MUSIC AND ARTS
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MUK

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Musical Performance Memory with Ar.Co.Sys, a Musical Mnemonic Method (AMMM)

AMMM was introduced in 2017 in the last year of the International Piano Academy Freiburg, continued as a special research project of the IWF (Institut für Wissenschaft und Forschung) at the MuK Vienna University in 2018, and features a multi-year study of a methodology specially developed to analyze and train the pianist musician's onstage performance memory. It draws on the millennium old knowledge of mnemonics, the art and science of memorization, as well as recent cognitive, psychological, and scientific research, and introduces a completely innovative aspect: The creation and methodical development of ArCoSys ~ Artificial 'Color Synesthesia' (or 'Chromesthesia', or 'sound-color synesthesia') chromatically applied to the primary harmonic relations of the Circle of Fifths. The integration of ArCoSys systematically into a multilayered retrieval structure by repetition with purpose is the object of study and foundation of the ArCoSys Musical Mnemonic Method. AMMM is a voluntary and feed-back based open study with a growing number of participants; students and professionals from all institutions are welcome to participate.*

• Repetition is the mother of memory. But retrieval structure is its father!

Multi-Integrational Neuro-Synaptic Coding **- a fancy name for part of a process that can be used to specifically train and improve musical performance memory which remains a challenge for most aspiring international concert pianist and recording artist as well as for the myrmidons of the musical world.**

As we know from the study of memory, mnemonics, it is the development of a retrieval structure that enables access to a large amount of data. While motivated amateurs and young Padawans can remember a shuffled deck of cards in under 2 minutes and the number π at no less than 2000, confirmed world records in memorizing a shuffled deck of (52) cards lies at 21.9 seconds for speed - statistically about 2.35 cards per second, a card every 0.42 seconds (hello Vegas), and in memorizing the number π at 67,890 digits for volume - Mr. Chao took one year to memorize Pi and was going for 100,000 when he made one mistake, stumbled at number 67,890, which conspicuously happens to be a straight (good bye Vegas).

The quintessential lesson from the perspective of musical and piano pedagogy is the realization that the heroic feat of memory mastery is not a miracle but based on a learned and relentlessly trained special ability: mnemonics. Analogous is seems that musical memory is not only the result of talent (a noble lie, which doesn't hurt), nor genius, nor by genetic inheritance, nor inexplicable mystery, nor magic; not dipping in dragon blood or the river Styx, nor by a kiss of the gods, nor by the assistance of a six-winged Seraphim angel replacing the beating heart of a prophet with an ember of illuminating fire … the special ability of wielding mnemonics is a spectacularly and progressively developed skill, a "technique", and mastering it takes 10 years, 10,000 hours. Just like mastering the special ability to "play the piano" really, really, really, really well.

Some of the most commonly used Eurocentric mnemonic systems are the most famously the 'Memory Palace' (Method of Loci, Sir Conan Doyle immortalized in the character of Detective Sherlock Holmes), the 'Journey Method' (or Narrative Method), the 'Major Mnemonic Method' (formalized number/letter/word/color association), and the 'P.A.O.' (Person-Action-Object, or 'Dominic') System. Champions and Savants in the field design and develop their own unique systems based on similar principles, often without formulated realization: essentially artificial, as in trained, Synesthesia, cultivated by repetition with purpose; also known as 'deliberate practice' (K.A. Ericsson).

Ten thousand hours to start, 20.000 for Mastery …

Musical memory and especially musical performance memory are most complex systems and not entirely understood today. Quantum Computing and Artificial Intelligence research and application may change that rapidly and reading (and remembering) score from the music stand may become obsolete with retinal or contact lens hud-display ('terminator view') applications. As of today, observational data is available of for example "first time repertoire memorization in controlled environment" (i.e. how many repetitions, how many mistakes, how big the chunks, overall time, onstage performance, electrodes on cranium mapping neuro-cluster firing zones &cetera; e.g. from the Music Lab of Dr. Roger Chaffin), but it is a difficult field to study as some musicians can memorize and perform 20 minutes of music at once, at a glance. While the art of traditional (non-musical) mnemonics can be trained by formalized methods (and 10,000 hours) to the level of world champion, savant, even near genius, and as world class musicians often perform feats of incredible memory ability (e.g. playing a 30.000 notes concerto, 40 mins of music, or conducting from memory a 6 hour opera with almost 100% precision on stage, as they also perform at emotional peak output, expressively and with abandonment) which are absolutely on-par with mnemonic world champions … it is remarkable that there is no methodical or formalized mnemonic system for musical performance memory. It is all learning by doing. And doing it more gets better results, as we know from experience and observation. If a pianist takes a year to memorize all Beethoven Sonatas and then performs them in concert – that pianist's memory will have improved substantially; and learning more repertoire will become easier. The brain is a muscle - in the sense that it can be trained (by methodical repetition) and becomes stronger with continued exercise.

Repetition is clearly an important factor, but from traditional (non-musical) mnemonics we know that the creation of a retrieval structure is the key - with firm grasp of grouping, clustering, chunking, which is to train to form and as many associations as possible as fast as possible within a known (trained or natural) environment. Mnemonic masters don't train to memorize or to remember, the train their retrieval structure. Rainman, brilliantly portrayed by D. L. Hoffman in the eponymous movie, was grouping, clustering, and chunking matches and probably had a savant, potentially synesthetic (even chromesthetic – seeing numbers also as colors and clusters of numbers as color clouds) mathematical awareness.

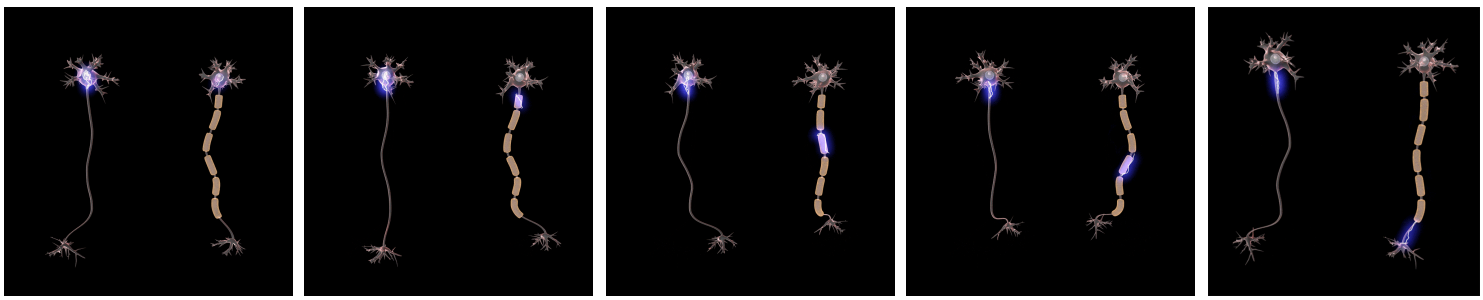
All methodical approach to the improvement of musical performance memory necessitates a greater, more defined ability of attention to detail and a formalized grasp of musical form that necessitates knowledge of music theory and formal analysis, not difficult things to acquire as a student, best by the age of 8 or 12. Taken that knowledge for granted* we can grasp a classical 8 bar cadence - create linked neuro clusters - by analyzing its form (harmonic cadence), melody (interval contour independent of tonality/keyboard layout), emotional (happy-sad, calm or excited) and programmatic (phrase culmination) narrative, &cetera, and add artificial color synesthesia (the colors not representing emotional content but rather a chromatically and logically organized mnemonic device). The more associations we create, and the more we repeat that process, the better the results. This system is fallible because we are not machines, but it has unlimited potential because of its ability to recombine and improve. The AMMM aims to form and then to train a solid multi-integrational retrieval structure.

Pegasus

You should rely on formal, harmonic, tonal, melodic, and pitch space music analyses not as crutches to be thrown away once you feel secure enough, but as the winged warhorse you ride into battle.

A reliable memory is like a perfect gesture – a gesture repeated so much and so consistent that that whole neuro cluster is connected by reliable and fast neural pathways – instead of a diffuse cloud, the electricity travels straight like a lightning. When you repeat a passage and sometimes it works and sometimes it doesn't, you are practicing the mistakes as well as the hits … mastery is to repeat a passage flawless 10,000 times. When the neuro cluster is properly linked, the synaptic pathways are sheathed by a saltatory agent – myelin – to facilitate faster transmission. The flash in the pictures below on right side was traveling through a familiar and often repeated, easier accessed and more efficiently connected (as in 'memorized', 'easier to retrieve at will') pathway creating neuro clusters.

Like – once you pictured it – Moonwalking with Einstein. Imagine the whole Michael Jackson thing, iconic silver glove and socks, and with him Einstein, disheveled hair and three-piece suit, both moonwalking, music, lights … and you as MJ with AE onstage … many access points triggering each other). Take a moment here to imagine it again in more detail, it doesn't have to be 10,000 times**



Myelination of neural pathways

Effect of saltatory conduction

Dating back to the poet Simonides of Ceos (the father of the Method (of) Loci, ca. 500 BC), traditional mnemonics is an arcane art. Mnemonics was critical to the acquisition and retrieval of knowledge since before the Homeric Epic. Mnemonics include the knowledge and assistance of alphabet, grammar, mathematics, numerology, architecture, the 'Method Loci', 'Major' or 'Dominic' 'Systems', mnemonic devices such as the hand (including the phalanges), the pentagram (five-pointed star), the dodecagon (twelve sided solid), Plato's mystical Polyhedron, from Astrology, the Tarot deck of cards, the circle of fifths, &cetera – all to create a retrieval structure. The special ability Mnemonics is a spectacularly and progressively developed skill, a 'technique', very much like playing golf, chess, or the piano on a world-class level. Almost any special ability can be cultivated by repetition with purpose; also known as 'deliberate practice'.

The Benedictine monk and musicologist Guido Monaco, or Guido d'Arezzo (ca. 1000 AD), the Italian Dominican friar, philosopher, poet, and cosmological theorist Giordano Bruno (ca. 1500 AD), and many more used mnemonic devises in the formative time of classical western music. Mnemonic art was slowly abandoned after the advent of Johannes [Gensfleisch zur Laden zum] Gutenberg's printing press (c.a. 1500 AD), but remains critical to e.g. modern cryptology, psychology, and AI research. Curiously no methodical memory training developed in the field of classical music performance; no retrieval structure designed specifically for music performance was formulated. Ever since the advent of 'playing from memory' (ca. 1850, great grandfather Liszt invented the 'piano recital') and especially since modern recording technology (ca. 1950) and its standard setting jeweler's-lens clarity in studio productions, almost every adult concert pianist has been and remains concerned with onstage performance memory; it is one of the most fundamental aspect of pre- and onstage fright for students and professionals.

The AMMM (ArCoSys Mnemonic Musical Method) research project aims to develop, test, and eventually publish a musical performance memory method introducing an Artificial Color Synesthesia (ArCoSys) Color Circle of Fifth (CCO5) combined with a sequential arranged and repetition-based score recognition and memorization system with many levels of integrated associations, i.a. formal, functional, melodic, spectral, emotional, visual, tactile, &cetera.

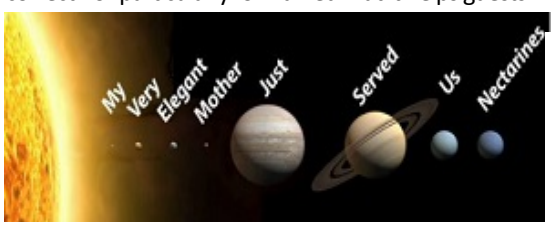
As musicians and pianists, we have access to a number of distinct memory agents, and of course there are grey zones:

- **Formal and Structural (e.g. eight bar phrase, first theme, exposition, sonata movement)**
- **Harmonic and Functional (e.g. cadence, figured bass)**
- **Natural and Nurtured Melodic Memory (sing it)**
- **Perfect or perfectly Relative Pitch (absolute and relative intervals)**
- **Emotional and Expressive (happy-sad, how much)**
- **Programmatic Narrative (story)**
- **Pattern Recognition and Reproduction (sequences, gestures)**
- **Topography (specific symmetry) of the Keyboard**
- **Rote Repetition *Muscle Memory* (really cascades of complex gesture neuro cluster firings)**
- **Natural Color Synesthesia (frequency and/or key signature)**
- **&cetera**
- **& Artificial Color Synesthesia**

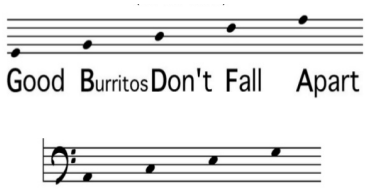
Which ones do you think you are using in the practice room and on stage?*

Mnemonic devices (multiple access point organization of retrieval structure) are used in many situations and environments and incorporate simple versions of traditional systems:

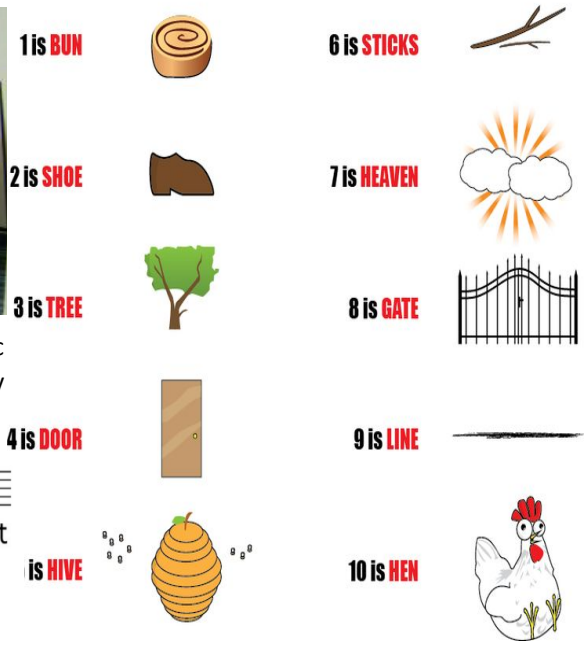
Signs in a hotel parking garage – a classical application of the 'Major Mnemonic Method' (formalized number/letter/word/color association) though neither chromatically correct nor particularly formalized. But it helps guests find their destinations.



'Narrative Mnemonic Method'
It used to be … &Peaches … poor Pluto



All Cars Eat Gas
Both (almost) true



Major Mnemonic Method'
Notice rhyme as (formalized) number/word link

** Do you still remember 'Moonwalking with … ? It is an example of the P.A.O. (Person-Action-Object) or *Dominic System* at work. Moonwalking with Einstein: The Art and Science of Remembering Everything – is also a memorable book by Joshua Foer (2011).

Interludium I: Considerations of Musical Performance Memory

• Fight, flight, or freeze

Stress and adrenalin result in fight, flight, or freeze - i.e., nervous behavior. Understand that phenomenon and counteract it on stage by slowing down and listening to the music you create. Do not try to get through on muscle memory autopilot. Conscious listening needs to be prepared in rehearsal, in practicing. If you wake up on stage with only muscle memory at your service, you are in jeopardy. If musical, melodic, harmonic, formal, and topographical synesthetic memory hasn't been formed and you rely on "flow" alone, you might find yourself in trouble. Don't prepare preparation; prepare performance.

Achilles was invincible on the battlefield not because he was double dipped in Phlegethon,
but because he studied with Chiron for 20 years – repetition with purpose!

• The Flow

The state of flow, an inspired performance, Kairos^, is the highest pursuit of a concert artist. It seems that we are willing to abandon musical, melodic, harmonic, formal, and topographical synesthetic memory – once we feel secure – In search of the flow, a state of effortless attention, satori.

But consider this: We certainly agree that Mozart, Beethoven, Chopin, and Liszt were performing with the absolute abandonment of an inspired flow. Can we imagine that they were not deeply aware of and completely certain about rhythmic patterns, harmonic systems, key signatures and names, interval contours and with the foresight of improvisation? It is reasonable to assume that they were. Much of the music they performed was their own – original compositions – and they were all category-shattering improvisers. To master the flow we need a rich retrieval structure. More retrieval structure awareness gives a more difficult wave to ride, but the flow is evermore so exceptional.

• A safety line in the blizzard

In the regions of eternal ice, buildings are connected by safety lines so that inhabitants can find their way between living quarters, laboratory, and outhouse in extreme weather conditions.

On stage we sometimes find ourselves lost in the blinding darkness of an adrenalin blizzard. Suddenly our usual faculties are confused due to a glandular infused augmentation of our attention capabilities which can also lead to 'impulse variability'. Usually we can crunch a certain amount of data when practicing, that's what we are used to and prepare with; but with adrenalin, our computational abilities are supercharged (fight or flight) and besides being able to notice everything that we are used to from the practice room, we find ourselves suddenly able to also think about our laundry list, wonder whether that cough from the audience meant disapproval, notice how strange and alien our left hand is behaving, and observe ourselves doing all that from the outside, suspecting that that can't be good and expecting imminent disaster. That condition is, if nothing else, terribly distracting and devastatingly terrifying. We experience panic if we are unprepared for that condition and thus permit the confusion and sometimes freeze and/or poke at the instrument. In the Polar Regions, many froze to death a foot from their door without a safety line due to disorientation.

In preparation we need to create a safety line, better several, for the blizzard. The first and most intuitive is melody (usually in the right hand). We have to prepare the knowledge of the melodic line independently of the keys in front of us, the way we know a song melody without ever memorizing it from the score - awareness of intervals and rhythm. Transposition is a good method to become independent from the topography of the keyboard. We have to understand the melody at all times, not rote-memorize it. The second is the bass line. We have to understand the foundation of the harmonic steps, to know the structural points (usually in the left hand) again as a melodic line, and be aware of the harmonic functions - it's usually cadence, sequence or modulation. Transposition is again a good approach. Most all else - middle ground - is usually patterned; it's good to be aware of the kind of patterns. In addition, it's helpful to have a structural understanding of the music on different levels - exposition or development, A or B, first or second theme, or transition …

If we practice performance with safety lines for the eventuality of an adrenalin blizzard, and we find ourselves confused by a moment of augmented attention capabilities onstage, we can instantly fall back on our safety lines. If the mind is about to get you lost, bring your attention back to the melody, the bass line, the familiar. If we create the necessary precautions in preparation, adrenalin can provide an exhilarating and unique experience, a jolt of joy, a feeling of being particularly alive, a Kairos^.

• Practice room to Stage Doorway Effect

Scientific research (Brenner & Zacks) observed that walking through doorways interferes with memory, facilitates forgetting. More specifically: the "doorway effect" is a theory based on the fact that retaining a memory is more difficult after literally walking through an actual doorway (to another room, the outside, the other lecture hall, in or out the church, a stage door). It appears that memory works better when remaining in the room in which it originally captured the information, and that one loses some of the information when walking out of the room - in real locations (like your practice room, the university, a museum, a shopping center, the green room) as well as in virtual reality simulations (like an Avatar program at DARPA, or Skyrim, the Sims, or Destiny on PSX). It's called the "encoding specificity" principle and suggests that memory organizes information (amongst other things) 'location based' (exterior).

Research suggests that memory is optimized to keep information 'at hand' until its "shelf life" (statistical usefulness, need of projected accessibility) expires. This sort of memory representation has been called "event model" by Radvansky. In these cases, the brain doesn't store information in an organized retrieval structure (as that takes more calories). Imagine being in a subway station memorizing the numbers (and perhaps names) of stops to your destination, an opera house let's say. After you passed through the sliding train doors and entered the portal of the opera house (a couple of doors really), most likely the brain estimated each time that the usefulness, shelf life, of the information has expired, been proven correct each time, and slowly diminished its recall-ability. It is apparent that a narrative is easier to remember than a shopping list for the untrained memory.

Master memory is cultivated by mnemonic training – the cultivation of a multi-layered and often emotionally connected retrieval structure. Soloists are capable of remembering a tremendous amount of information based on several, mostly inexplicable and un-researched, mnemonic applications. Concert pianists, for example, can perform a 45-minute piece with 30.000 individual notes, that have to be performed in an absolutely particular order, with rhythmical and dynamic variability, passionately creating an emotional and formal narrative, from memory, live on stage. And in Rach III they in addition coordinate with a large body of musicians, also from memory. The research on the doorway effect is for the career musician (concert pianist for example) and the methodical pedagogue quite insightful and relevant:

The stage and the practice room must become the same room.

As with all things of value, cultivation and constant practice is key. To keep all that has been achieved behind the practice room door, one should attempt to create a comfortable and familiar environment in the practice room, gain authority and mastery of the music and the instrument, and return to the same enjoyable and intimate environment on the stage. Imagine the door out of the practice room is the door onto the stage Matrix style. The concert performance is the tip of an iceberg - always keep that in mind and in sight.

• Creations that appeal to the archetypes of man become collective memories.

Mnemonics, the art and science of memory, develops the ability to formulate images, scenarios, or systems (known or invented], and learn (and exercise, as in improve speed and precision through deliberate practice) to link them to random information or ideas.

Imagination is a related phenomenon but with a different purpose: not to remember the past but to experience the present. To formulate images, scenarios, or systems [known or invented], and link them from memory to ideas or information through the filter and magnifying glass of personality, with ideally innovative and exquisite results.

Creativity is a similar ability but serves yet another purpose: to create for the imminent future. To formulate images, scenarios, or systems, link them with imagination (based on memory) to felicitous ideas or information through the filter and microscope of personality and character, then materialize and project the results, and then share them with the world.

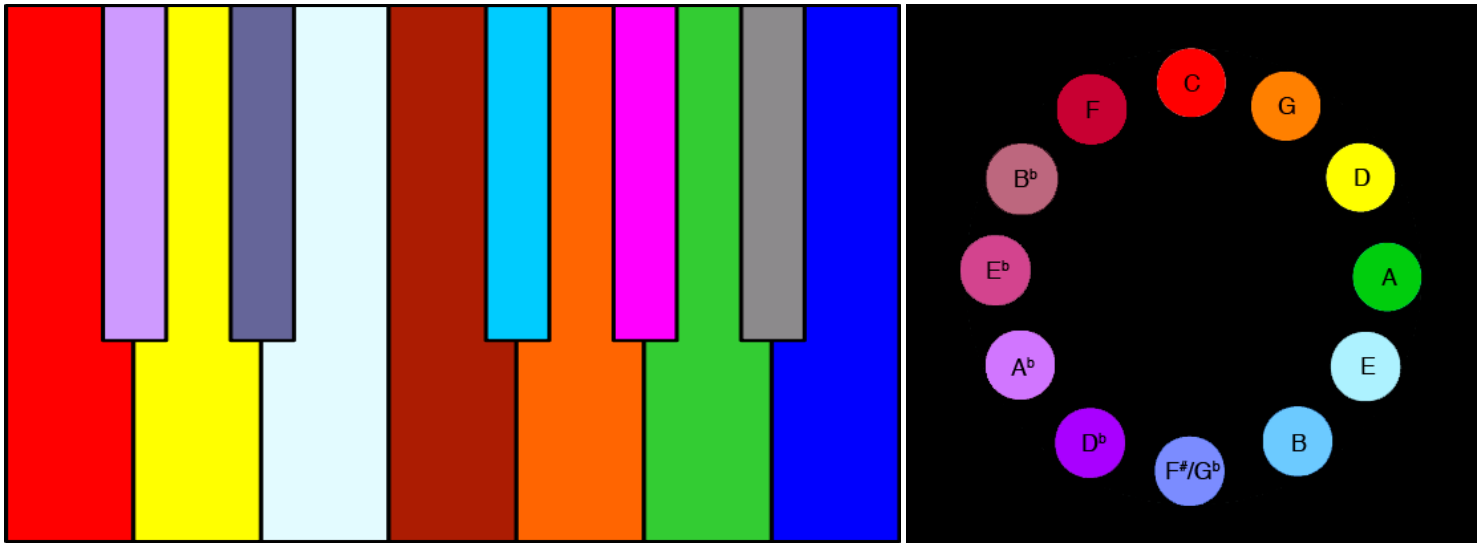
Emotions are of course the driving force for the creative process. To pursue memory, use imagination, and to be creative is an emotionally rewarding experience and can bring inspiration and fulfillment if you pursue Kairos^ and technical excellence with method and abandonment. Emotions feel particularly good when given shape (be it a statue, a sonata, or a kiss) and need an approach, a medium that is provided for example by technique or application. Emotions are the ignited fuel, but technique is the combustion chamber, the engine that propels creation.

Creations that appeal to the archetypes of man become collective memories.

^Kairos, or Caerus, was the other god of time. Chronos, the three-headed god-father of time [similar to the later Fate with the sand clock, the hooded cloak, and the tome of destiny], was a personification of measurable (quantity) time. Kairos, the rather ineffable concept of the time between time in which something momentous happens, was a personification of change-bringing and experienced (quality) time: A supreme moment, a blessed kiss, a physical or metaphysical climax, the ascendance to transcendence.

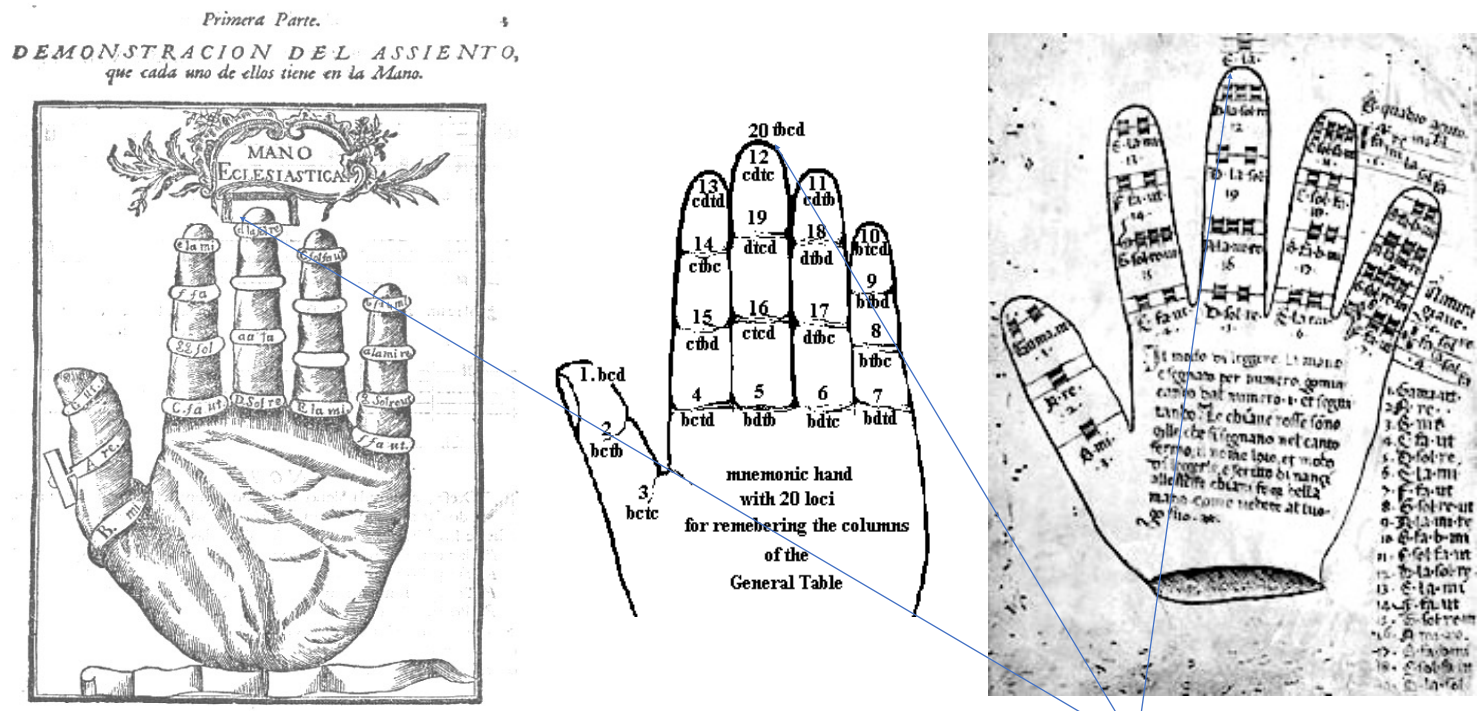
Interludium II: Famous use of Color Synesthesia
Mnemonic devices in (musical) history

Prometheus: The Poem of Fire, Op. 60 (1910) with a *Clavier à Lumières* or *Chromola Color Organ*. The ArCoSys project suggests that Scriabin's color circle of fifths was not a natural but an artificially created color synesthesia. The organization of 12 colors, while a surprisingly colorful *'farbenreich'* (if not seemingly chaotic) and individual arrangement on the keyboard, seems unlikely to merely accidentally reflect the order of the chromatic spectrum when arranged in the Circle of Fifths.



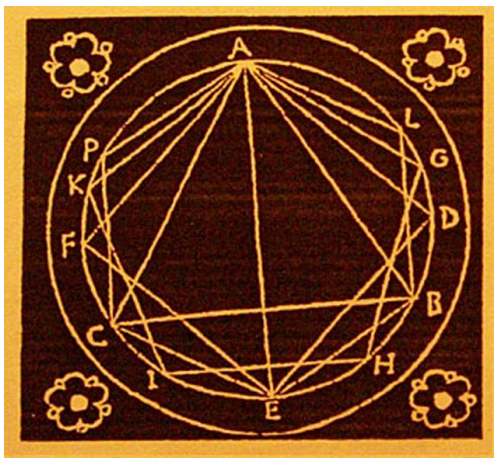
Alexander Scriabin; illustrious Color Keyboard and it's surprisingly organized Cicrle of Fifths with same colors. The colors appear to be arranged without breaking the rainbow chain. Can that be coincidence?

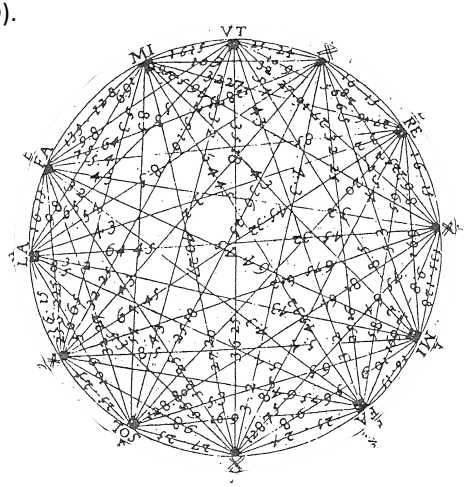
We find remarkable similarities in historical mnemonic devices and musical theory such as the Guidonain Hand (ca. 1000 AD, not a galactic fantasy weapon) and the Mano Ecclesiastical which both used 4+1 fingers and/or 16 +3/1 phalanges of the hand to organize placeholders (Guido's musical notation: solfègized intervals in tetrachords).



Mnemonic single Hand Devices and the 'Guidonian Hand' with an arrangement of 4 +1 fingers (16 +3+1 phalanges, 20 placeholders

The mnemonic device of Giordano Bruno (ca. 1500 AD) is a (slightly lopsided) dodecagram, using 12 alphabet letters in a geometric arrangement, is strikingly similar to an early representation of the dodecahedral Circle of Fifths by Marin Mersenne featuring geometrical/harmonic connections (ca. 1600 AD).





"Music is Geometry in time."

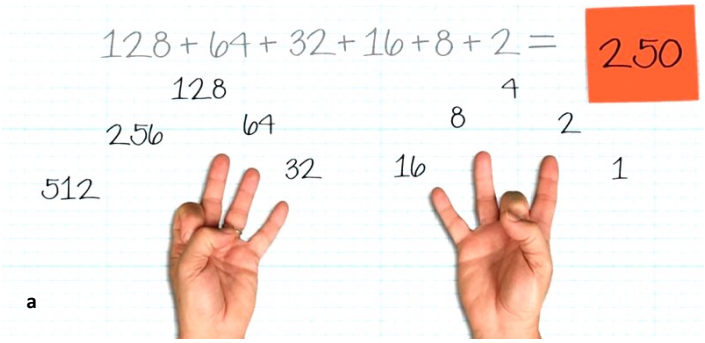
Arthur Honegger (1892-1955)

"There is geometry in the vibrations of the strings."

Pythagoras (ca. 500 BC)

One of Giordano Bruno's Alphabetic and Geometric Mnemonic Devices and the 12 pointed 'Mersenne Star'

For millennia before the grand piano, hands and fingers have been serving mankind as expressive and aggressive tools and as mnemonic devices. In many traditional cultures as well as in modern society, hand and finger gestures are used to express emotional states in combination with hand mnemonics, e.g. enthusiastic thumb up (+1, happy), fateful thumb down (-1, sad). Since hands and fingers are generally fascinating to pianists, a short (certainly incomplete) historical introduction into hand mnemonics:



The remarkable **Finger Binary**[1]- (counting up to 1024, 1 Gigabyte) the pugnacious **Knuckle Heads**[2]- (counting up to 14)

and the even simpler **Finger Hand(s)**[3]- (counting 5 in one hand and 10 in both) **-Methods**.

[1] **Finger Binary** (nerds know, a form of dactylonomy) here show = 250 (a) and 971 (g massively overshooting the onscreen objective). Notice the use of also another mnemonic device: Chunking – (a) right hand shows 26 and left and right hands show 224; lh-rh 224 + rh 26 = 250 (same in picture g – lh+rh = 960 + rh 11 = 971). Since thousands of years ago Merchants used complex dactylonomy (and a sharp-edged abacus) to count and organize numbers. It seems likely that, when numbers (hands) and frustration (emotion) merged, rather hectic gestures were used in agitated negotiations between merchants, bankers, creditors, debtors, and loansharks … 1023, 250, or 250 in finger binary thrice thrown with emphasis could be misunderstood. In reply perhaps, the more modern 'Talk to the Hand' (d) in finger binary usually means number 31, or 32 if the other hand is a fist.

[2] **Knuckle Heads** here shows = April (b). With 16 (14+2 thumbs) numbers it is probably a more archaic tradition, since perhaps the first simple pre-barter societies. It holds, used with one vacant 2 'valley+knuckle', 12 months of the year (ca. 3000 BC, conveniently showing the 30/31 days/months) or the full spectrum of the zodiac 12 (8,000 BC) by assigning the ridges and valleys of the knuckled fist linear to months or other placeholders. The sight of two fists (b), especially approaching from this perspective, suggest less a selection of months or birthdays, but much rather an agitated merchant negotiation getting out of hand, so to speak.

[3] **Finger Hand(s)** here show single handed = 1,6, 3, unusual 3, and 2 awkward 3s (c,d,e,f, g, and a). The use of the opposable thumb inspired cave dwelling forefathers (ca. 25000 BC) to more than round-holding a stick, and the hand and fingers plus thumb eventually gave our forbearers an advantage surely not only by the versatility of physical use (hammer, plow, sword, sickle, writing, healing, tiger claw, piano playing) but also as a mnemonic device. Children learn the decimal system on ten fingers ever since.

If (accidentally) **Finger Binary** or **Finger Hand** numbers are interpreted as colloquial and cultural gestures, pic a (250) = 'Gangsta' 10OK (especially over cross), pic b = '00' or approaching 'KO', pic c = 'Gladiator Lives', pic d = 'High Six', pic e = 'A-OK', 'all good to go', pic f = 'Totally Disco'. Pic e in some cultures means 'all good' or even 'excellent', and in others it is an aggravating insult. Some binary finger numbers, e.g. 4 or 132, are considered rude and even offensive in most cultures today.

SPECIAL RESEARCH PROJECT:
Musical Performance Memory
with ArCoSys, a Mnemonic Musical Method (AMMM)

The Artificial Color Synthesis Musical Mnemonic Method (AMMM) introduces a Color Circle of Fifths (CCO5) with White as the center – to the dismay of painters ('it's. not. a. color!') but to the delight of pianists ('well, it is actually white on all keys and has no accidentals"). The chromatic spectrum is divided into 12 distinct colors, easy to identify, name, and remember (prime colors non-equidistant). The colors do not signify an emotional meaning to the key in the tradition of 'affective key characteristics' (ca. 1800s, before equal tuning), but are meant as a mnemonic device to connect and recall colors interlaced with their key signatures (and their harmonic relations) and to create additional access (and trigger) points for the retrieval structure of musical performance memory.

The Method Loci (or Memory Palace) uses a known environment at first, e.g. your own house, as a retrieval structure, before it moves to more complex and abstract buildings all the way to an actual Memory Palace holding 10,000 distinct rooms. Considering this and other traditional mnemotechniques, the AMMM experiment begins with the creation of a retrieval structure: participants (musicians) shall use the known environment of the Circle of Fifths and attach to each key signature the colors of the Artificial Color Synesthesia Circle of Fifths (last page), eventually memorizing the CCO5.

Curiously mnemonics is often used in the first place to learn the – now familiar – circle of fifths:

Mnemonic	bMajor Key	bMinor Key
Fat	F major	D minor
Bear	Bb major	G minor
Eats	Eb major	C minor
Apple	Ab major	F minor
During	Db major	Bb minor
Good	Gb major	Eb minor
Christmas	Cb major	Ab minor

Memory Needs Every Method Of Nurturing Its Capacity. (Is a mnemonic for spelling 'mnemonic')

That color/key signature access-point should be as vivid and imaginative as possible: There are many kinds of colors similar to the ones represented on the CCO5 – 'orange' can be gold or fruit; 'red' can be a fainting flower or toreador's flag; 'brown' can be as dim as dirt and as shiny as a horseback in gallop. The more associations the merrier and one should imagine not just a color, but a colored texture, intensity, hue, saturation, surface … yellow can be like a lightning bug or a summer sun ray.

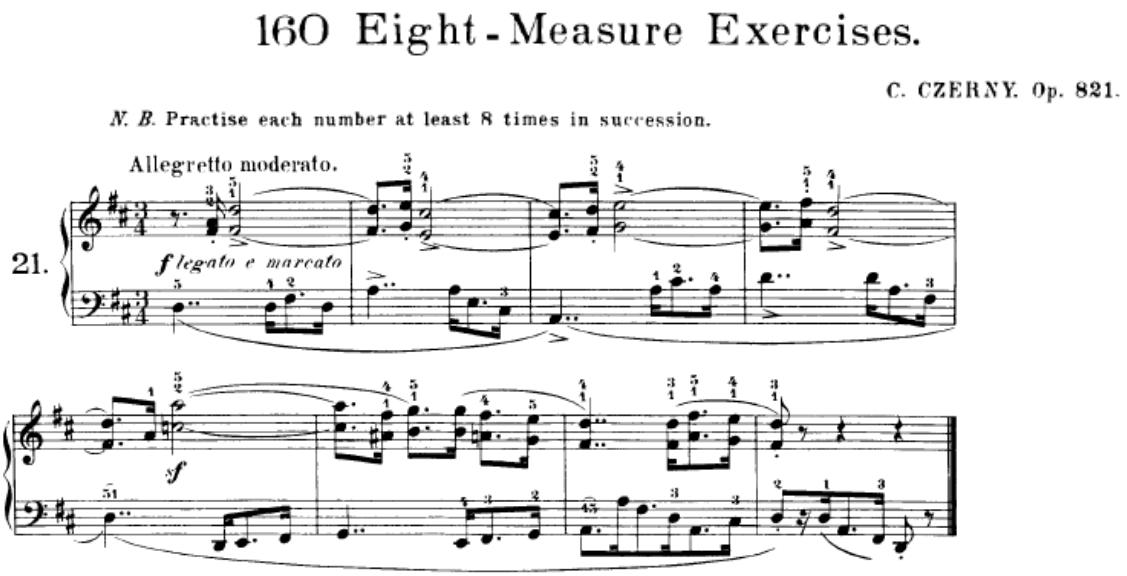
To the initiated eye, the logic of going from white middle C (or 'Do') toward the right/red with more *#s sharps* (Latin: dūrus = hard, firm, vigorous) seems compelling; as does going toward the left/blue and *b flats* (Latin: mollis = gentle, soft, tender). Over time one might find another color names that are more natural to one's chromatic imagination, and that's ok – everyone is ultimately the maker of their own retrieval system.

Question: In your imagination, is Green a distinct color, or a mixture of Blue and Yellow? What about Orange (Red and Yellow)? Bonus Question: which do you prefer, Purple or Violet, and are they different, how?

The AMMM experiment usually begins with a lecture based on the previous pages and continues by applying the ArCoSys color association to an actual musical piece at the piano at the participants own discretion. Once a protocol has been established (*form below), a first two times monthly, then five bi-monthly email updates within a year is agreed on. As one would surely prefer to encounter master pieces with an already formed mnemonic model, I am hesitant to suggest precious Bach, Beethoven, Brahms, or Berg as experimental material. Let us therefore take a simple 8 bar phrase from one letter further in the alphabet and off mainstream piano repertoire.

Either at or off the piano we proceed with a methodical approach: separation, analysis, repetition, reintegration of melodic and harmonic arcs, which – even without the ArCoSys component – remains but a sound alternative to 'just playing it over and over'. An analytic approach to performance repertoire seems daunting; I am aware that many pianists learn pieces by 'playing it over and over' (did it when I was 7). Relying heavily on so called 'muscle memory', really a chain of complex gesture neuro clusters, is a feeble strategy. Gestural memory did not evolve to accommodate complex structures. Surely the composers did not know their music in that way …

Story from Old Russia: To train memory properly in young pianists, the famous 'Wolf Method' was notorious in St. Petersburg and beyond for many decades; the method was to memorize Bach's 48 prelude and fugues from an open score. 'Voices separately' as the only further instruction; extreme advance by extreme exposure, like Conan the Barbarian getting really strong after pushing a millwheel for 15 years. Obviously after 'doing that', the memory of the young pianist would have improved immensely and most likely a mnemonic device will have been created. As a result of the AMMM project I imagine that it should be possible to memorize an eight-measure form almost instaneniouly, (including the ability to transpose it) thus enabling practical application in vastly larger repertoire. Let's use this example:

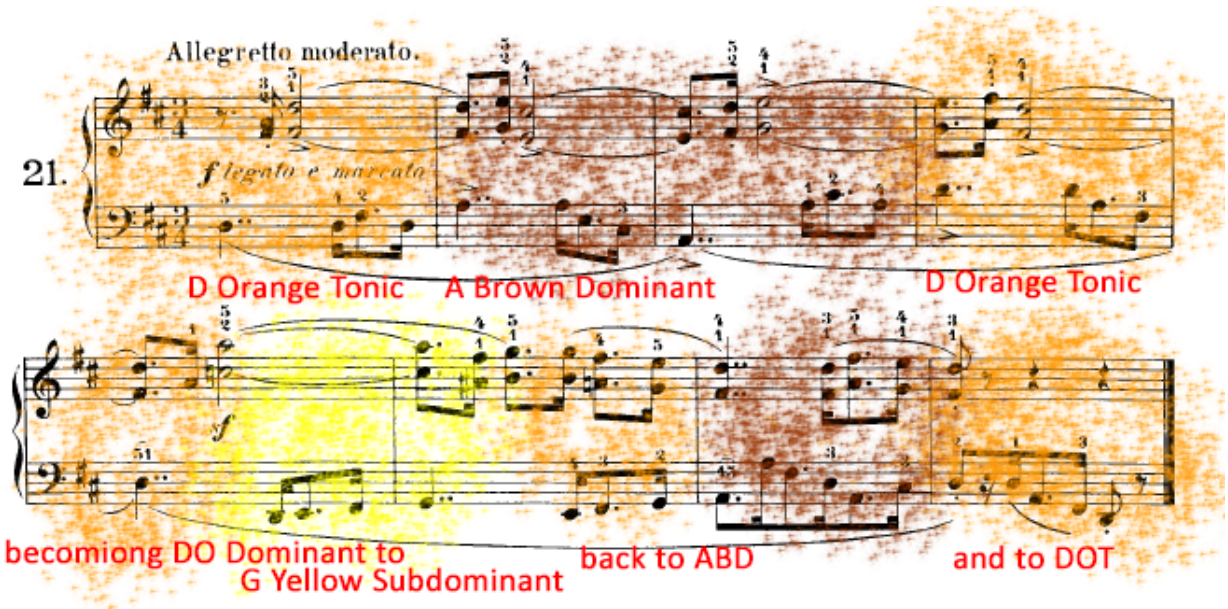


We want to learn this structure (and 159 more) by repetition of the following steps in your mind and at the piano. Grasp:

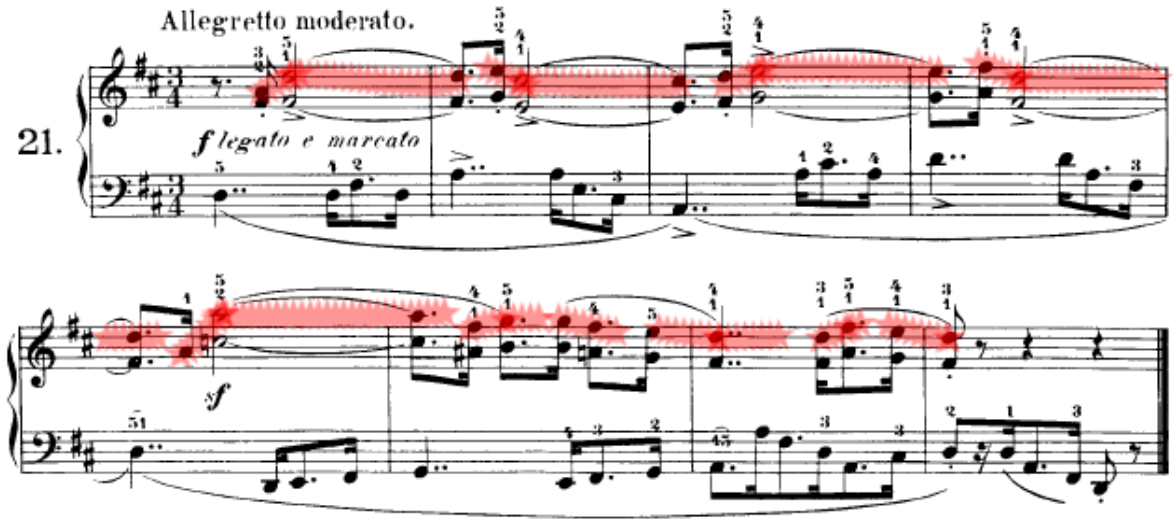
1: Harmonic Arc: i.e. cadence with functions, figured bass, and colors; an out-composed middle-ground from the bass line can become an interjected combination as a first step;
2: Melodic Arc (dynamic main voice; secondary voices an out-composed middle-ground from the melodic line can become an interjected combination step; as a second step; 1 and 2 can be reversed;
3: Combination and Reintegration of these (and/or more interjected combinations) steps in a clean, controlled, and expressive rendering of the musical score (at the instrument).

It is also possible to start with Melody first and Harmonic bass line second before combining both. In that case, the next two pages can be read in reversed order (version 2/1 – 1/2). In addition, depending on repertoire, other steps (e.g. 'out-composed harmony' in middle ground, a second, third voice in polyphonic music, structural form, emotional narrative, &cetera) can and should be included in the analytic phase, creating more intermediate combinations.

Once the cadence, the harmonic arc, is analyzed by either melody, harmony, or both elements, depending on the actual arrangement, we add ArCoSys color to that eight-bar form. Note the close relationship between the three colors here represented. Have a look at the ArCoSys Color Circle of Fifths colors superimposed on Number 21 of '160 Eight Measure Exercises Op. 821 by Carl Czerny (1791- 1857):

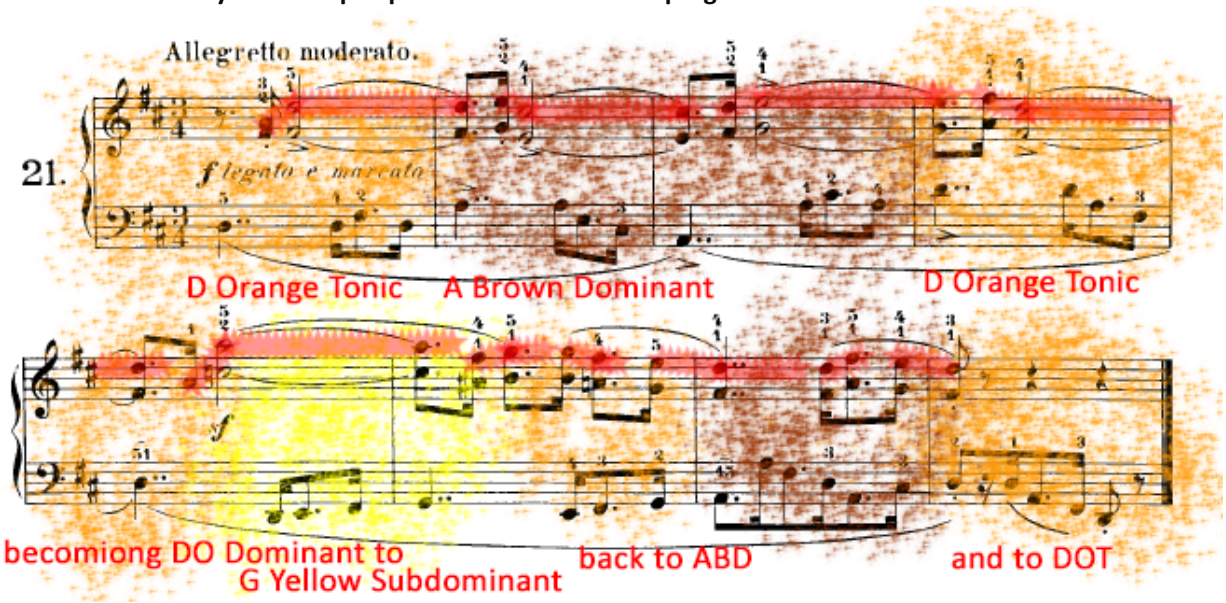


Step 1 and 2 can be reversed. Let us look at the Melodic Arc:



Grasp the interval structure (chains) and repeating patterns (chunking) as in the first four bars essentially D, C#, E, D with appoggiaturas in the French Style, typical chaconne material. Culmination in bar 5 on Tonic becoming Dominant to its own Subdominant (!) with the highest note so far, an "a; lingering on f#, descending to D, &cetera.

One can also look at the melody from the perspective of the harmonic progression and color:

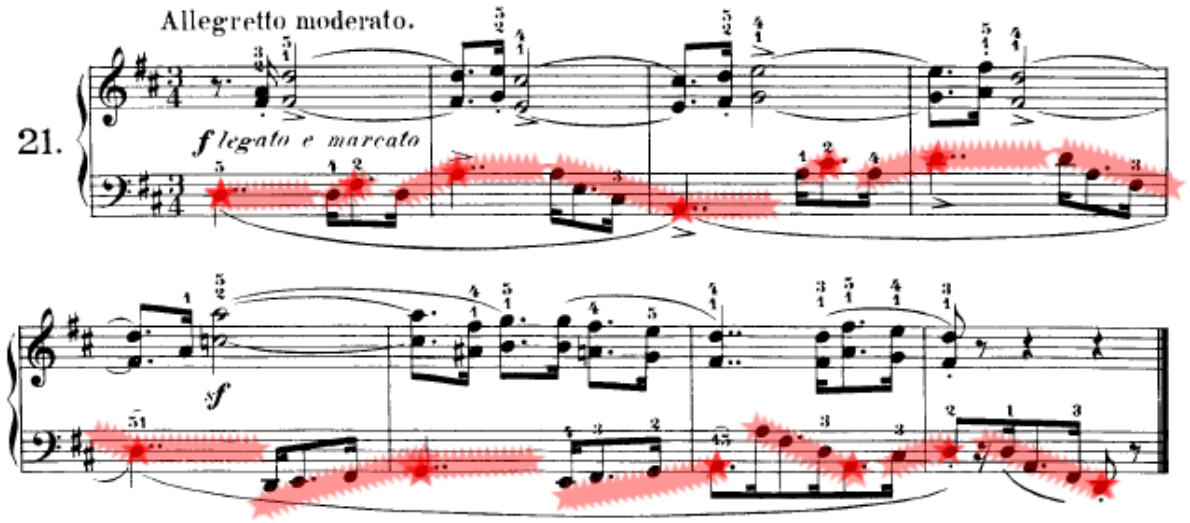


There are many ways to create a narrative from the notes; another one is singing solmization or solfeggio, a Guidonian Glove: la Reeeeeee, mi Dooo, re Miiiiiii, fa Reeeeeee &cetera.

And of course, we can memorize melody (not necessarily harmony) by repeated listening (exposure) and singing along … who doesn't know 'Twinkle, Twinkle, Little Star" … without ever having consciously memorized it. Repeated exposure ☺️. When we play a melody on the piano, let us distance ourselves from the topography of the keyboard and focus on intervals (absolute and tonal). Transposition in the next keys of the circle of 5ths is a great way to train independence of musical memory and 'muscle memory'. Topography as part of memorization may come in handy later, but for now we are focusing on retrieval structure.

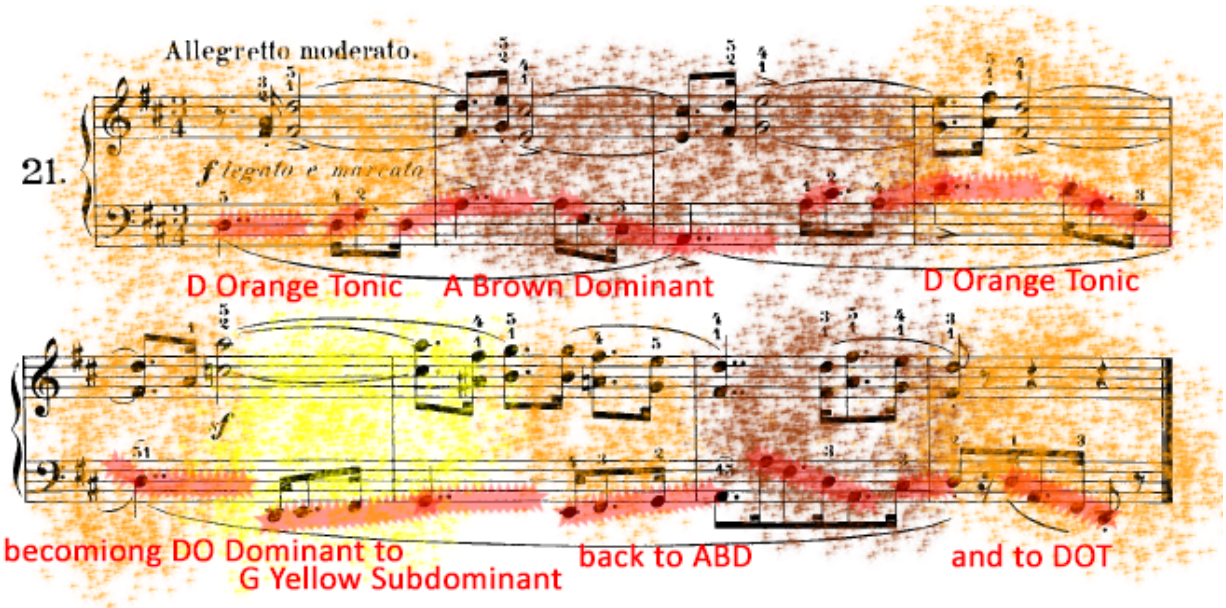
Step 2/1

Step 1 and 2 can be reversed (but pick one for consistency). Let us look at the Harmonic Arc:



Grasp the interval structure (chains) and repeating patterns (chunks) as 1-5 falling chord in bars 1,2; then 5-1 and falling chord in bars 3,4. In the main key of D the left hand harmonic base moves Tonic to Dominant in the second bar, remains until moving (not surprisingly) back to the Tonic in bar 4, classical. Then culmination of the phrase (sF) when the Tonic turns Dominant on its own Subdominant bar 5; then two sequences, Dominant in bar 7, and Tonic bar 8, both with the familiar falling chord. Not quite Beethoven.

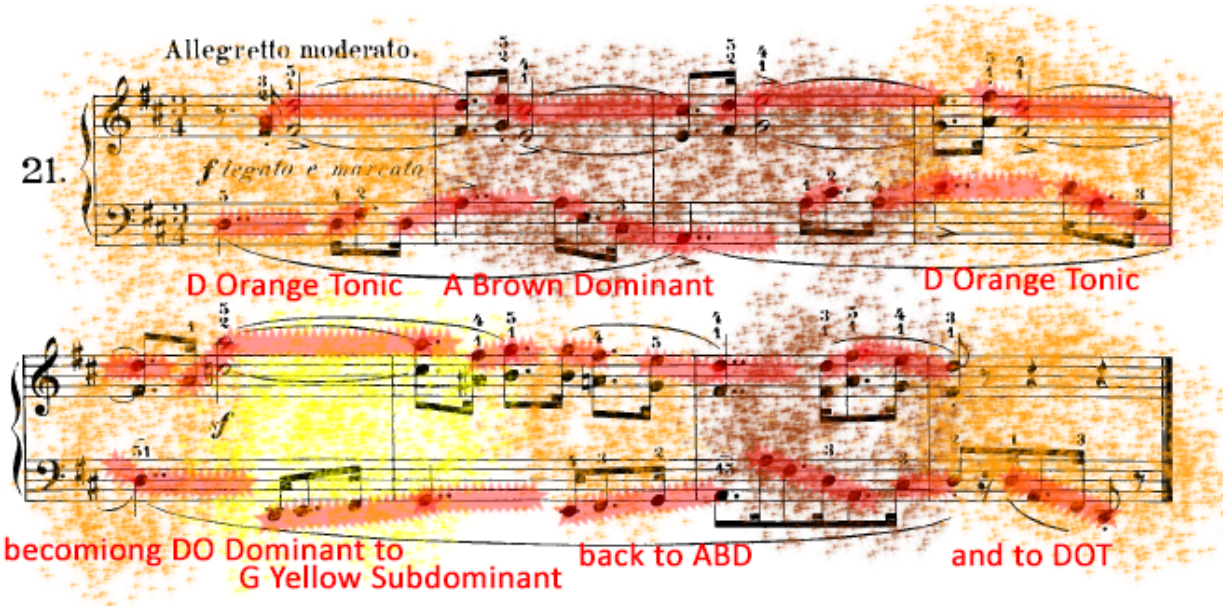
Let's add color:



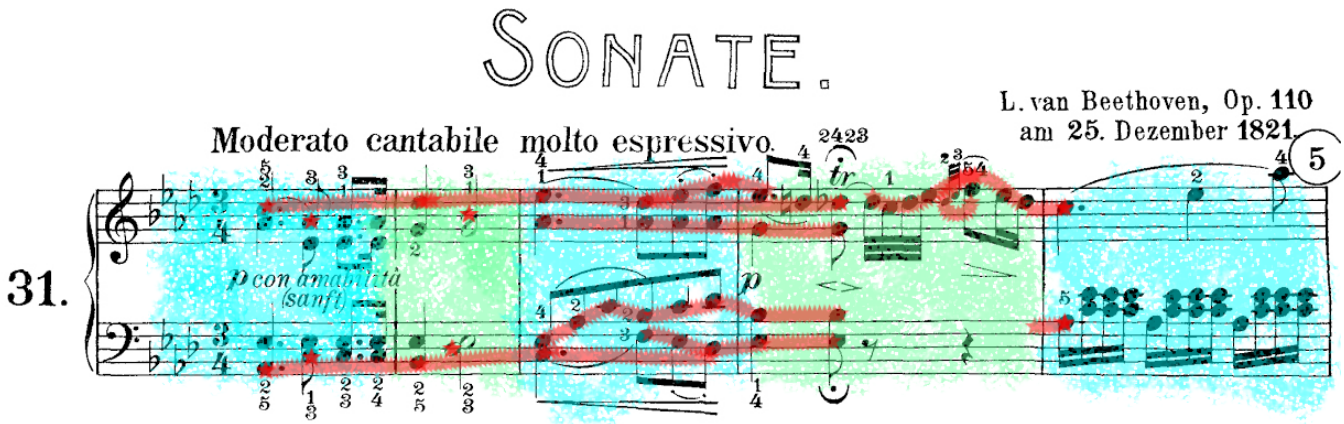
As you play the left hand, repeat the name of the key, the color, and function. Whisper, speak, or sing if you like. Make the associations of the color not one dimensional, but imagine texture, hue, saturation, temperature, &cetera. Make it your own.

Step 1 and 2 can be reversed (but pick one for consistency and always including the ArCoSys CCO5). More steps can be included, e.g. intermediate combinations of out-composed middle ground, complex symphonic or polyphonic open score, three-line notation (*Petrouchka*), Concerti, &cetera.

As 3rd and last step, we combine all parts all at once, first slowly, not to make mistakes. Before playing a wrong note, hesitate, listen, try to recall … and if not sure – look in the score. This system can serve as an introduction to memorization in general and – without colors – has similarities to the Leimer-Gieseking method and other 'awareness and replay' methods.



Proceed with at least 12 pieces in different key signatures from the Opus 821 collection, better 120. As Czerny suggested: "Practice each number (step) at least 8 times in succession"! Eventually the artificial color synesthesia will be more intuitive and recallable, still just a device like the circle of fifths, and with exposure one will develop personal approaches to this system and perhaps device own methods. One can branch out to larger forms and concert repertoire, of course, as soon as one feels compelled. Another example:



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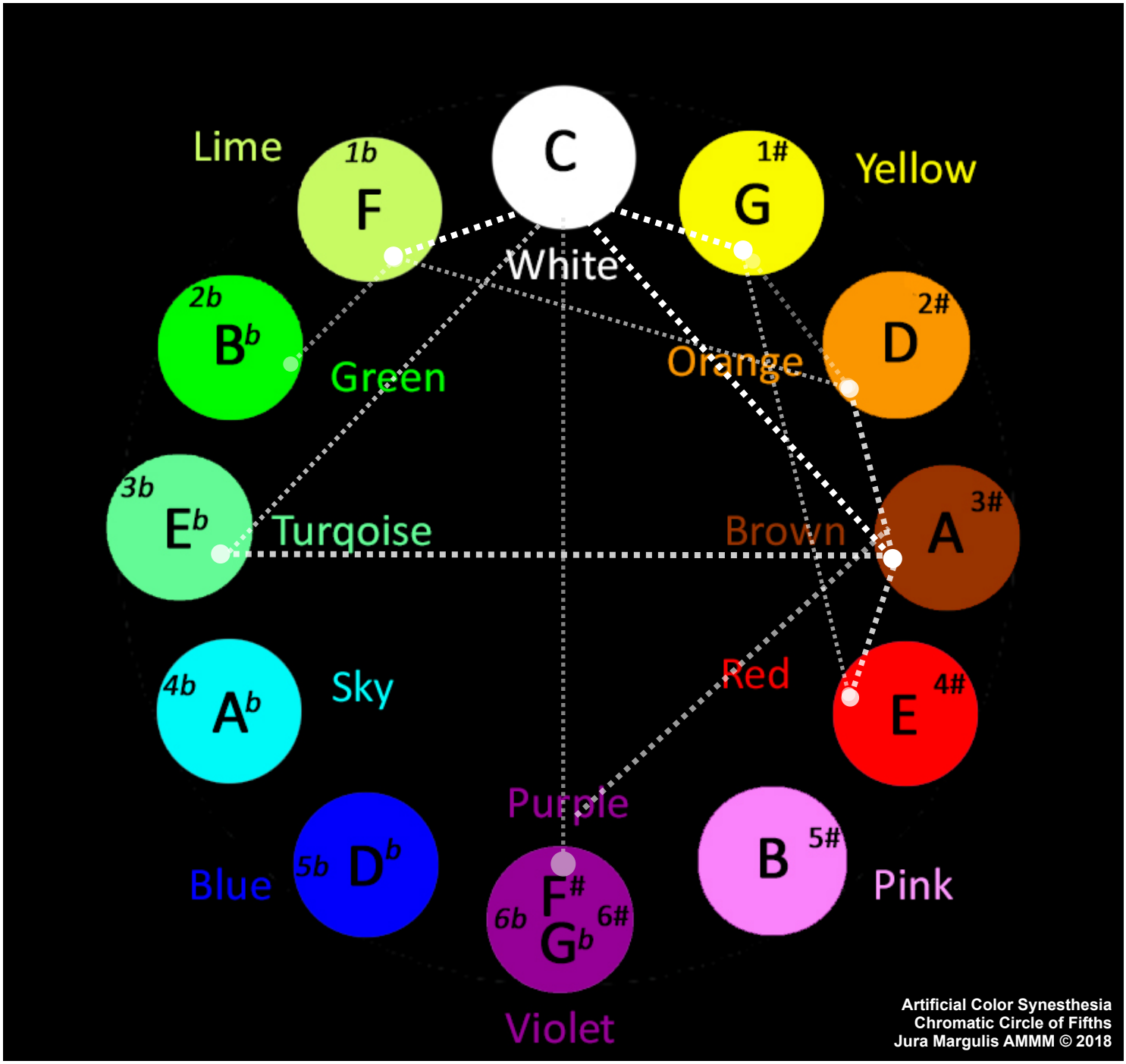
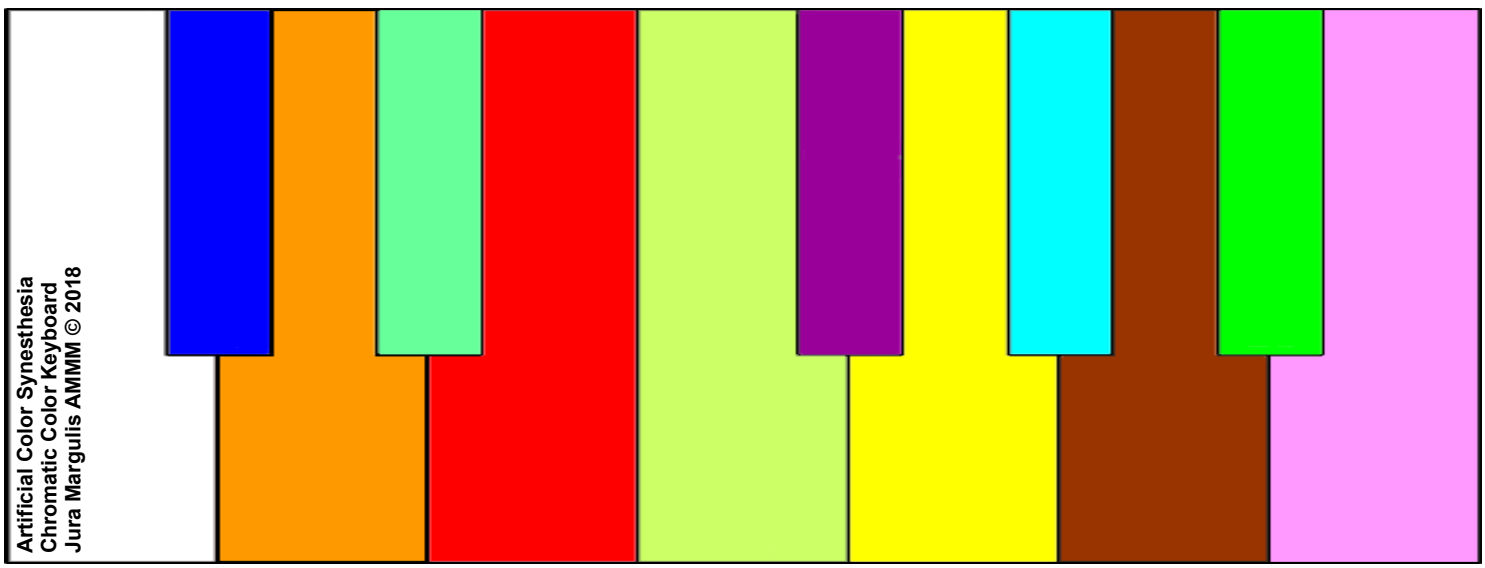
***Protocol Assignment for AMMM study participation: Fill out the following interactive Application & Assignment PDF form, check question boxes, save (as PDF, smartphone picture, scan), attach to Email and send to Prof. Jura Margulis, Jura@JuraMargulis.com, comments and observations are welcome. Subject line: AMM Application & Assignment.**
If you have natural color synesthesia: please draw your own color map (keyboard or circle of fifths) and email to JM. This email will establish the beginning of the AMMM participation and a study log.

This project applies to min. conservatory level piano performance majors or equivalent. The AMM is a voluntary and feed-back based open study with a growing number of participants; students and professionals from all institutions are welcome to participate.

PS: 'AMMM' is the sound one makes when trying to remember, desperately seeking an established retrieval structure …

Artificial Color Synthesis Mnemonic Musical Method (AMMM) Color Circle of Fifths





AMM Participation Application & Assignment

Personal Information / Persönliche Informationen:

_____

t Family Name / Familienname **t First Name / Vorname**

_____

t City / Stadt **t Country / Land**

_____

t Date of Birth / Geburtsdatum **t Nationality / Nationalität**

_____

t Teacher(s) / Professor(s) **t Currently (or last) Studying at / Aktueller (oder letzter) Studienort**

_____

t Email **t Location and Date / Ort und Datum**

Qa) which do you think you are using when practicing (on and off the piano)?
Qb) which do you think you are using when actually performing onstage?

- ☐ **FORMAL AND STRUCTURAL analysis**
  - ☐ **onstage performance**
- ☐ **HARMONIC AND FUNCTIONAL analysis**
  - ☐ **onstage performance**
- ☐ **NATURAL AND NURTURED MELODIC MEMORY analysis (interval and harmonic)**
  - ☐ **onstage performance**
- ☐ **PERFECT or perfectly RELATIVE PITCH recognition (interval and relative position)**
  - ☐ **onstage performance**
- ☐ **EMOTIONAL AND EXPRESSIVE (happy-sad)**
  - ☐ **onstage performance**
- ☐ **PROGRAMMATIC NARRATIVE (story)**
  - ☐ **onstage performance**
- ☐ **PATTERN RECOGNITION**
  - ☐ **onstage performance**
- ☐ **TOPOGRAPHY AND SYMMETRY of the keyboard**
  - ☐ **onstage performance**
- ☐ **ROTE REPETITION gestural muscle memory (really cascades of complex gesture neuro cluster firings)**
  - ☐ **onstage performance**
- ☐ **COLOR SYNESTHESIA recognition (frequency and/or key signature)**
  - ☐ **onstage performance**
- ☐ **& ARTIFICIAL COLOR SYNESTHESIA**

_____

Qc) t are there any that you find missing, that you know of or use?

_____

_____

t Comments