then do groups of three. Next time play the first two notes and begin groups of 3, etc.

Continuous Grouping: This is a term I use when individual units that are practiced by themselves with groupings are played as part of the larger whole with the same grouping. The example herein is from Villa-Lobos' Etude 2. In this piece each measure (a full arpeggio) can and should be practiced on their own with all sorts of strategy changes. However, when playing the whole piece and applying groupings the location of the long notes will shift each measure giving an added challenge. Take the repeats in the piece or not, start with less notes than the target grouping as described above. All of these displace the long notes and challenge and focus the brain.

Self-Control

- Also called executive function by neuroscientists and self-regulation by psychologists. Many people call it willpower. This refers to the basic ability to choose "should" over "want".
- This is wired up in the pre-frontal cortex of the brain.
    - The PFC is very underdeveloped in the young and will not finish developing until the age of 25 (ever wonder why your insurance goes down, or you can't rent a car until you are 25?).
    - Self-control is learned just like instrumental skills – we engage in the behavior (create the neural network) and then reinforce it by repeating it over and over (myelination).
    - Because this control of impulse is unpleasant for a young person, and indeed many people, many times they have to be taught, and sometimes structured into these behaviors. It takes a good deal of self-control on the part of parents and teachers to make children do things that appear to make the child uncomfortable in the interest of making them self-reliant adults. That is one of the greatest acts of love we can do for a child: not praising them effusively for doing nothing or being their friend.
    - We have a limited amount of this resource and it while it is governed by the PFC it is fueled by glucose. (Baumeister and Tierney)
    - These glucose fueled neural networks are *generic willpower*, that is to say that they can be used to make yourself do any number of things you may not feel like doing.
- Self-esteem movement of the late 80's
    - Studies show self-esteem correlates with good grades (self-control) (ibid)
    - Educators and others believe that praising children for nothing (everyone gets a first place trophy!) will impart self-esteem thus facilitating better grades.

© 2015 Gregg Goodhart

- Researchers ran with it, with one in 1994 praising it. It made news, but what did not make news was the end of his report in which he said it was "disappointing" to see the lack of really solid evidence "to date". (ibid)
- Does anyone see the problem? What is the causal factor? Why believe that self-esteem leads to good grades *when it seems obvious that good grades lead to self-esteem,* and that is indeed what later research found and it seems this movement is coming to an end. But not after a generation was raised to believe they are superstars for doing nothing and expect to be treated that way. They have underdeveloped pre-frontal cortices and many of them are living with their parents as adults *with no intention of accomplishing anything else.* They may expect their parents to treat them a certain way, but that is not going to work with society at large.
- Google, "You Can do Anything," a Saturday Night Live sketch for a hilarious view of this phenomenon. After you laugh you may cry when you realize how accurate it really is.

- Creating motivation without failure.
  - This world does not exist, however there is much that can be done to reduce the negative and produce lasting positive habit patterns.
- <u>We are called to be their mentors, not their friends.</u>

<u>Habit Pattern Development</u>

- Practicing, and doing work properly, can be developed incrementally into a habit. (Duhig)
- 30 days to build a solid habit. (Coyle)
  - Let's address practice.
- We are working on two things here: *amount* of work and *type* of work (as discussed earlier). Both can be trained simultaneously. Both are like muscles and can be developed as one would develop a muscle. Start with a little resistance and increase as strength increases.
  1. Amount of practice.
     - Find 'sacred' practice time.
     - Getting started, assessing time (see attached time inventory sheet), quit without guilt. Identify the smallest details and begin building from there.
     - Start with 10 minutes 5 days a week. After two weeks it will begin to become a habit. That is to say that the act of getting started and going through the first 10 minutes is like tying your shoes. It may not be pleasant, but it is just something you do automatically without any significant discomfort.
     - Go to 15-20 for the next two weeks. The student can quit without guilt at 15. All I ask is that they *try* to push through for another minute. If not right away then eventually they will go past that without even noticing.
  2. Type of practice. Focus; what it is and how to train it
     - What many people think is focus and work toward improvement is not. Thus significant improvement is rare. Getting work off of one's desk is much different than getting the work done right which is the essential concept of skill development.
     - Attention to every detail, the smaller the better – build up from there.
     - Always endeavor to not give answers, ask questions to let students find the answers. This is harder than just giving information and is a mark of master teaching. If you are new to doing this it will be a bit confusing and mentally uncomfortable. You are going through desirable difficulty (Feel the Blearn!), don't abandon it, embrace it.

© 2015 Gregg Goodhart

- Meta coaching.
- 10x perfect game.
- What if. . .
- I'm going to ask you to play and listen to yourself and everyone else in your group. When you we finish this section be prepared to speak for 2-3 minutes about every aspect of everyone's performance. This brings the student to acute awareness paying attention to as many details as possible in order to fill the time (I usually start by becoming totally silent for 30 seconds. It seems like an eternity and then I tell them I'll want them to fill at least four times that amount with their critique). I do not make them speak, but they always perform better on that attempt and learn what good focus is.

Mindset

- Researcher Carol Dweck and growth vs. fixed mindset.
  - Her three decades plus of research has addressed why, to put it colloquially, most of us can't get out of our own way when it comes to learning.
  - See attached handout
  - Praise the work, not the 'talent'. This is simply the truth and not a manufactured motivational strategy.
  - Perseverance/patience.
    - Setting goals is good, setting deadlines may not be.
- Don't believe the road signs that nature puts up along your quest for skill development.
  - Research shows that there is no fast track to improvement. Level of accomplishment always correlates with amount of practice.
  - Don't measure yourself against where you want to be, measure yourself against where you have been and how you have improved over the course of months, at least.
  - Setting goals is great, setting deadlines may not be.
  - Adults thinking they should learn music, or other brand new concepts, as they do in science and math and reading (All things they've had a massive amount of practice in over the years). They will not be able to assimilate a brand new skill like playing an instrument the way they acquire higher level knowledge in those fields.
  - Don't compare yourself to others by age. Compare by hours put in and, more specifically, the type of work done during those hours.
  - How progress is measured. Days vs. weeks or months. The long arc of performance development.
- Perseverance and patience.
- Skill acquisition is set up backward to what most people perceive it should be. Many perceive that because something is hard at first and little progress is made with great effort that they do not have talent. In reality it is pushing through this initial phase and getting to a level of competence in which higher level accomplishment can be trained *is itself* 'talent'. Many tend to think that being really good at something right away (which never happens, the research is overwhelming on this) reveals a 'talent' and then hard work to reach one's potential can begin. This is part of the misunderstanding of talent.
- Accountability/assessment.
  - ASTA article 8/2012. Christopher Selby. "10 Strategies for Developing a Strong Student Practice Ethic"

© 2015 Gregg Goodhart

Real Accomplishment as Motivator

- We cannot get there without pushing through the initial learning (Blearn, motivation, allocation of time, acquisition of instruction, etc.) just like your muscles would be sore and you would hurt for a while if you started working out, the brain will 'hurt' as one engages in meaningful skill acquisition. It is a myth that any given individual begins learning a skill *with no previous exposure or participation in that domain* significantly faster than anyone else.
- Development and Adaptation of Expertise: The Role of Self-Regulatory Processes and Beliefs by Barry J. Zimmerman.

A New Paradigm

- What are 'talent' auditions and gifted/academic admissions?
    - Pre-built learner tests
    - Demonstration of a long term commitment to deliberate practice.
        - This is very significant.
    - A willingness to take coaching/teaching (they did not get there on their own)
    - A willingness to keep doing this with the right mindset.
- What about the many schools that don't get top tear, or near top teir, pre-built learners?
    - A new paradigm
    - The Art and Science of Learning
    - Practice coaching
- Why does this issue exist between college and high school?
    - College expects pre-built learners and is mostly content delivery. This is fine for pre-built learners.
- What is the reality.

Advocacy

- The President's Committee on the Arts and the Humanities identifies, " . . . instrumental outcomes derived from high quality arts education . . . including transfer of skills learning from the arts to learning in other academic areas. AEP followed up its original compilation of research with Critical Links: Learning in the Arts and Student Academic and Social Development (Deasy, 2002) that reported on 62 separate research studies, including several meta-analyses, many of which found transfer of skills from the arts (visual arts, dance, drama, music, multi-arts) to learning in other subject areas. 11 Other studies report positive outcomes such as habits of mind, self-motivation, and social skills, including tolerance and empathy and positive peer interaction, from arts engagement." (PCAH 16-17). Now we know how and why that works.
- Why Music Education Matters in Academics: It May Not Be What You Think. (Goodhart)
- There is another transfer of skills that can occur. "The documented benefits of arts integration have also been accumulating over the past decade, although only recently have researchers begun to understand why arts integration may hold unique potential as an educational reform model. While the term arts integration takes on different meanings to different people, it can be loosely defined as teaching through" and "with" the arts, creating relationships between different arts disciplines and other classroom skills and subjects (Burnaford, 2007). In recent years, it has formed the basis for several successful school reform initiatives, and has generated a lot of enthusiasm from classroom teachers, school administrators and policy researchers for its ability to produce results. Studies have now documented significant links between arts

© 2015 Gregg Goodhart

integration models and academic and social outcomes for students, efficacy for teachers, and school-wide improvements in culture and climate. Arts integration is efficient, addressing a number of outcomes at the same time. Most important, the greatest gains in schools with arts integration are often seen school-wide and also with the most hard-to-reach and economically disadvantaged students." (PCAH 19)

  - Experienced music teachers understand the basic issues outlined here as part of their normal teaching. What is new is the coalescing of research, first from cognitive psychology then from neuroscience, that allow us to fill in the blanks and understand how all of these things function as part of a larger model. When we come to understand that we know how to teach others to do what we do.

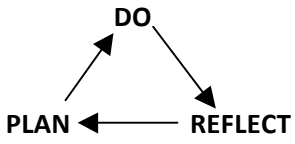
- "The potential contribution to the overall improvement of teaching, including augmenting teachers' skills in problem-centered, project-based and inquiry-oriented learning; performance assessment; and cross-disciplinary work with real world application." (PCAH 39-40)
- We are also advised, "Likewise, it is important to consider that replacing music programs with reading or math instruction in our nation's school curricula in order to boost standardized test scores may actually lead to deficient skills in other cognitive areas." (Benjamin et al. 12)

<u>Creativity</u>

- Creativity, as most experience it, is a performance of intelligence.
  - "Creativity is intelligence having fun." - Albert Einstein
  - Big C, little C and mini C creativity (Colvin 159)
- In this brand new age of globalization there will always be someone somewhere who is willing to manufacture something more cheaply than we can do so in America and maintain the expected quality of life. Former Federal Reserve Chairman Alan Greenspan wrote of this;
  - "Manufacturing jobs can no longer be highly paid, since it is consumers who at the end of the day pay the wages of factory workers. And they have balked. They prefer Wal-Mart prices. Those prices, reflecting Chinese low wages, are inconsistent with a funding of high-wage traditional U.S. factories. Forcing U.S. consumers to pay above-market prices to support factory salaries eventually would run into severe resistance. But by then, the American standard of living would have fallen." (Greenspan 395-396)
- "In a world of forces that push toward the commoditization of everything, creating something new and different is the only way to survive. A product unlike any other can't be commoditized." (Colvin 146)
  - ". . .too many of our students languish at too low a level of skill upon graduation, adding to the supply of labor in the face of an apparently declining demand." (Greenspan 399-400)
- Take Apple – created here, made there.
- There has been a push to teach creativity in schools for some time. Sometimes with disastrous results.
  - In 1989 the National Council of Teachers of Mathematics, ". . . report recommended a curriculum that dropped emphasis on basic math skills (multiplication, division, square roots, and so on) and pressed students to seek more free-flowing solutions and to study a range of special math topics. I always wondered how you can learn math unless you have a thorough grounding in the basics and concentrate on a very few subjects at a time. Asking children to use their imagination before they know what they are imagining

© 2015 Gregg Goodhart

about seemed vacuous to me. It was. (Greenspan 406). They have since reversed that position.
    - ". . .cognitive load theory suggests that the free exploration of a highly complex environment may generate a heavy working memory load that is detrimental to learning. This suggestion is particularly important in the case of novice learners, who lack proper schemas to integrate the new information with their prior knowledge." (Kirschner, Sweller, and Clark 80)
- And this about where we currently stand when it comes to teaching creativity in most subjects. How, then, should we do it?
- The first thing we should understand is exactly what Greenspan was addressing – How can you create in a domain without requisite knowledge?
    - ". . .the epistemology of a discipline should not be confused with a pedagogy for teaching or learning it. The practice of a profession is not the same as learning to practice the profession." (ibid 83)
    - Do what they did, not what they do.
- Creativity at the atomic level. The creative process is present in the steps involved in deliberate practice.
    - **Plan** - Even the most rudimentary solution, even a wrong one that the student should be guided to understand was wrong in the reflect stage, is problem solving which is separate from problem discovery. This the exercise of rudimentary creativity. – generating an answer that was not there before. The continued refinement of those answers over time is the refinement of the creative process.
    - **Reflect** – This is the act of critical thinking This can be done with the young, though they need to be scaffolded in the problem discovery process. In a 1987 study on that issue researchers found, "These results suggest that problem discovery is associated with creative performance in adolescents. . .This result is consistent with Arlin's (1875) position that problem finding is a developed skill and only becomes distinct from problem solving skill during adolescence." (Runco and Okuda 217) Can you see the educational progression from the very basics to higher level creativity?
    - High level creative thought has already worked through basic solutions thousands of hours and repetitions ago. What is left is novel solutions born of a rich mental model.
- This follows the recommendations of The President's Committee on the Arts and the humanities.
    - ". . .the approaches used in teaching the arts are very compatible with the development of balance among the three types of abilities associated with creativity as described in a well-known theory of creativity development:
        - synthetic ability or generating new and novel ideas;
        - analytic ability or critical thinking which involves choosing which ideas to pursue; and
        - practical ability or translating ideas into action (Sternberg & Williams, 1996)."(38-39)



© 2015 Gregg Goodhart

- Manipulate basic information using strategy changes to apply deliberate practice at the earliest stages and reinforce to students, and everyone else for that matter, that they are learning the very beginning stages of high level creative thought.
    - Examples

This stuff works, why not do it?

Some final thoughts on education from a book I am writing.
Everyone seems to agree we have a crisis in education. The situation at the college level is particularly acute. I have to side with researcher Yong Zhao when he said while addressing an audience, "Some say our education system is broken. I disagree. . .It never worked in the first place."

You can Lead a Horse to Water, but can You Make Him Think?
If we think about it we have been waging the 'war on bad education' for over 50 years. Clearly we have not gotten it right, and will wait for the next big thing to implement and fail. Recently the provost of CSSB contracted with Udacity to offer online remedial courses so that students could be brought up to speed in order to tackle college level courses in core subjects. The pass rates were abysmal. The reason for this is the same reason they have not developed the skills in their pre-college coursework – they don't know how learning really works, and nobody has taught them.

As the provost said, "You can lead a horse to water, but you can't make him drink." What if it turns out that our horses don't even realize they are thirsty? What if they've been expending great effort to suck the dew off of the leaves each morning barely subsisting while a gushing well of water is nearby? What if they did not know the correlation between water and thirst and just did whatever seemed necessary at the time to survive.

That is how most students navigate the educational process. The few who do know about the gushing well and take advantage of it we call 'gifted' and single them out for more intensive training. However, the well is available to everyone and has a limitless supply of water.

Why do we have grade stratification? Why is it that some students under the same teacher get wildly disparate grades (learning). Generally, we chalk it up to intelligence. Our A students are brilliant and F students are still good folks anyway, right?

What if this understanding turns out to be entirely wrong? What if much of what we believe about intelligence and achievement is a misunderstanding?

Learning works almost completely backwards as to what most people, including many teachers, parents, and administrators, think. As UCLA researchers Bjork and Bjork write, ". . .optimizing instruction will require unintuitive innovations in how the conditions of instruction are structured."

The core process of learning, one of trying solutions, learning from failure and gradually forming understanding *at the atomic level* is counterintuitive to our memorization model of education. As with many aspects of education we get it just a little wrong, just enough to make it ineffective.

© 2015 Gregg Goodhart

Yes, learning is the storage in long term memory of processes and information that can be brought into working memory and used to think critically. Anders Ericsson has proposed a third structure called *long term working memory* that is used in that process. In any case it is a good way to understand this relationship.

However, acquiring foundational domain knowledge (facts, figures, basic processes) is one small part of building the mental model needed in long term memory to bring to bear in solving complex problems in the domain. Yet we treat it as the be-all-end-all in our testing system encouraging strategies by students that circumvent actual learning. Those that understand and participate properly in learning are our 'gifted' students. How well the others figure that process out and implement it will be reflected in their grades. They do it better for some classes and worse for others, and sometimes worse for all.

This is not entirely the fault of educators. These folks are tasked with grading hundreds of kids. Right now the most efficient way is through testing domain knowledge at terminus points. Most of these teachers have never been *taught how to learn* and while many are very good at learning they do not know exactly how they do it because they have not been taught how to learn. If you don't know *how* you do something you can't teach it effectively. Mastering domain knowledge is only half of the equation. Mastering teaching is the other.

What if it turns out there is an education model in which students could learn at a high level that transcends what is being tested? The tests would be aced, but not necessary. This can exist

We can blame the government too. But understand this – the paradigms they've come up with are in response to a great many teachers and administrators who, frankly, don't do their jobs. I taught some high level award winning courses in high school and I've got a list of accomplishments in that realm as long as John Gotti's rap sheet, yet because of the governmental credentialing system I am unqualified to teach public school where I could really do some good. Yet that credentialing system came into existence when we had a system that had teachers who could not do basic algebra teaching things like trigonometry. How could anyone who cares about the education of our students do or condone that? Yet it was prevalent and the response to that unprofessional, uncaring, and damaging situation was the credentialing process. We brought it on ourselves, just as we've brought most of the other government education initiatives we like to complain about so much on ourselves.

This ethos pervades education. It is an environment in which human teachers are largely left on their own to do what they want. Give most humans freedom like that without the tools to create a rich working environment and many will slack. Many act just as they did in high school, but now they are the big fish.

The irony here is that our teachers go about their teaching the way students go about high school. Since they have not been taught how to learn and how to teach that to others they try to figure it out on their own. The ones who do we call great teachers and see them in little vignettes on the evening news. Everyone else who is trying to find answers, and some don't care to, are going to elaborate educational events and mandatory professional development. All of this time and effort and we've still got serious problems in education.

© 2015 Gregg Goodhart

Where are the answers?
As is frequently the case we've got it right wanting to get teachers into regular professional development. As with many aspects of education we get it just a little wrong, just enough to make it ineffective.

We latch on to this or that piece of research or information and then let the hype carry us away. When it does not work out, or when we don't really implement it with a whole heart, we move on to the next big thing and discard the last.

It turns out that many of these hyped things do work when correctly implemented, *but* they are just pieces of a larger picture. We seem to be enamored with the one solution that will revolutionize teaching. It is as if we have figured out that an engine is a crucial part of making a car move. We work hard on building a great engine. Then we sit on it and it goes nowhere. We declare the engine a good idea, but it does not work in practice and discard it. Then we get to work on the steering because we heard of new research on CNN that showed how crucial a good steering system is in a car. Certainly there are companies out there who will be happy to sell you professional development in this brand new single solution. It will be your next workshop and the cycle continues.

In short here is the current problem with education – students, teachers, parents, administrators, and the government, but other than that we're doing really well. You'll probably be the first to tell me that it is folly to try and change it, but I think we may have a chance. If we do not get it right then America will lose its place as the most powerful nation in the world and all of the other countries that implement learning to learn protocols will be the ones ahead of us. The country that facilitates intelligent creativity, which is a learned skill, will innovate their way to number 1 in the new economy. That is the period in history we are currently in. If we do not take real, serious action we will look back with regret.

For all of the problems there are genuine people, more than a few, who are ready to do the things necessary to bring our education system out of the dark ages. Many, like me during my teaching career, are viewed as eccentric as the solutions are so counterintuitive. Many keep quiet about it, or try to make a difference and are struck down by administrators and parents, but they are there ready to go and we can utilize them.

There is an opportunity for grass roots change that can sweep up everyone. Once learning to learn protocols are in place, even at the individual classroom level, the results will be obvious. Other good and genuine teachers and administrators will want to learn what is working. Anyone who does not is in education for reasons other than teaching and should stand out like a sore thumb in this environment. My humble recommendation for anyone who approaches such a life altering profession for thousands of people as teaching is to get out, now, and for those around them to get them out as soon as possible. I have, unfortunately, worked with more than a few of these teachers and administrators. Change or get out.

The Reality
Any healthy student is capable of acing all of their courses and being 'gifted' with the same average amount of effort as anyone else.

© 2015 Gregg Goodhart

Bibliography

Araque, Alfonso, and Maria Navarrete. “Electrically Driven Insulation in the Central Nervous System.” *Science* 333:6049 (Sept. 2011): 1587-1588. Print.

Baumeister, Roy F., and John Tierney. *Willpower*. New York: Penguin, 2011. Print.

Bjork, E. L., Bjork, R. A. “Making things hard on yourself, but in a good way: Creating desirable difficulties to enhance learning.” *Psychology and the Real World: Essays illustrating fundamental contributions to society*. Eds. M. A. Gernsbacher, R. W. Pew, L. M. Hough, J. R. Pomerantz. New York: Worth Publishers, 2011. 56-64. Print

Colvin, Geoff. *Talent is Overrated*. New York: Penguin, 2010. Print.

Coyle, Daniel. *The Talent Code*. New York: Bantam Dell; Random House, 2009. Print.

Coyle, Daniel. *The Little Book of Talent*. New York: Bantam; Random House, 2012. Print.

Csikszentmihalyi, Mihaly. *Good Business*. New York: Penguin, 2003. Print.

Dana Foundation. “How Arts Training Improves Attention and Cognition.” Cerebrum, 505 Fifth Avenue, 6th floor New York, NY 10017. Web, 14 September 2009

Doidge, Norman. *The Brain That Changes Itself*. New York: Viking; Penguin, 2007. Print.

Delaney, Peter F., Reder, Staszewski, and Ritter. “The Strategy-Specific Nature of Improvement: The Power Law Applies by Strategy Within Task.” *Psychological Science*. 9.1 (Jan. 1998): 1-7. Print.

Duhigg, Charles. *The Power of Habit*. New York: Random House, 2012. Print.

Dweck, Carol. *Mindset*. New York: Random House, 2006. Print.

Ericsson, K. Anders. “The Influence of Experience and Deliberate Practice on the Development of Superior Expert Performance.” *The Cambridge Handbook of Expertise and Expert Performance*. Ed. K. Anders Ericsson, Neil Charness, Paul J. Feltovich, Robert R. Hoffman. New York: Cambridge, 2006. (683-703). Print.

Ericsson, K. Anders, Ralf Th. Krampke, and Clemens Tesch-Romer. “The Role of Deliberate Practice in the Acquisition of Expert Performance.” *Psychological Review.* 100.3 (1993): 363-406. Print.

Ericsson, K. Anders, and Walter Kintsch. “Long-Term Working Memory.” Psychological Review. 102.2 (1995): 211-245. Print.

Ericsson, K. Anders, William G. Chase, and Steve Faloon. “Acquisition of a Memory Skill.” Science. 208 (1980): 1181-1182. Print.

Flynn, James R., “The Mean IQ of Americans: Massive Gains 1932 to 1978.” *Psychological Bulletin.* 95.1 (1982): 29-51. Print.

Foer, Joshua. *Moonwalking With Einstein*. New York: Penguin, 2011. Print.

Goodhart, Gregg. “Why Music Education Matters in Academics: It May Not Be What You Think.” *American String Teacher* 64.3 (Aug. 2014): 26-29. Print.

Gopnik, Allison. "The Dangers of Believing That Talent Is Innate." *The Wall Street Journal*, 4 Feb. 2015. Web. 9 Feb. 2015.

Greenspan Alan. *The Age of Turbulance*. New York: Penguin, 2007. Print.

Hardiman, Hariale, Luke Rinne, Emma Gregory, and Julia Yarmolinskaya. " Neuroethics, Neuroeducation, and Classroom Teaching: Where the Brain Sciences Meet Pedagogy." Neuroethics 20 May. 2011: n. pag. Web. 15 July 2014.

Hill, Nicole M. and Walter Schneider. “Brain Changes in the Development of Expertise: Neuroanatomical and Neurophysiological Evidence about Skill-Based Adaptations.” The Cambridge Handbook of Expertise and Expert Performance. Ed. K Anders Ericsson, Neil Charness, Paul J. Feltovich, Robert R. Hoffman. New York: Cambridge, 2006. (653-682). Print.

Jentzsch, Ines, Anahit Mkrtchian, and Nayantara Kansal. “Improved Effectiveness of Performance Monitoring in Amateur Instrumental Musicians.” *Neuropsychologia* 52 (2014): 117–124. Print.

© 2015 Gregg Goodhart

Kirshner, Paul A., John Sweller, and Richard E. Clark. “Why Minimal Guidance During Instruction Does Not Work: An Analysis of the Failure of Constructivist, Discovery, Problem-Based, Experiential, and Inquiry-Based Teaching.” Educational Psychologist. 41.2 (2006): 75-86. Print.

McGonigal, Kelly. *The Willpower Instinct*. New York: Penguin, 2012. Print. Newell, Allen, and

President’s Committee on the Arts and the Humanities, *Reinvesting in Arts Education: Winning America’s Future Through Creative Schools* 505 Fifth Avenue, 6th floor New York, NY 10017.

Rosenbloom, Paul S.cn, "Mechanisms of skill acquisition and the law of practice" (1982). *Computer Science Department.* Paper 1616.

Runco, Mark A., Shawn M. Okuda. “Problem Discovery, Divergent Thinking, and the Creative Process.” *Journal of Youth and Adolescence* 17.3 (1988) 211-220. Print.

Royal Conservatory of Music.” “iSCORE.” TELUS Centre for Performance and Learning, 273 Bloor Street West, Toronto, Ontario, Canada, M5S. Web, 3 April 2012 <http://www.rcmusic.ca/iscore-home-page>

Selby, Christopher. “10 Strategies for Developing a Strong Student Practice Ethic.” *American String Teacher* 62.3 (Aug. 2012): 98. Print.

Sloboda, John A., et al. “The Role of Practice in the Development of Performing Musicians.” *British Journal of Psychology* 333.6049 (Sept. 2011): 1647-1651. Print.

Smith, Tovia. "Does Teaching Kids To Get 'Gritty' Help Them Get Ahead?." *NPR*. National Public Radio, 17 Mar. 2014. Web. 22 Dec. 2014.

Wake, Hiroaki, Philip R. Lee, and Douglas Fields. “Control of Local Protein Synthesis and Initial Events in Myelination by Action Potentials.” *Science* 87.2 (May 1996): 287-309. Print.

Xie, Lulu, et al. “Sleep Drives Metabolite Clearance from the Adult Brain.” *Science* 342.6156 (Oct. 2012): 373-377. Print.

Young, Robert G., Ann M. Castelfranco, and Daniel K. Hartline. “The “Lillie Transition”: Models of the Onset of Saltatory Conduction in Myelinating Axons.” *Journal of Computational Neuroscience* 34.3 (2013): 533-546. Print.

Zimmerman, Barry J. “Development and Adaptation of Expertise: The Role of Self-Regulatory Processes and Beliefs.” *The Cambridge Handbook of Expertise and Expert Performance*. Ed. K Anders Ericsson, Neil Charness, Paul J. Feltovich, Robert R. Hoffman. New York: Cambridge, 2006. 705-722. Print.

Whether you think you can, or you think you can’t – you’re right.

-attributed to Henry Ford

© 2015 Gregg Goodhart

Recommended Reading

These three are the jumping off point for everything you want to know and research and are a good starting point. They are part of a much more extensive list of books, papers/studies/articles, and my writing available at ggoodhart.com

Talent is Overrated: What *Really* Separates World-Class Performers from Everybody Else
Geoff Colvin

For my money the single best reference on the nuanced overarching idea of talent, how we wrongly perceive it, and how these implications inform teaching and learning. Unlike Outliers Colvin describes the things that you need to do to be successful. He also points to research you can review on your own. It is scholarly, but also it is an entertaining read.

Willpower: Rediscovering the Greatest Human Strength
Baumeister and Tierny

These researchers have done some amazing work on what happens in the brain with regard to self control and how it is been trained. They also cite other relevant research and weave together a compelling take on how discipline is learned. Another scholarly entertaining read. This, TIO, and Mindset are the fundamental must-reads of this list.

Mindset: The New Psychology of Success
Carol Dweck

Professor Dweck has spent over three decades researching the *psychology* of learning. Since learning is different than what most people think it is things like failure and mistakes seem to indicate a lack of ability to them. In an attempt to appear competent they cover this by not participating in learning. It is, of course, more complex than that and her work is fascinating. You will recognize it all around you and likely, as did I, in yourself to some extent.

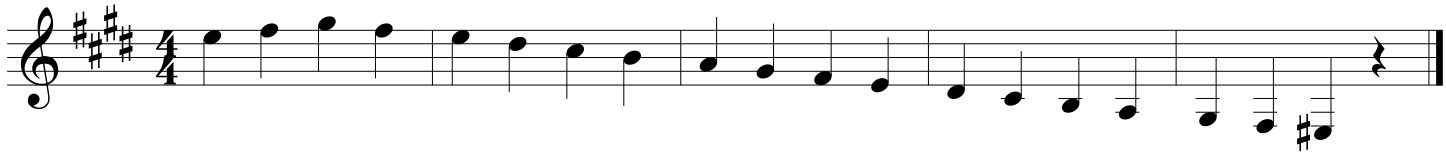
". . .optimizing instruction will require unintuitive innovations in how the conditions of instruction are structured."

-Drs. Bjork and Bjork

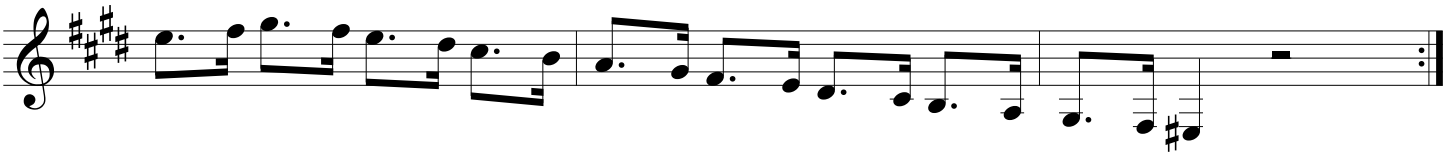
© 2015 Gregg Goodhart

Strategy Shifts

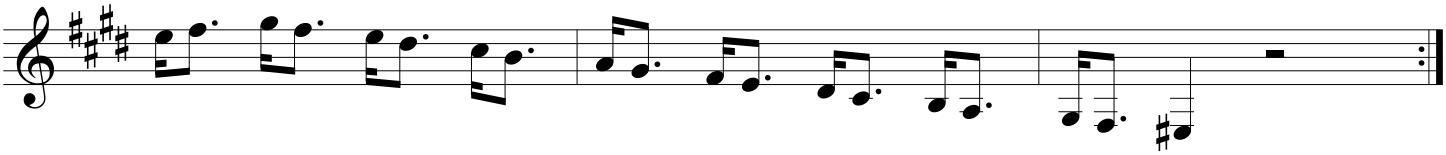
Opening of Villa-Lobos Etude 7 (originally in 16th notes, pick up on the and of 4)



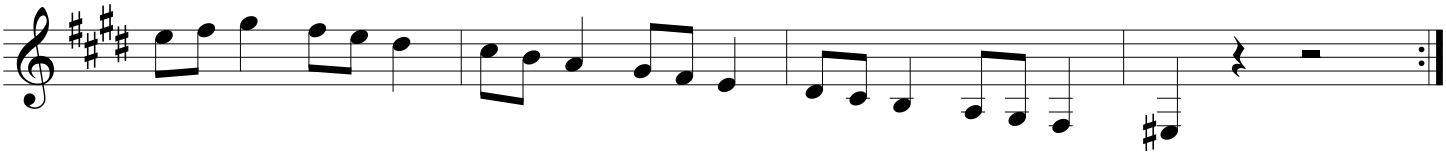
Dotted Rhythms



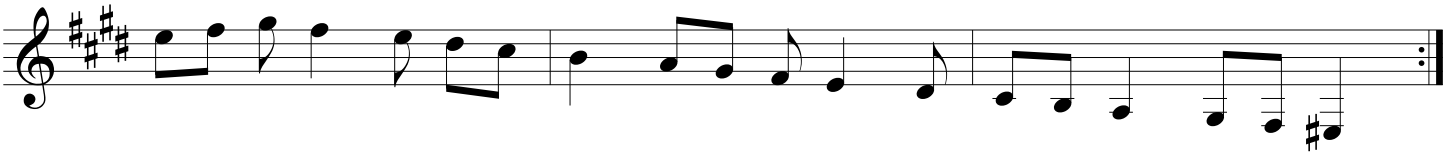
Reverse Dots



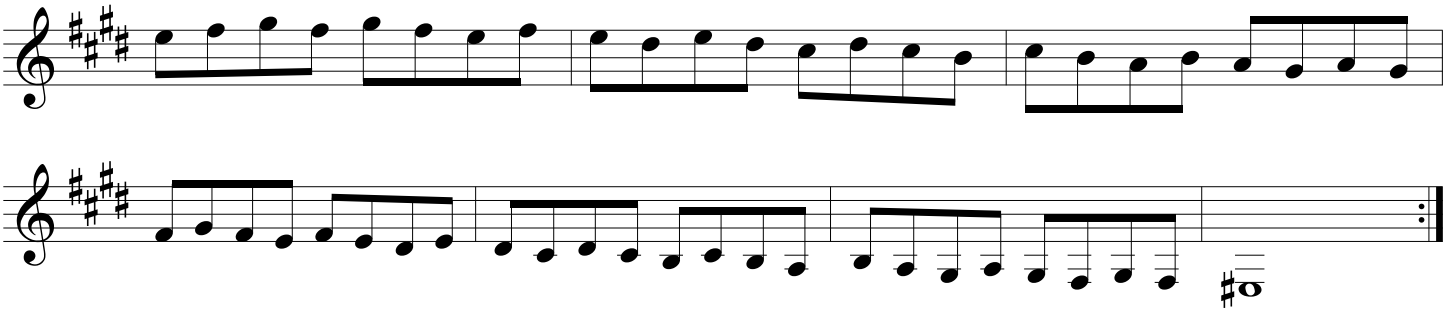
Note Grouping 3's



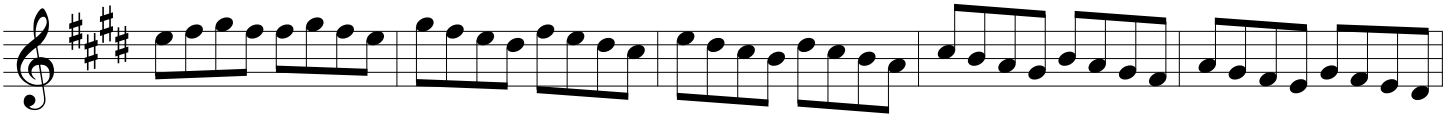
Note Grouping 4's (etc.)

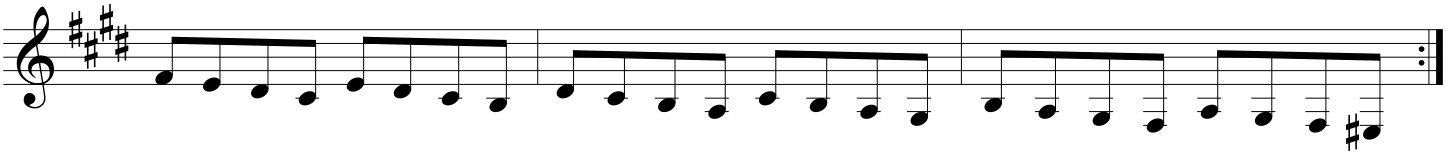


3 Note Sequence

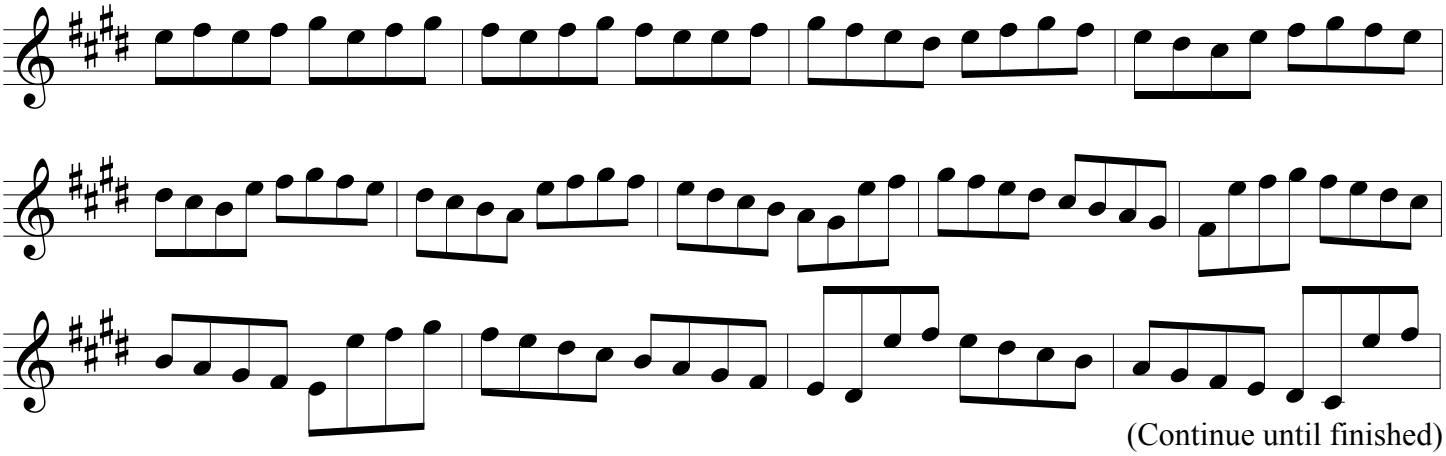


4 Note Sequence (etc.)



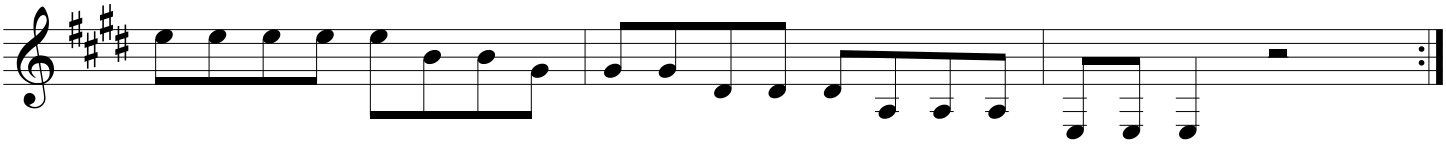


Add a Note (Feel free to pause before each iteration if you wish)

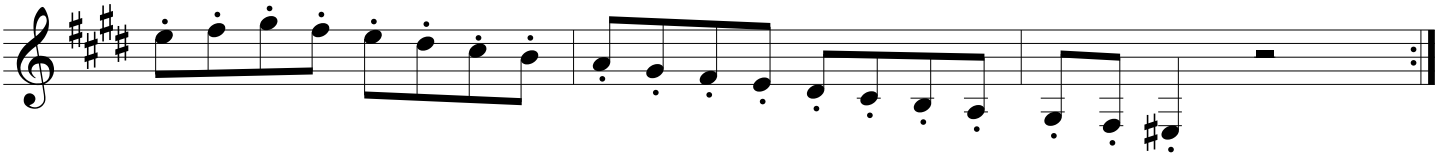


(Continue until finished)

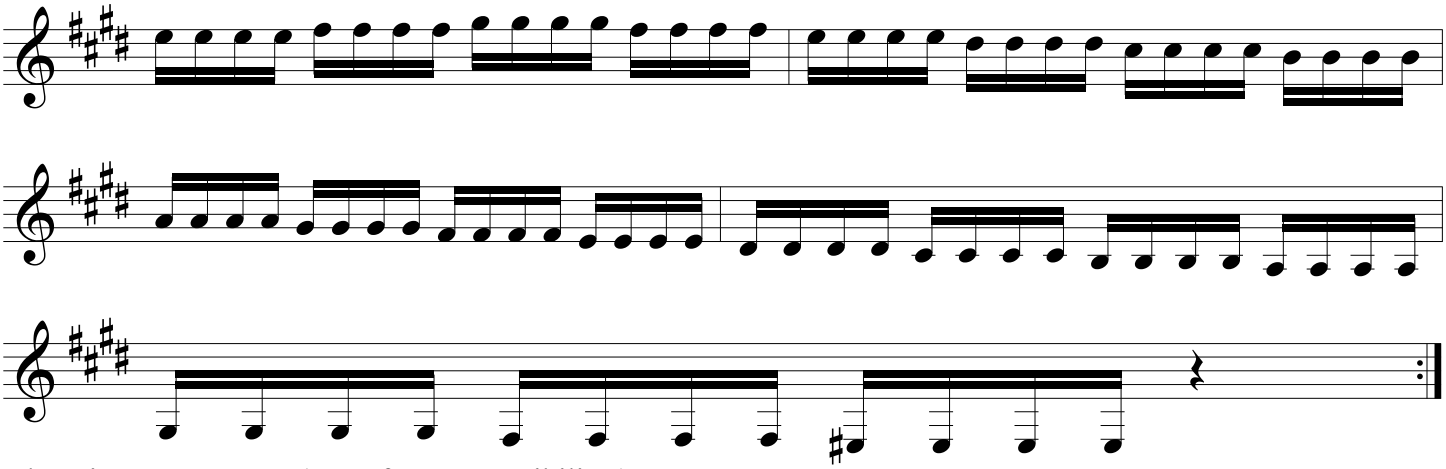
Right Hand Only



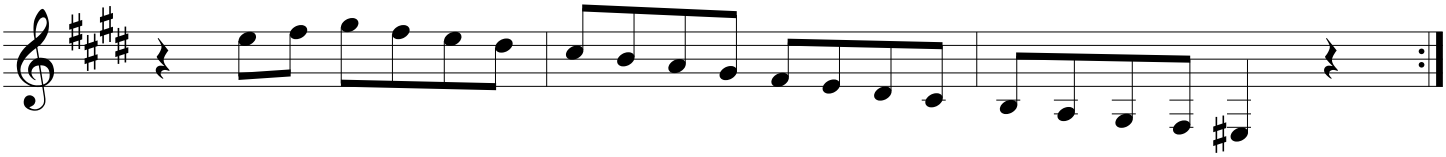
Planting (when crossing strings bring the finger to the new note instead of back to the string for the staccato)



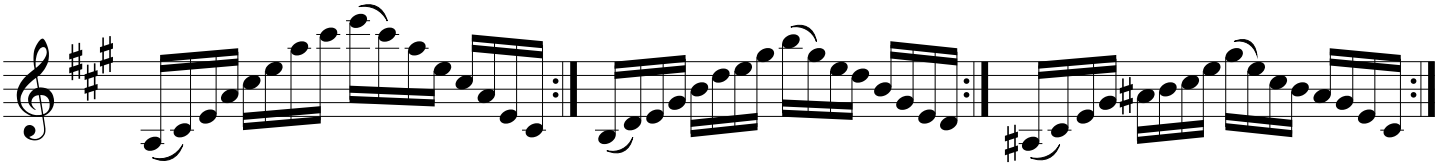
Tremolo Scale Runs



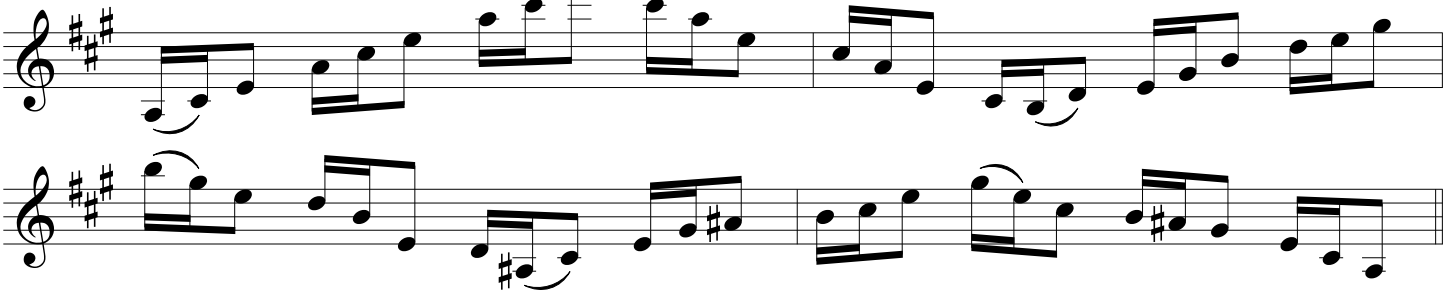
Changing Strong Beat (one of many possibilites)



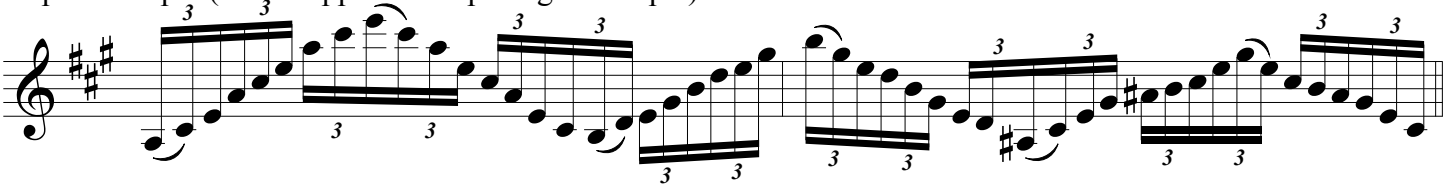
First two measures of HVL Etude 2



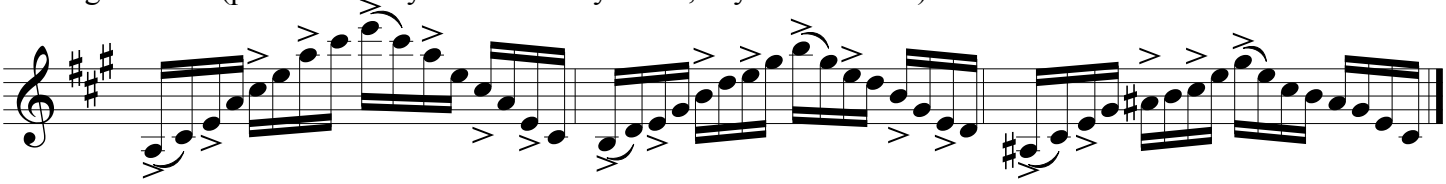
Continous note grouping using 3's



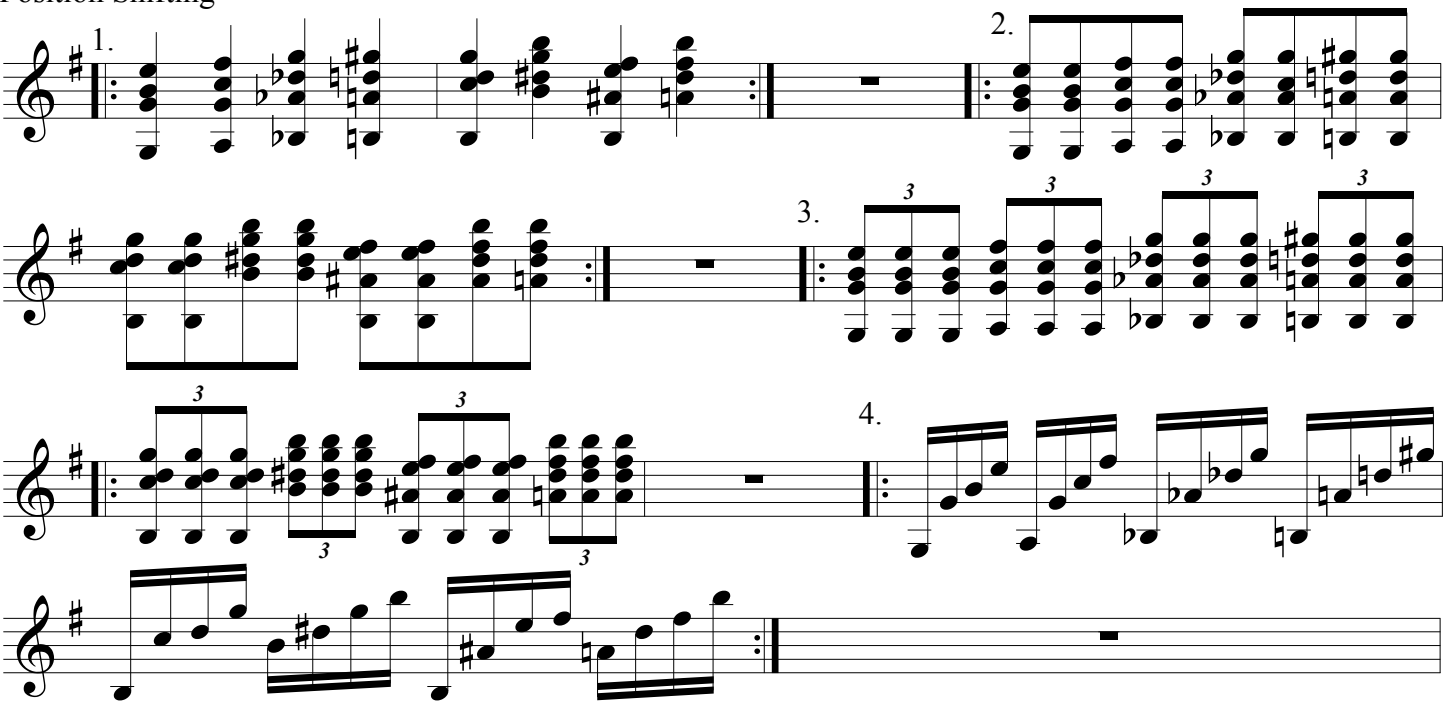
Duple in Triple (do the opposite for passages in triple)



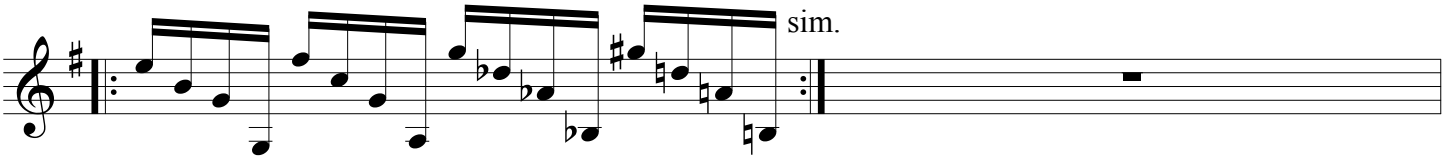
Adding Accents (put them everywhere and anywhere, any combination)



HVL excerpt from Etude 6 (original in 2/4 with eighth notes)
Position Shifting

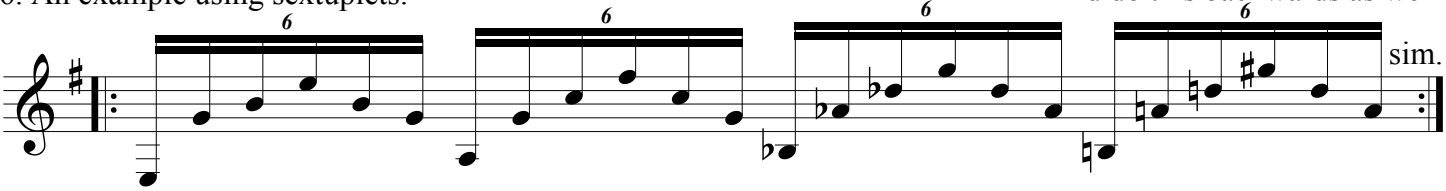


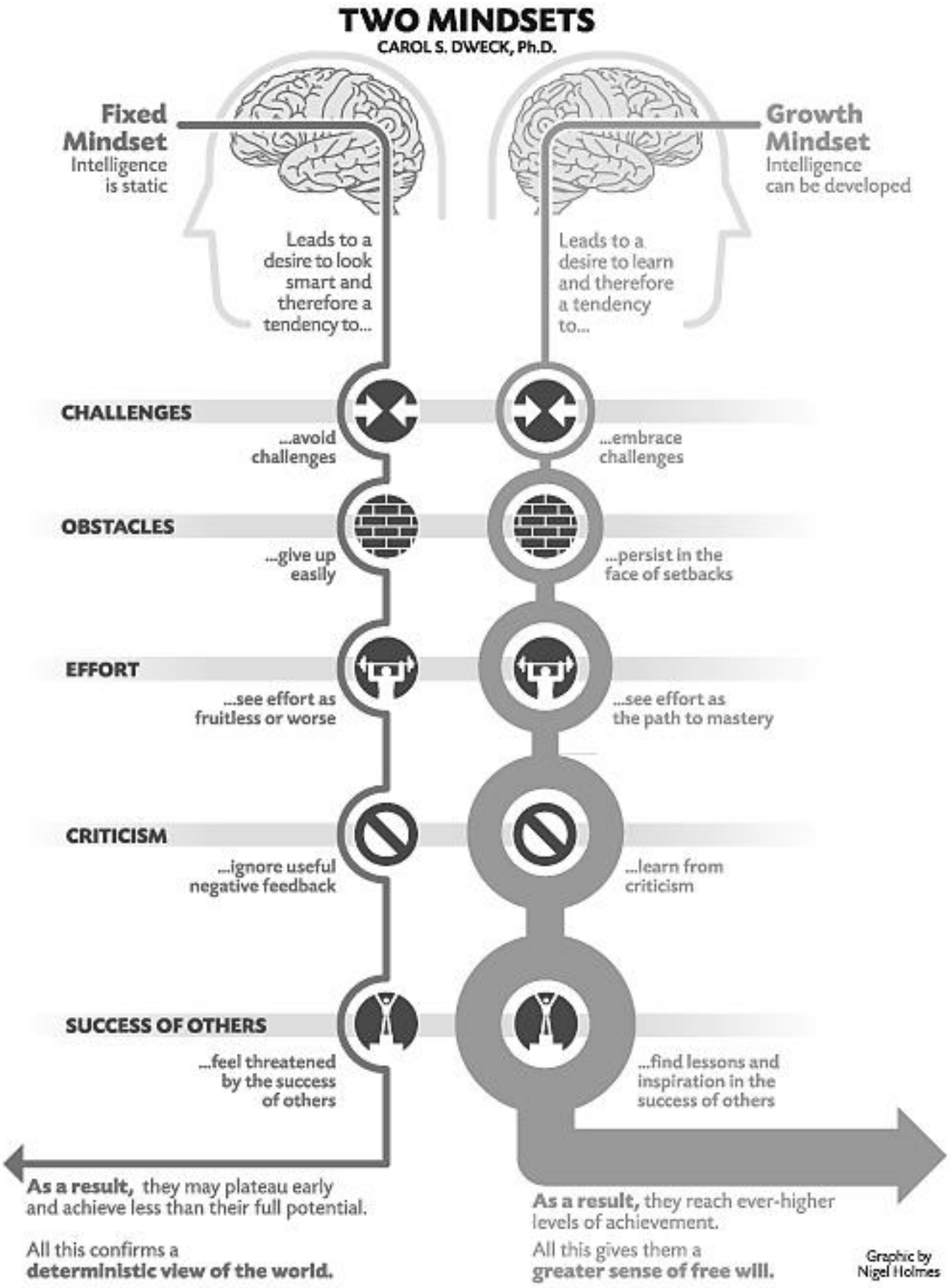
5. Now try that pattern backwards to ensure you did not cheat and get off the lower notes early.



6. An example using sextuplets.

And do this backwards as well





Used by permission

Why Music Education Matters in Academics:

It May Not Be What You Think

by Gregg Goodhart

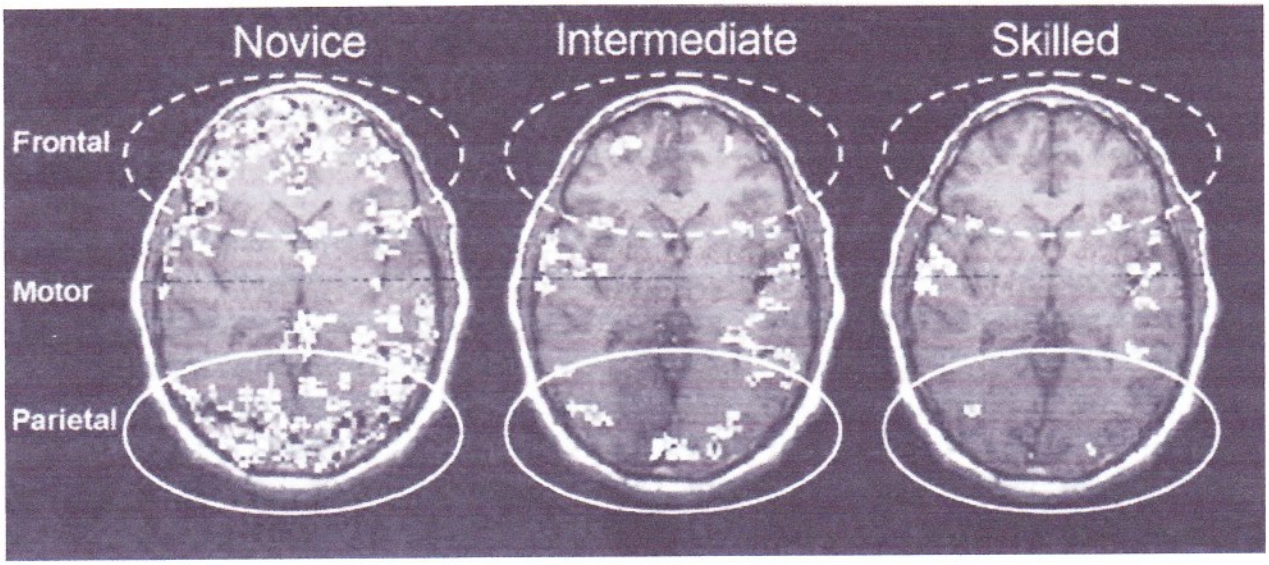
As much as I'd like to believe it, I've always been a little dubious about research citing music instruction as a causative factor of positive outcomes in other areas of life. The "Mozart Effect," ill-conceived as it was, took on a life, and an industry, of its own. I've wondered if the type of young person interested in playing the violin in orchestra is even the type of person who would ever be interested in joining a gang.

Advances in science clarify learning

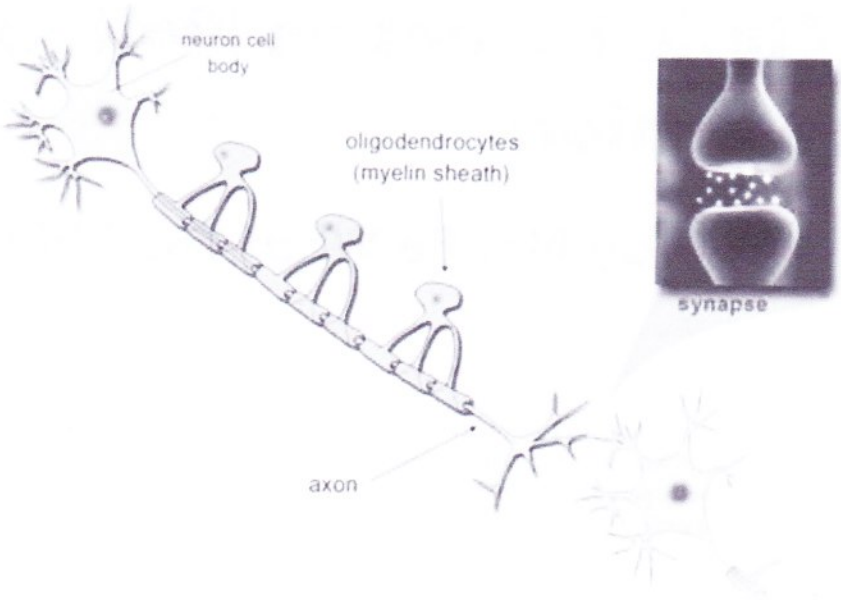
Significant advances in neuroscience are painting a pretty clear picture first brought to us by cognitive psychology educational best practices, and the answers are enlightening, unintuitive and powerful.

We may have heard that we only use 10 percent of our brain, and by inference might assume that if we used more, much more, we would be smarter, better, faster. However, when too much of the brain is active a seizure occurs. The initial, and one of the most significant parts of the learning process, involves using less of the brain.

In "Changes in the Development of Expertise: Neuroanatomical and Neurophysiological Evidence about Skill-Based Adaptations," (Hill and Schneider) researchers published functional Magnetic Resonance Imaging (MRI) showing the brain learning a task. At first it is lit up like a Christmas tree. Most notably the pre-frontal cortex, responsible for executive function, is very involved. As the task is learned, more and more regions drop out as the brain finds the perfect efficiency point for the desired ability. This has been called a process efficiency change and a skill is learned once it is completed. This process involves difficulty and frustration as the brain is trying to figure out how to best deal with it.



But this is only the first step to becoming fluent in that skill. At this point a specific neural network has been created. Everything we do and think is represented by neurons (brain cells) connecting with other neurons and these communications are neural networks. Each time an action potential (electrochemical nerve impulse) is sent between neurons it travels down an axon then across a gap called a synapse. When that happens, specific cells attached to a part of the axon (specifically the internodal parts), called oligodendrocytes, produce an insulating sheath for the axon called myelin (Araque and Navarrete; Wake, Lee, and Fields). The more of this insulation there is, the stronger the current (action potential) remains, and the faster it travels. It takes a lot of repetition, but the more myelin that is wrapped around an axon the faster we think, play or execute any other skill we are working to learn.



What this means, in simpler terms, is one must focus and continually problem solve even when it is frustrating until the solutions to learning the skill are found (process efficiency change). This crucial step in high-efficiency learning has been called desirable difficulty by researchers (Bjork and Bjork). Then the skill needs to be repeated over and over to increase processing speed (myelination). As of this writing, researchers have not been able to find the upper limit of this speed. Take a moment and consider what that means with regard to the potential of all students.

Moving in the right direction, and finding answers

In 2009, the Dana foundation published "How Arts Training Improves Attention and Cognition," by the eminent education research psychologist Michael Posner and a colleague. Posner has done a significant amount of work over 50 years on the brain's attention networks (focus). He wrote, "If there were a surefire way to improve your brain, would you try it? Judging by the abundance of products, programs and pills that claim to offer 'cognitive enhancement,' many people are lining up for just such quick brain fixes. Recent research offers a possibility with much better, science-based support: that focused training in any of the arts—such as music, dance or theater—strengthens the brain's attention system, which, in turn, can improve cognition more generally. Furthermore, this strengthening likely helps explain the effects of arts training on the brain and cognitive performance that have been reported in several scientific studies, such as those presented in May 2009 at a neuroeducation summit at Johns Hopkins University (cosponsored by the Dana Foundation)."

At the time, Posner had only a hypothesis about the building of attention networks. He wrote, "Taken as a whole, the findings to date tell us that music training can indeed change brain circuitry and, in at least some circumstances, can improve general cognition. But they leave unsettled the question of under what circumstances training in one cognitive area reliably transfers to improvements in other cognitive skills." He continued, "As we have seen, recent studies have transcended the failed paradigm of simply exposing people to the arts, and now concentrate on the effects of arts training over months and years. We need more studies like these to determine whether, beyond strong correlation, causation occurs. Arts training may influence cognition through other brain processes as well. Because arts training strengthens the brain network related to the art being practiced, other tasks that rely on the same brain circuitry or pieces of it presumably would be affected."

We are now getting that research. The study, "Improved Effectiveness of Performance Monitoring in Amateur Instrumental Musicians," identified the link in 2014. Among other findings it noted, "More importantly for present purposes, higher levels of musical practice also were associated with a better engagement of cognitive control processes, as indicated by more efficient error and conflict detection… and reduced post-error interference and post-conflict processing adjustments." To put it another way, it trains the brain to search for areas of error, maintain focus instead of giving in to frustration, and then make adjustments based on finding those errors over and over as one works. I believe we teachers have a word for that—learning. That is how learning works for any subject, any skill, anything. The more you do of it the better, smarter and faster you get.

The study went on to say, "Here we show that already moderate levels of musical activity are associated with improved executive functioning when performing basic nonmusical cognitive tasks." Executive function refers to the basic ability to choose "should" over "want," a crucial skill for adult self-reliance, as well as good learning now. This is wired up in the prefrontal cortex (PFC) of the brain. The PFC is underdeveloped in the young and will not finish developing until the age of 25. Have you ever wondered why your insurance goes down, or you can't rent a car until you are 25? Actuaries have noticed this phenomenon for a very long time; now we have insights from neuroscience to bear this out.

In the enlightening book "Willpower; Rediscovering the Greatest Human Strength," researchers Baumeister and Tierny show, among many other amazing insights, that the PFC functions like other parts of the cortex. That is, you learn a skill (wire up a neural network) and then, through repetition, make it stronger (myelination). This is to say that focus, self-discipline, perseverance rely on strong neural networks that need to be created in the PFC. Notice I did not identify a specific skill. This is the ability to focus, push through frustration, and learn at a high level for anything. This ability to control one's focus and behavior successfully is the essence of self-reliance, and how well students build that skill will translate directly to how successful they are as adults.

Putting all of this together we can begin to see that these networks are created and strengthened in music training, then are made available for all academic work. Why is this?

There are no B+ averages in music

There are no B+ averages in music. Imagine a performance in which a full 11 percent of it was mistakes. Yet, many times,

students who maintain a B+ average for an academic class are considered excellent.

This is because arts teachers must teach process over content, while the general strategy usually employed elsewhere emphasizes content over process. How much did teachers teach you how to learn? And was it drilled over and over the way content was drilled? Creating the neural networks and myelinating them over and over, for years? It is that learning process that you need to become fluent in the domain while using the content during that process.

Music teachers must, as a normal part of their jobs, to be considered "good," get all of their performing students to about 98 percent or better. The really good ones get very close to 100 percent. I taught music successfully for 13 years at the high school level. It is a common myth that music teachers at the pre-college level seek out "talented" students, or identify them in their classes, and then develop them. What we do is take anyone and everyone, and know that if they will follow our directions (the learning process in its purest form) they will get good. This develops the PFC as well.

Think of your rehearsals or performance classes, is that how math and science are taught? That is why you see such a stratification of grades in academic classes. In a competently designed curriculum there is no reason anyone should get below an A with reasonable effort. The reason this does not happen is that most students do not know how the learning process really works. They are left alone to figure it out and their grade will reflect how well they did so. An A means, at best, fluency, not mastery. That is another level. The few that can figure out the process on their own are called "gifted."

How do we deal with gifted students? We place them in accelerated courses for focused training within the rich mental models they have already built. This fits squarely into the paradigm of skill development; work properly over time, build a mental model in order to think critically in the domain, once fluency (A's) is achieved then get intensive higher level training to progress toward mastery. This process can be taught to any healthy student, and everyone is capable of "gifted" achievements.

The gifts are already there waiting to be opened by all. They are in music. With any luck, academics will catch on to this process. Currently, there is a nascent national interest in neuroeducation.

The brain is designed to enjoy learning

Making oneself do this can, at first, seem unpleasant for a young person. Many times they need to be structured into these behaviors (creating PFC neural networks). However, on the other side is a rich engagement of the brain that produces what the researcher Mihaly Csikszentmihalyi calls "flow." This is the state the brain enters when it is fully engaged. We have experienced this as hours, seeming like minutes, when we are engrossed in a task. He argues this is the most enjoyable state for the brain to be in and makes a distinction between pleasure (lying on the beach, playing a video game) and enjoyment (when the brain is fully engaged and we are truly enjoying learning). This state can only be achieved once some fluency is acquired as it involves higher level problem solving in the domain, and that is the difficulty (desirable difficulty) of the initial part of learning.

The good news is it appears the brain is designed to crave high level problem solving/cognition. After all, that is how humanity has advanced over the course of time. But the price of this productive state of enjoyment is persevering through the initial unpleasant stages. Most do not want to do that, thus few seem to be "gifted."

After the initial difficulty, true fluency in a domain produces enthusiasm for learning more about that domain generating genuine and lasting learning, self-esteem and self-reliance (Zimmerman). Passion for music can be created by learning to play it well.

There also are strategies to begin gradually building positive habit patterns so that doing work properly becomes habituated (Duhigg). Starting and engaging in focused learning becomes like tying your shoes. It is neither pleasant nor unpleasant. It is just something that you do. After that, flow is not far behind.

These things are very important. But what I have written here is just the tip of the iceberg. Please research and decide for yourself. There is a bibliography included, and you can get more information and resources at my website betterlearningthroughneuroscience.com.

Also, make sure students eat well and get exercise. They must nourish and take care of their bodies, for they will grow into the ones they'll need as adults. And make sure students genuinely participate in music. Like their bodies, they must nourish and take care of their brains.

Implications for music teachers

I'm sure we can see the use of this information for advocacy with administrative and faculty members. There are a few other things to consider.

Every good experienced music teacher I have encountered understands the basic issues I've outlined as part of their normal teaching. What is new is the coalescing of research, first from cognitive psychology and then neurobiology, that allow us to fill in the blanks and understand how all of these things function as part of a larger model. When we come to understand that, we learn how to teach others to do what we do.

We will certainly need more than one article in a journal to get to this place. However, when we do, we can advise entire departments—all of them in fact—on to how all students can achieve that 98 percent. Any good, experienced music teacher is very close to understanding how to teach that. Teaching it should take about as long as it takes to develop students to be in your top orchestra, and the process will be the same. Depending on where a given teacher is in their own development, this could take one to four years.

I started an after-school discussion group that was well attended by faculty. The process slowly began interesting others with all of the good information available, as well as relevant contributions from the group.

If we look around, we can see a groundswell of things pushing education in this direction. There are websites that claim to train your brain; the excellent work and conventions held by The Learning and the Brain Society, The Dana Foundation; areas

such as graduate study in music cognition like the one at Eastman; a slew of books addressing myriad issues surrounding this paradigm — including the currently popular "Focus."

I believe no other conclusion can be reached: our issues with education lies in the teaching of process, and technology can take care of most of the content.

Bibliography

Araque, Alfonso, and Maria Navarrete. "Electrically Driven Insulation in the Central Nervous System." *Science* 333:6049 (Sept. 2011): 1587-1588. Print.

Baumeister, Roy F., and John Tierney. *Willpower*. New York: Penguin, 2011. Print.

Bjork, E. L., Bjork, R. A. "Making things hard on yourself, but in a good way: Creating desirable difficulties to enhance learning." *Psychology and the Real World: Essays illustrating fundamental contributions to society.* Eds. M. A. Gernsbacher, R. W. Pew, L. M. Hough, J. R. Pomerantz. New York: Worth Publishers, 2011. 56-64. Print

Csikszentmihalyi, Mihaly. *Good Business*. New York: Penguin, 2003. Print.

Doidge, Norman. *The Brain That Changes Itself*. New York: Viking; Penguin, 2007. Print.

Duhigg, Charles. *The Power of Habit*. New York: Random House, 2012. Print.

Ericsson, K. Anders, Ralf Th. Krampke, and Clemens Tesch-Romer. "The Role of Deliberate Practice in the Acquisition of Expert Performance." *Psychological Review* 100.3 (1993): 363-406. Print.

Hill, Nicole M. and Walter Schneider. "Brain Changes in the Development of Expertise: Neuroanatomical and Neurophysiological Evidence about Skill-Based Adaptations." *The Cambridge Handbook of Expertise and Expert Performance*. Ed. K Anders Ericsson, Neil Charness, Paul J. Feltovich, Robert R. Hoffman. New York: Cambridge, 2006. (653-682). Print.

Jentzsch, Ines, Anahit Mkrtchian, and Nayantara Kansal. "Improved Effectiveness of Performance Monitoring in Amateur Instrumental Musicians." *Neuropsychologia* 52 (2014): 117–124. Print.

Learning and the Brain. *PIRI/Learning & the Brain*, 35 Highland Circle, First Floor, Needham, MA 02494, 273 Bloor Street. Web, accessed 13 June 2014 < http://www.learningandthebrain.com/>

The Dana Foundation. "How Arts Training Improves Attention and Cognition." *Cerebrum*, 505 Fifth Avenue, 6th floor New York, NY 10017. Web, 14 September 2009 https://www.dana.org/Cerebrum/2009/How_Arts_Training_Improves_Attention_and_Cognition/

Wake, Hiroaki, Philip R. Lee, and Douglas Fields. "Control of Local Protein Synthesis and Initial Events in Myelination by Action Potentials." *Science* 333.6049 (Sept. 2011): 1647-1651. Print.

Zimmerman, Barry J. "Development and Adaptation of Expertise." *The Cambridge Handbook of Expertise and Expert Performance*. Ed. K Anders Ericsson, Neil Charness, Paul J. Feltovich, Robert R. Hoffman. New York: Cambridge, 2006. (705-722). Print.

Gregg Goodhart has a passion for excellence in music education even though he teaches guitar! He founded and directed the internationally acclaimed Servite High School Classical Guitar Program in Anaheim, California for 13 years. In 2009, he was named the ASTA Outstanding School Music Teacher of the Year for Los Angeles and Orange Counties and received the 2011 Outstanding Contributions to Education award from the Orange County Department of Education. His writing and research in music education have been published in *Soundboard*, *The American String Teacher*, and *The Orange County Register* among others. In pursuit of excellence in teaching, he has spent years doing extensive research in cognitive and behavioral psychology and neuroscience. In 2014, he founded *Better Learning Through Neuroscience* to coach students and teachers in the foundational learning process necessary to truly master any domain, or just get as good as they would like. He travels the country doing small and large workshops for students, teachers, and administrators as well as doing distance coaching in these areas by Skype. There is more information on his website betterlearningthroughneuroscience.com.

music.asu.edu | 480.965.5069

arizona state university

school of music

The Arizona State University School of Music in the Herberger Institute for Design and the Arts is a comprehensive music school offering undergraduate, masters and doctoral degrees and is ranked among the top music schools in the nation by U.S. News & World Report. Internationally recognized faculty, innovative and exciting curricula, outstanding performance facilities and more than 700 public performance opportunities each year create the perfect place for students to embrace their musical passion.

Visit music.asu.edu to learn more about the ASU School of Music, our faculty and admissions.

string faculty

Danwen Jiang, *violin*
Katherine McLin, *violin*
Jonathan Swartz, *violin*
Nancy Buck, *viola*
Thomas Landschoot, *cello*
Catalin Rotaru, *double bass*
Julie Smith Phillips, *harp*
Frank Koonce, *guitar*
Margaret Schmidt, *string music education*
Timothy Russell, *director of orchestras*

visiting quartet in residence

2014–15 Shanghai String Quartet

ASU Herberger Institute FOR DESIGN AND THE ARTS
ARIZONA STATE UNIVERSITY

Weekly Time Inventory

Time	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
5:00							
5:30							
6:00							
6:30							
7:00							
7:30							
8:00							
8:30							
9:00							
9:30							
10:00							
10:30							
11:00							
11:30							
12:00							
12:30							
1:00							
1:30							
2:00							
2:30							
3:00							
3:30							
4:00							
4:30							
5:00							
5:30							
6:00							
6:30							
7:00							
7:30							
8:00							
8:30							
9:00							
9:30							
10:00							
10:30							
11:00							
11:30							