

**HOW NEUROSCIENCE CAN SERVE MUSIC TEACHING:  
Insights for viola teachers**

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## Abstract

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While Finland is at the forefront of education, art teachers nowadays have seen the scope of teaching possibilities extended through new technologies, crossed-art projects and multidiscipline exchanges. Science has worked its way into art and neuroscience, in particular, is a subject that fascinates many. However, despite the profusion of neuroscience research nowadays, very little of this research has been translated into concrete advice that is of value to music teachers. Leaning on theoreticians' work of the neuromusic field such as Hodges' (2008, 2010), Flohr's (2007, 2009) and Gruhn's (2004, 2008), this master research project conducted in Finland, investigates the neuroscience findings as it relates to education and the way experienced teachers teach, in order to develop « neuro-based » teaching strategies specially directed to violists. The starting point of this study is the collaboration between a teacher from the Sibelius Academy and her students, and a researcher specialised in cognitive science and music pedagogy through interview sessions and class observations, guided by Denzin and Lincoln idea of qualitative inquiry (1994). The findings suggest that using a multisensory approach and actively looking for meaning through movement and emotion within the music, are valuable ways to ensure natural and efficient learning. This paper concludes by offering several suggestions and tips for teaching viola.

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# 1 INTRODUCTION

There most definitely is a 'slam on the keys' version on the violin- i scratch away at the fiddle violently and scream and stomp my feet- if i'm really upset, i'll kick the stand. Just throw a tantrum, go for a brisk walk, get something to drink (Powerade usually calms me down a bit), and then realize that you can't blame the violin for things that it cannot do, and you can't be angry at yourself for things that you cannot do yet- and THEN practice slowly. REALLY slowly. (Sharon Lee, 2006)

How many musicians experience this kind of frustration? I was definitely one of them. Conservatories and music schools are full of teachers and students passionate about their art and always seeking ways to develop their craft. The students often work many hours a day and despite their passion and motivation, sometimes face frustration towards improving their skills, at least once during their studies. For some, it is more like a daily routine: practice, get frustrated, practice while being upset, get more frustrated and repeat. Humans are wonderfully made and musicians will eventually improve, but at which price? And through how much effort? I recall myself playing 10 hours a day my violin back in the days, practicing scales in front of the television on the advice of a teacher, which according to him, would make « my playing automatic ». I remember the hard work, the frustration concerning my goals, which seems to recede as soon as I thought I got closer to them, and I remember the double tendonitis « tennis-elbow », one for each arm, I got from this intensive, passionate, but unreasonable work. The following years, I learned more about ergonomics, practicing skills and pedagogy. These subjects awoke a thirst in me and the longing to become a viola teacher who is seeking always more « natural » and holistic teaching approaches. While hoping to improving learning, it seems logical to think about brain science and well-being. In fact, « Observing the learning process through the lens of neurobiology initiates a new understanding of learning and may provoke altered teaching attitudes » (Gruhn & Rauscher, 2007, p. 213). Thus, neuroscience became appealing to me and I thought it might provide some answers to my questions. Actually, the bridge between education and science has already been considered both valuable and beneficial:

What can brain research tell us about learning? Can methods be deduced from brain research? (...) teachers could become aware of when and how a content should be

presented so that it can pass an open window to get into an already established brain structure. Therefore, brain research is not a magic mystery that accounts for the teaching and learning, but - as in neurodidactics - it can base our knowledge on more solid and objective facts and look for the effect in an actual teaching and learning situation. By this, it could enable us to adopt the teaching to the mental state of a child, instead of trying to adopt the child to the structure of a given curriculum (Gruhn, 2004, p.7).

This previous quote from Gruhn illustrates perfectly the starting point of this research. Furthermore, this inquiry intends to guide teachers to find efficient, science based teaching guidance, and give them concrete advice. In 2007, Gruhn and Rauscher say about the subject:

If educators are informed about the underlying neuronal mechanisms of learning, their minds may open up to new arrangements for teaching so that they can adjust their teaching to the mental state of the children. We cannot rest on the traditional belief and opinion that good teachers know about good teaching. (p. 267)

## **1.1 Research aim and questions**

This research paper is a part of the master pedagogy studies of Sibelius Academy. I chose this subject because it correlates my interests in pedagogy while keeping in mind my own discipline, the viola, in order to make this inquiry both useful and valuable for my peers and myself. From this wish was born the overarching aim of my research which is to discover the teaching strategies based on neuroscience that teachers can use to enhance viola teaching and learning.

The research questions that address this aim are:

1. How do instrument teachers describe their teaching?
2. What kinds of strategies do instrument teachers use during lessons?
3. How can these strategies be understood through the lens of neuroscience?
4. How can we translate the general instrument teaching strategies to some exercises tailored for the viola?

In order to answer these questions I wrote the theoretical chapter (chapter 3) with the idea of using these reflections and knowledge to direct my research methods and analyses (chapter 4). The findings chapter (chapter 5) will meet the two first research questions, while the discussion chapter (chapter 6) will allow us to deal with the third one by relating the present study to the existing literature. In the concluding chapter, I will try to address the fourth research question and add my own opinion and experience on the matter. However, neuroscience is a constantly evolving science which is why this thesis does not intend to answer with finality the subject, but rather open reflections with the purpose to keep these studies to go on for the years to come.

## **1.2 Context of the study**

This inquiry takes place within the context of higher music education in Finland. Most of the data collected during the study came from the Sibelius Academy, which is an establishment conferring diplomas ranging from bachelor to doctorate in various music domains. This university was especially interesting as it promotes efficiency and personal development. Some courses like « Performance Coaching » intend to bring the student to a deeper level of music practice and psychology. Abreast of this, the general philosophy of the school is very modern, always trying new ideas and innovative projects. A lot is done around improvisation in every form and cross-art performances. Some teachers also offer courses with masters from around the globe thanks to new technologies (Kainulainen, 2007). The research department has a strong place and influence within the university and worldwide, while the catalogue of courses offered is quite versatile and bigger than any institution I have encountered. Kotilainen and Suomala (1993) wrote a short description of the different poles and resources of the Sibelius academy showing the school's diversity of offers. When we consider that this article was written already quite a while ago, we can imagine how much further the academy has gone nowadays. I describe the merits of this school to underline that it is in this context of innovation, research and variety this study took place. I thought it would be valuable to gather information from a place which is already thinking on how to improve its system and be at the forefront of the latest discoveries. This is without

saying why Finland is also renowned from its education system. Thus, it seems natural that my research should take place in this effervescent nest.

### **1.3 Outline of the research report**

This paper includes 7 chapters. You can find all additional documents, figures, graphics, guides and transcriptions I make reference to in the following chapters in the annex section at the end of this thesis. After this introduction chapter, I will present in chapter 2 the literature relevant to this inquiry while looking particularly at the lack of certain information concerning neuroscience and music within an apparently prolific field. After which I set the theoretical framework of this inquiry by using essentially the works of Huotilainen (2020), Kenney (2010), Flohr (2009), Curtis and Fallin (2014), Walter and Walter (2015), Collins (2014) and Hodges (2010) to describe extensively but in a everyday language the learning process in the brain and how we can from a scientific point of view, respect our natural bent toward learning. Chapter 4 explains the methodology I used to direct this research. It includes descriptions of the methods I chose and why they contribute to the research aim and questions, the way I analysed the data, the position I held during the study and the ethical guidelines I followed during this project. In chapter 5, I present the results I draw from the interviews and observations, while in chapter 6 I put these results in perspective based on neuroscience literature. The concluding chapter (chapter 7) gives a summary of the findings and the contribution of this study to the research aim and questions. It reveals some of the limitations of this inquiry and suggests some avenues for future research in relation to new technologies.

## **2 LITERATURE REVIEW**

For this inquiry, I took into account the research papers that were dealing with both neuroscience and education, and disregarded those articles dealing with only neuroscience or only pedagogy since I needed these two concepts intertwined for the purpose of this thesis. Since neuroscience is a very active and moving field, I excluded



all studies made before 2000 except one related to the important discovery of mirror neurons in the 80s from which researchers still find nowadays helpful and informational (Gruhn & Rauscher, 2007). Finally, I based my research on peer-reviewed articles.

Indeed, a lot has been already searched, written and found out about the correlation between neuroscience and music. Libraries are full of books describing how apparently music would be good for the brain and help people learn (Zatorre, 2005; Musacchia, Sams, Skoe, Kraus, 2007). Moreover,

Modern societies aspire to base decisions on strong empirical evidence. As a result, brain research is assuming an increasingly prominent role in educational debates, providing some powerful reasons to support new teaching strategies. Music practitioners, politicians, and many parents build their hope on results coming from neuromusical research to advocate for music in the school curriculum. (Gruhn & Rauscher, 2007, p. 209)

We know how learning music creates new connections and reinforces areas of the brain (Curtis & Fallin, 2014), and how researchers seem to think learning music might be beneficial to the learning of other disciplines (Sala & Gobet, 2017). Flohr (2009), for instance, describes studies which « found that music instruction showed gains in general intelligence with a stronger effect in visual-spatial skills than in verbal skills » (Flohr, 2009, p. 15). Regrettably because of some not well researched base assumptions, several neuromyths and other common beliefs appeared, (Flohr, 2009; Düvel, Wolf, Kopiez, 2017) saying for instance, that a child listening regularly to Mozart would increase its intelligence. However, when looking for researches that show how we can better learn music itself, the results are noticeably much slimmer. I did not find one researcher claiming an academic discipline (like history or math, for example) could be helped through music learning. The closest we get to this affirmation is with the discovery that music and language are processed in very similar ways by the brain and mostly in the same areas (Curtis & Fallin, 2014; Collins, 2013). This leaves us wondering if learning languages or being a polyglot could influence positively music learning?

Nonetheless, there is nowadays more and more literature regarding the link between neuroscience and pedagogy. Subjects such as neurodidactics, neuropedagogy, and neuromusic exist, providing insights from science to these other fields (Curtis & Fallin, 2014; Gruhn, 2014). Scholars agree generally upon four needs any human-being has when it comes to learning. They insist on the importance of repetition, of movement, of carrying emotions while learning, and being exposed to a rich environment (Blakemore & Frith, 2005; Walter & Walter, 2015; Flohr, 2009; Flohr & Trevarthen, 2007).

Some articles I rely on for this study have been written with the aim to give music teachers and others alike advice on how to improve their students learning. For instance, the excellent article *Brain-Compatible Music Teaching Part 2: Teaching “Nongame” Songs* written by Kenney in 2010 exposes in a clear manner advice presented to teachers. She illustrates her suggestions through examples taken from « Miss Zahni » music classroom.

Also in 2015, Walter and Walter wrote *How brain research can inform music teaching?*. In this article, after explaining facts related to the brain and the learning process, they offer several checklists and tables to use during the lessons. It is in this direction my study intends to go.

Nonetheless, « often information about neuroscientific research is not easy to access » (Blakemore & Frith, 2005, p. 459). They continue:

There is a vast amount of brain research of direct relevance to education practice and policy. And yet neuroscience has had little impact on education. This might in part be due to a lack of interaction between educators and brain scientists. This in turn might be because of difficulties of translating the neuroscience knowledge of how learning takes place in the brain into information of value to teachers. (Blakemore & Frith, 2005, p. 459)

This is why the aim of this study is to present this knowledge and facts in a more *user-friendly way* (term borrowed from Hodges, 2010) to empower teachers and give them tools rather than delivering interesting but hermetic graphics and images. Besides, often research inspired by neuroscience in order to give precise advice to teachers, addresses their school classrooms (Rosenshine, 2012; Kenney, 2010) but are too rarely translated

into concrete musical terms or situations. This is where this paper is filling a gap. Inspired by the works of Hodges (2010) and Collins (2013), I wanted to give detailed, practical instructions and tools to music teachers. Being myself a viola player, it was important to address this research for all musicians but also more specifically to string players, and give them perhaps more personal advice designed for their instrument.

### **3 THEORETICAL FRAMEWORK**

As a musician and teacher myself, I am constantly evaluating myself, looking to improve my teaching. My wish is the same as many other teachers I guess: to teach the viola in the most efficient and natural way. Theories such as constructivism initiated by Piaget are very valuable to pedagogues. It advocates a student-centered teaching and a philosophy where the student owns, builds and directs his knowledge (Munari, 1994). Such approaches seems to empower students, thus revealing their natural potential and skills. However I have always been fascinated by the mysteries of the brain and I wanted to be able to rely even more on biology. There is definitely a lot to sort out on the subject, but neuroscience is continuously making new discoveries. It is a very active and happening field. Therefore, neuroscience imposed itself as the lens through which I wanted to view my research.

In order to be poignant and valuable to teachers, I realised the information I deliver needs to be detailed enough to really understand the different concepts from a scientific point of view, while at the same time I should not forget that learning is a complex process that involves more than just electrical and chemical connections in the brain (Gruhn, 2004). Psychology for example is very much involved in this process. The personal environment, motivation, past experiences, to name just few, are parameters that interact and interfere with the learning process. In 2009, Illeris points out, that

The first important condition to realise is that all learning implies the integration of two very different processes, namely an external interaction process between the learner and his or her social, cultural or material environment, and an internal psychological process of elaboration and acquisition. (p. 8)

So I decided it would be beneficial to the research to get some insight from neuroeducation as well, which is a research area that incorporates psychology, cognitive neuroscience and pedagogy. In their article from 2014, *Neuroeducation and music, Collaboration for Student Success*, Curtis and Fallin define Neuroeducation as:

the process of learning through many different lenses. It considers the way our bodies and brains physically respond to a learning event as well as the psychological implications involved in learning a task or applying a strategy. It also involves the pedagogical implications of retaining information for application in the future. The core concepts of neuroeducation to be briefly examined here include brain plasticity, the activation of attention and cognitive transfer, memory pathways, and multisensory instruction. (pp. 52-53)

In the following paragraphs I will summarise what is happening in the brain when we learn something and what are the important functions which allow us to learn. To do so, I will rely mainly on the works of Blakemore and Frith (2005), Hodges (2010), Huotilainen (2020), Walter and Walter (2015), Curtis and Fallin (2014), Flohr (2009) and Kenney (2010). Then, based on this knowledge, I will see how neuroscientists and researchers discovered some theories that explain that humans learn best in a physiological way and thus how these discoveries should shape our teaching. I will end this chapter by looking at a specific model of music processing: the Koelsch's model.

### **3.1 The learning brain in a nutshell**

Since I will speak about the technicalities of the learning brain, allow me to give some definitions of specific terms relevant for the comprehension of what follows (The definitions of an Axon, a Dendrite, and a Neuron were retrieved from the Article *Neuroeducation and Music, Collaboration for Student Success* by Curtis & Fallin, 2014, p. 54. The definitions from a Glial cell and A Synapse were retrieved from *Skill Development: How Brain Research Can Inform Music Teaching* by Walter & Walter, 2015, p. 51).

- Axon: a long, slender projection of a nerve cell that transmits electrical impulses away from the nerve body.
- Dendrite: a threadlike projection of a nerve cell that receives electrical impulses and sends them inward to the body of a nerve cell.
- Glial cell: A class of cells that support the growth, health, and function of neurons. Glial cells are found throughout the brain and body.
- Neuron: Nerve cell, especially one found in the brain and spinal column
- Synapse: the location where two neurons meet.

### 3.1.1 Learning is creating new connections in the brain

Any task we perform is the result of an electrical and chemical communication chain (Huotilainen, 2020). For instance, a cognitive function will activate neurons that will « send a message » and, connect to other neurons. This process is here well described by Walter and Walter in 2015:

Researchers have found that when someone learns a new motor skill, neurons in the brain create connections with other neurons at junctions called synapses. These synaptic connections link neurons together to create neural circuits that allow for complex actions. When people engage in many repetitions of an action, they strengthen their synaptic connections and create stable circuits for well-learned motor programs. (p. 50)

In other words, « Neurons that fire together, wire together » (Donald Hebb, 1949 as cited in Hodges, 2011), which forms a permanent connection. This is what we call learning!

It is commonly believed that adult brains can not grow new neurons, but science proven this wrong (Blakemore & Frith, 2005). Adults can grow new brain cells in areas such as the hippocampus for instance, where they create new connections and thus enable learning at any age. This is what we call *brain plasticity*, a capacity of the brain to change, grow and evolve depending on the circumstances (Huotilainen, 2020).

To train or keep any skill requires that the neurons implied in that skill build a permanent connection. To do so, there must be a long-term activation between these

synapses. If the person continues repeatedly to practice, firing a specific circuit in the brain, the glial cells will notice it, and wrap the axons in a « fatty » substance called myelin. The more a person repeats this action, the more myelin that circuit gets. A frequently used axon could get for example, up to 150 layers of myelin (Walter & Walter, 2015). The role of this substance is to smooth the neuronal connection in order to allow « the message » to be transmitted faster. We can use the metaphor of a road. At the beginning when we learn a new skill, the neurons just began to fire together creating a new route in the brain. This route is not very stable, neither straight nor quick. By practicing again, we enlarge this road, clean it, straighten it, and it seems easier to perform the task. If we continue, this road will one day become a very straight, fast and efficient highway. This is myelination, and the highway is the axon wrapped in layers of myelin. From the new connections formed by firing neurons to myelination, this process shows how the brain is evolving and physically changing according to people's actions and experiences which is the foundation of learning (Curtis & Fallin, 2014).

### **3.1.2 Mirror neurons and imitation**

Giacomo Rizzolatti is a physician and biologist well-known for his discovery of the Mirror neurons in the 1980's. The mirror neurons are a group of neurons that activate in the brain while a person is observing or performing something (Rizzolatti, Fadiga, Gallese & Fogassi, 1996; Huotilainen, 2020). During his study with macaque monkeys, this theory has been made clear especially for tasks such as manipulating an object for example.

So if I see my colleague take his phone, or if I take my phone, the same set of neurons will be activated in my brain as supported by Gruhn and Rauscher in 2007:

In humans, mirror neurons resonate to motor movements of the hand, the mouth and the foot that are only observed in another individual. Data from an fMRI study suggest that the coding of a viewed motor action in the mirror neuron system can be transferred to a recombination of these acts in order to replicate it according to the presented Model (Buccino et al., 2004). (p. 266)

Another interesting fact is that mirror neurons activate not only while observing tasks, but also emotions, like sadness for instance. This could explain the human capacity to empathise with others. It would also seem to follow that humans would be able to reproduce not only actions but also sounds. According to Gruhn and Rauscher in 2007,

Humans, like very few animals (such as birds, dolphins, whales, and seals), possess a neuronal mechanism that enables them to imitate arbitrary sounds to which they are exposed. (...) Human vocalizations also build upon the audiovocal ability to produce distinct sounds according to what they hear. Three neural pathways (...) are believed to build a complex phonological loop that enables humans and songbirds to control their vocal production by ear (Jarvis, 2004). (p. 268)

This theory is supported by Hodges and Gruhn when they later wrote that « the function of mirror neurons may be involved in audio-vocal matching in songs ». They underscore that this function « may be relevant to both audio-vocal and visuo-manual processes » (Hodges & Gruhn, 2008, p. 218).

Imitation is a pillar of the learning process. Scientists have proven that performing an action activates approximately two times more neural activity than just observing it, which leads us to believe that doing a task (playing a down bow on the viola for example) while observing the teacher doing the same maximises brain activity (Huotilainen, 2020). In addition, the intention we put forth into the action is crucial: « a recent brain imaging study showed that activity in the brain's motor regions is further increased if the observer watches someone else's actions with the intention of imitating them later (Grezes, Costes & Decety, 1999). Your brain mimics other people's actions even if you don't » (Blakemore & Frith, 2005, p. 463).

### **3.1.3 Memory**

We need memory in order to retrieve information. Learning would be useless if we were not able to do so. There are different memory systems: short, working and long-term memory. The short term memory is where we remember something for a short amount of time before it is stored in long-term memory where the information can stay for a life time (Huotilainen, 2010). The working memory as its name implies,

« works » with the information, manipulates it in order to keep it in the short term memory. For example, remembering the 10 digits of a phone number can be tricky. The working memory allows us to chunk this number into units that we are much more likely to remember, usually +/- 4 units according to Cowan (Cowan, 2001 as cited in Huotilainen, 2020). Thus, remembering 040 578 39 26 will be easier than 0 4 0 5 7 8 3 9 2 6. Our long-term memory is equipped with different systems (Henriques, 2013; Curtis & Fallin, 2014). The semantic system process the information through words. This is where we remember general knowledge like: Who was the French president 10 years ago? How much is the mass of an atom? A second system is the episodic pathway which recalls an event through our senses and participation. For example, « I remember I burned my hand on the stove 3 years ago » or « I remember this movie I went to see at the cinema last week ». These two systems are called « declarative » memory systems because they are a conscious process. We can know exactly the answer or a situation if we are asked to. There is a third system: the procedural memory. This pathway, contrary to the others is mainly unconscious. It is how we make things automatic. If we try to explain how we run, ride a bike, brush our teeth, etc... we answer generally by « well I just do it! ». We can make mention of a final system which is sometimes included in the episodic pathway. It is the emotional pathway. Curtis and Fallin say in 2014:

The final neural pathway to enhance memory is called the emotional pathway, those memories that are often processed into long-term memory faster than other memories as they are encoded through intense emotional connection—musical experiences that trigger strong emotional responses. (p. 54)

The stronger the connection between the information and the emotion, the more likely it is that we will remember, and remember it a certain way (Henriques, 2013). This can cause problems with post-traumatic stress for example.



### **3.2 The solution suggested by neuroscience and researchers to enhance learning**

Before looking at ways to enhance our learning process, I should mention that a balance life style is needed to get good results as with many other kinds of tasks. The learning process is dependant on it since the brain for example is in need of good fats (fish and vegetable fats), rest and oxygen to function at its best (Huotilainen, 2020). Nourishment, sufficient sleep and physical activity are basic elements that should be part of our routine if we want the brain to function efficiently (Huotilainen, 2020). Indeed, fresh air and exercise seems to be an ally to learning since several studies have shown that intervals of 1/2 to 5 minutes in cold weather (0 to 12 degrees Celsius) improve learning for 1 hour (Huotilainen, 2020). In addition, studies have also been made showing the benefit of regular physical exercise on academic work. Researchers have found that students doing more physical activity in school were more likely to get higher grades (Trudeau & Shephard, 2008). Trudeau and Shephard explained this phenomena. They explain that « the hippocampus has an important role in the consolidation of memory » and that « chronic exercise favourably influences the hippocampus through 3 mechanisms » (Heightened neurogenesis, augmenting long-term potentiation and increase of neuroprotective factors) (Trudeau & Shephard, 2008, p. 8). This proves that having a regular physical activity is beneficial to the learning process. Besides, if we want to remember something, it is important that the information goes from the short-term memory to the long-term memory. We can help it by not doing too many tasks at one time, nor having too many things to remember. Any distraction or interruption while learning can make us loose our focus and « steal » the information we try to learn before it has the time to be encoded and stored. So it is important to create a study space where we feel safe, comfortable and free from distractions (Huotilainen, 2020).

### 3.2.1 Multisensory exploration and multiplicity of strategy tools

One result we get from studies is that senses are very important for memory. As Gruhn suggests it, « the brain reflects all practical embodied experiences. Therefore, students need many options to prime the brain for learning and to install the most efficient neural networks » (2004, p. 6). The more senses are implied in something, the more we offer to the brain different routes to remember it. « Multisensory instruction uses multiple senses at one time and provides the brain with multiple ways of « knowing » something » (Curtis & Fallin, 2014, p. 54). It is a bit like looking at a gem for example. By looking at it from different angles, I understand it better, I know it better and I remember it better. This is a very natural way of learning, and we actually do it from the beginning of our lives: « Doing what comes naturally to young children—singing, drawing, and playing—engage the young child in multisensory experiences that « wire » the brain for success » (Curtis & Fallin, 2014, p. 53). Furthermore, children like to play and explore their surroundings. Some studies show that in a music lesson, children are more engaged when they can explore and create their own sounds. Flohr tells us « Researchers find that the brain is more activate when improvising music than when reproducing music » (2009, p. 17). This freedom and involvement can be observed at any age, even with professional musicians who improvise together, for example. Improvisation and creativity appear to be a way to improve motivation and brain activity, which could result in better long-term learning. While thinking of the learning process and multisensory experiences, scientists have found also that a sense like smell is connected to memory (Huotilainen, 2020). They discovered that studying the Bartok viola concerto while having a rose smell in the room for example, and then by breathing that same smell at night will actually enhance the consolidation of the Bartok viola concerto into memory.

The multiplicity of the senses, as we have seen, are important in learning. Besides, as essential as this is, so is the multiplicity of point of views and strategies (Flohr & Tervarthen, 2007). We are all different and learn in different ways. What is relevant and interesting for one is not necessarily for another. A « good » teacher appears to be then, one who has a large « tool box » he can use depending on the

situation. Flohr says clearly as well that there is « evidence that a teacher's effectiveness is influenced by her or his repertoire of strategies (Stronge, 2007) » (2009, p. 16).

### **3.2.2 The importance of « Deliberate practice »**

We discussed about the decisive place of myelination in learning. Donald and Jennifer Walter (2015) warn us nevertheless that the brain does not do any discrimination between correct or incorrect actions. The brain will strengthen whatever is repeated. This is why teachers and students should pay close attention to repeat only those actions they choose. « Deliberate practice » appears to be then, as Walter and Walter claim, a necessity. In their opinion it is insufficient to repeat over and over an action when not knowing exactly what to improve or what to look for. So here is a series of advice they give on the matter:

First, deliberate practice is a well-defined task. For musical practice, this is the difference between a global statement such as « make it sound better » and a more specific statement like « correct the intonation of the C-sharp located on the G string of the viola ». Second, the well-defined task must be at an appropriate level of difficulty. The target task should be slightly beyond what a music student can already accomplish but not so far beyond as to be unattainable. (...) Third, completion of an appropriately difficult task must be accompanied by formative feedback. (...) Fourth, students need opportunities for repetition and correction. Once a teacher provides formative feedback, he students must have the opportunity to apply that feedback to correct or reinforce their performance. The students must be given the luxury to try and try again. (...) Teachers should take care to have students practice with purpose, that is, with clearly defined goals that the student can evaluate for success. (...) One approach to focus student effort would be the use of a checklist that delineates desired practice outcomes. (2015, pp. 51-52)

However, knowing how to practice is a skill per se that the students need to learn. As Walter and Walter (2015) suggest, students have a tendency to do what the teacher does and not what the teacher says. Consequently on this matter as well, the teacher might profit in showing what deliberate practice is and would then « engage in setting

appropriate goals, evaluating performance trials, making corrections, and completing correct repetitions » (Walter & Walter, 2015, p. 53).

### 3.2.3 Stop and think!

Repetition has been referenced as an important factor since the beginning of this chapter. However some researchers as we have seen warn us about the dangers of any mindless practice. Learning and practice should be organised and thought about. First, Susan Kenney gives us a *brain-compatible* way of teaching music relying on repetition and time. She suggests that before asking a child to repeat a song or a phrase, we should let him hear it several times, internalise it. After few repetitions, he will be able then to reproduce what has heard (Kenney, 2010). In 2010, Hodges stresses also the need to give time to the student:

It may be that students fail to learn successfully sometimes because the rapid influx of information is not counterbalanced by an adequate amount of time for reflection. Teachers can facilitate the search for unity by inserting pauses or creating spaces so that students can take a moment to reflect on what has just transpired. Teachers can guide these momentary respites through careful questioning, they can allow students to talk to one another about what they have just experienced, they can ask students to write in a journal, or they can allow students to introspect in relative privacy. (paras. 15)

To continue, Susan Kenney claims « To be effective, the repetition must be meaningful to the learner » (Kenney, 2010, p. 31). She explains:

Mindless repetition becomes boring to the children, so the teacher must find ways to make the repetition « meaningful » or interesting to the learner. What keeps a learner interested depends on the age of the learner. But for the most part, young children want to move. In fact, Frank Wilson says, « The mind does not come into being or grow without bodily movement » (Wilson, 1985, p. 39). (Kenney, 2010, p. 31)

Another *brain-compatible* way of teaching music is to approach a new song, for instance, from a larger scale, a broader point of view. Quite often we try to teach phrase by phrase, in detail. We « zoom-in ». One suggestion by Kenney relying strongly on

Hodges' theory (2010) is to « zoom-out » because the brain is made to recognise patterns, and by breaking the song into small units we remove the meaningful connections of the units to the whole. Kenney defines the brain as a « pattern detector » (2010, p. 34). According to her, it is beneficial to hear a song several times for instance and let the brain extract « meaningful patterns » from « what appears to be chaos » (Kenney, 2010, p. 34). She continues: « it is a pleasure for the brain to be given the opportunity to hear the whole song many times so it can find the « patterns embedded » in the song » (Kenney, 2010, p. 34). Now anybody who learned an instrument knows we need to learn things deeply and work in the details, but maybe we can change the focus of our « zoom » regularly to ensure we understand the music also in its entirety. Nonetheless Hodges refers to Zull's work (2002) and maintains that the way to understand something is through our senses:

The simplest presentation of the learning cycle is Sense → Integrate → Act (p. 15). Sense refers to information coming into the brain from the outside through the sensory organs. When we engage in music activities, the raw auditory, visual, and tactile sensory information comes to us in bits and pieces and has little or no meaning. To derive meaning, we must integrate the sensory information into a meaningful whole. (Hodges, 2010, paras. 1)

### **3.2.4 Movement**

Movement is such a natural part of life. Through movement we were born, we develop and experience life. Actually it has been proven that movement and development are connected, which means movement and learning are connected (Flohr, 2009). Through movement, we also experience music which becomes a natural part of life. Moving is a concrete act that encompasses most of our being. The chemical reactions generated by a body moving in response to music bring us deep pleasure (Hodges, 2010). « This explains why it is so natural to move to music, whether playing or listening » (Hodges, 2010, paras. 2).

A movement is also a vector of emotion. We know how emotions are important for the involvement and memory of the students. The more we look into the component of the learning process and what could enhance it, the more we realise everything is

interconnected, mind, body and soul. It is almost impossible to disconnect movement and emotion. Pedagogues such as Dalcroze understood that learning also means to embody the information:

The work of Émile Jaques-Dalcroze suggests how we should conceive music emotion and movement as inseparable. He believed that humans feel emotions from various sensations produced at different levels of intensity in muscular contraction and relaxation. (...) The sensation of contraction and relaxation in human emotion is reflected in the tension and release of the rhythmic movement of music in time and space. Both emotion and music come about in movement. Dalcroze spoke of how there is « a gesture for every sound and a sound for every gesture ». We might add here that there is a gesture for every sound that corresponds to an emotion, and a sound for every gesture that evokes an emotion. (Flohr & Trevarthen, 2007, pp. 72-73)

### 3.3 The Koelsch model

After seeing how the brain learns and encodes information, after getting some suggestions about what to nurture in teaching, I thought it would be interesting to look more closely at how the music is processed by the brain. Neuroscience, neuromusic, and neuroeducation are quite intertwined nowadays and Koelsch (2011) provides a model of music processing that underlined the importance of certain factors in perceiving music, doing a musical activity, and, thus by extension learning music. Figure I shows the original Koelsch model, where Figure II shows how Anita Collins, the author of the article *Neuroscience meets music education: Exploring the implications of neural processing models on music education practice* translated these scientific terms into musical terms more accessible to a larger public. The main point of these models is to show that music processing is happening first with extracting features working their way gradually, eventually to a body movement.

As Collins points out, the model « works from left to right » (2013, p. 223).

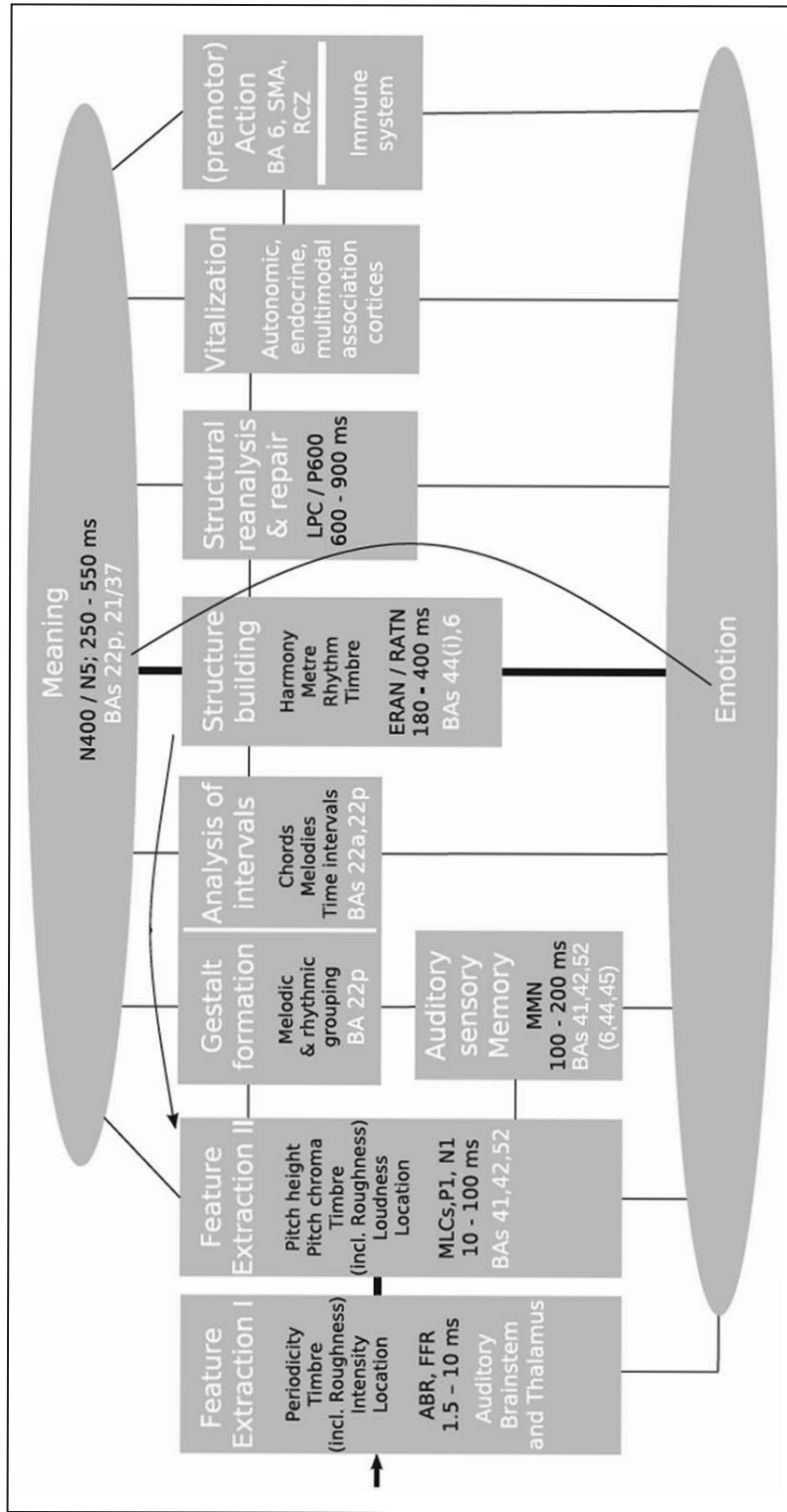


Figure 1. Neurocognitive model of music perception (Koelsch, 2011)

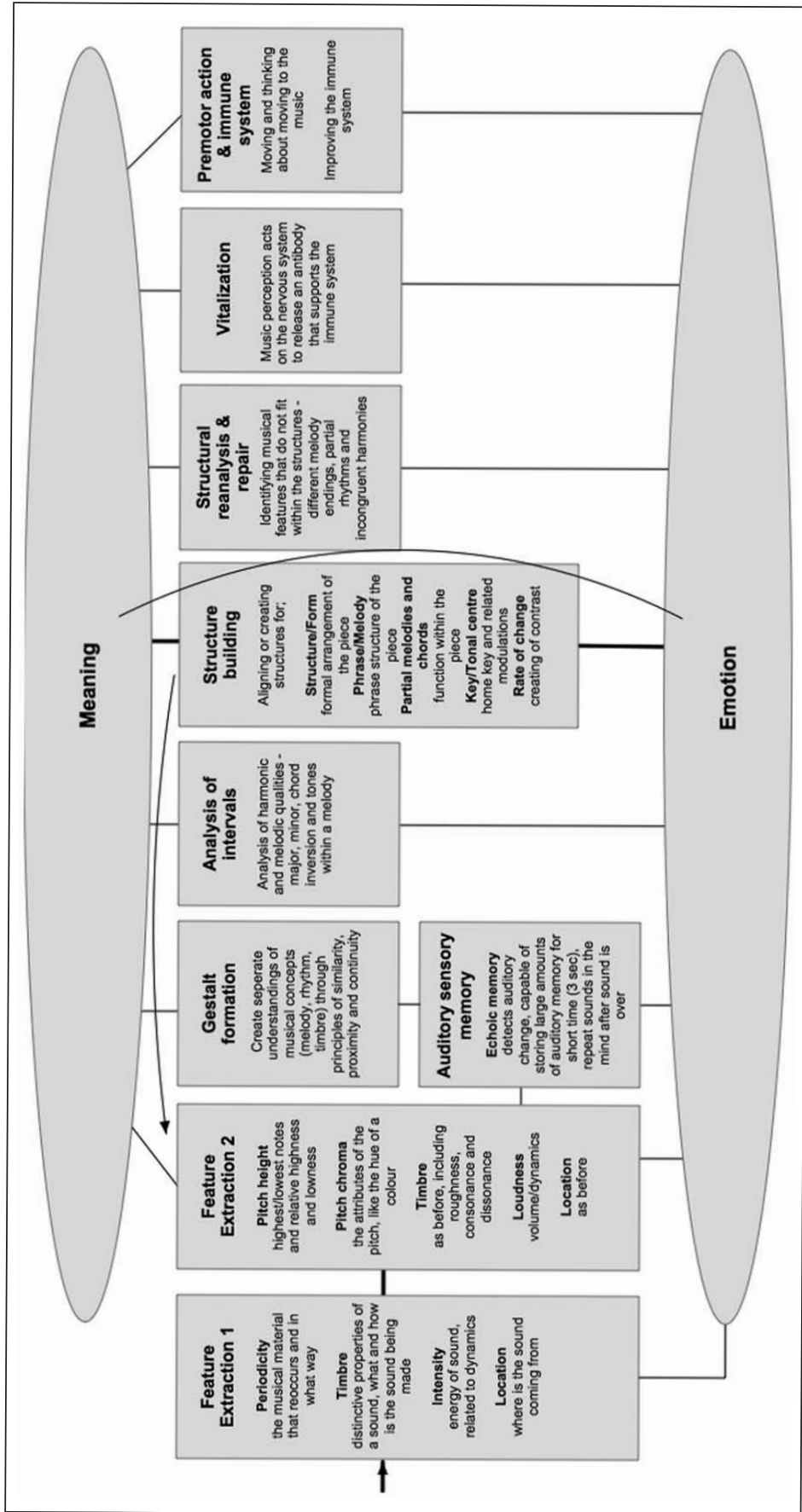


Figure 2. Author translation of the neurocognitive model of music perception (Koelsch, 2011)



She continues:

Advanced musicians can articulate those steps explicitly using musical language. But when we begin music education with young children, or with pre-service teachers who are not highly musically-trained, we work with the model from right to left. *We work backwards*. We begin with bodily movement and embrace the positive physiological effects of music first and from this point we build musical understanding and language (Collins, 2013, p.223).

This model provides us with two aspects appearing to be essential in the way we perceive thus learn music. This process is constantly connected through every step to an eventual meaning and emotion. Also, some research done in reference to memory has shown that the emotion attached to an experience can have a significant impact on the meaning of the experience (Hamann, 2001; Otani et al., 2011 as cited in Collins, 2013). In addition, where it is the starting point or the consequence of the process, movement seems to have a place of choice. Collins work is precious to our reflection in the sense it corroborates the theories detailed in the previous sections not directly through neuroscience, but through our perceptions and senses. It is interesting to note that both come to the same conclusion.

Collins, in 2013, gives us a final insight where a successful music teaching strategy is an approach that considers the student as a whole, with everything that is constitutive of its being, while respecting the natural learning processes we find in other disciplines (language learning for example):

This holistic approach is reiterated by Swanwick (1996) who contends that the principles for music educators should be to ‘care for music as conversation, care for the autonomy of students, teaching for expressiveness and promoting fluency before literacy’ (p. 16). Mirroring Koelsch’s model some 15 years later, Swanwick compares this final point, the ability to make music before reading it, with language development and the ability to speak before we can read. (p. 227)

## 4 METHODS

This chapter presents the methodology I used during this study. It shows why a qualitative approach was the most appropriate for this research and how the methods employed served the goal of my research, which is to discover the teaching strategies based on neuroscience that teachers can use to enhance viola teaching and learning. The research questions that address this aim are:

- How do instrument teachers describe their teaching?
- What kinds of strategies do instrument teachers use during lessons?
- How can these strategies be understood through the lens of neuroscience?
- How can we translate the general instrument teaching strategies to some exercises tailored for the viola?

The following sections will show my attempt to direct a detailed, richly informed and ethical research. To begin with, I will use Denzin and Lincoln (1994) arguments to justify the relevance of a qualitative inquiry in that research. Then I will explain the procedures I used to collect and analyse the data. Toward the end of this chapter I will discuss about how my position in that study was both an asset and a disadvantage. I will finish with some ethical considerations.

### 4.1 Methodology

The subject of this study is linked directly to biology, more specifically neuroscience, but also psychology and education science to name just a few. Learning remains still a personal matter even if general laws can be found and usually applied, the individuality of the subjects will always bring a unique point of view. Teaching implies many different human interactions. Personal environment is also a key importance. Thus I thought directing this research only by a quantitative approach would not be helpful enough. The need to gather facts about the brain is undeniable, but dealing only with percentages did not seem appropriate. A very personal orientated research, such as a narrative one would not serve this purpose any better. Looking at history of the scholarly world, qualitative research has found, through sociology or

anthropology for example, a golden place. The subject of this study implies subjectivity as well as facts, that's why I decided to direct this research using a qualitative approach. I find important to point out that qualitative research, contrary to quantitative ones, tries to « capture the individual point of view », « to examine the constraints of everyday life », or « to secure rich descriptions » (Denzin & Lincoln, 1994, p. 2). Allow me to quote a definition of a qualitative research that describes perfectly the reasons why I chose this approach:

Qualitative research is multimethod in focus, involving an interpretive, naturalistic approach to its subject matter. This means that qualitative researchers study things in their natural settings, attempting to make sense of, or interpret, phenomena in terms of the meanings people bring to them. Qualitative research involves the studied use and collection of a variety of empirical materials - case study, personal experience, introspective, life story, interview, observational, historical, interactional, and visual texts - that describe routine and problematic moments and meanings in individuals' lives. (Denzin & Lincoln, 1994, p. 2)

I must say I also liked the position this kind of approach put me in. Denzin and Lincoln in their handbook of Qualitative Research refer to the researcher using a qualitative approach as a *bricoleur*. Explaining further this concept, they write: « The bricoleur produces a bricolage, that is, a pieced-together, close-knit set of practices that provide solutions to a problem in a concrete situation » (1994, p. 2). This « patchwork-kind-of-study » is I think exactly what this study needed to be fruitful. The same authors also defend the idea that the solution or outcome of a project changes with the methods used and input rises during the research. I hope in our case, I managed to let myself be molded by different sources and methods in order to get informed, efficient and sensible results.

Qualitative studies, however, have been largely criticised as unscientific, subjective and biased (Denzin & Lincoln, 1994). I hope to avoid these traps by basing my research on scientific facts. To do so, in addition to reading articles about the correlation between brain and learning, I took a course at the University of Helsinki called *Neuroscience of learning for teachers* and interviewed a researcher specialised in cognitive brain research, which brings us to the next section.

## 4.2 Data generation methods

While my desire is to stay as close as possible to the scientific aspect of this study, I also wanted to keep the debate intelligible for non experts in this field. I was fortunate enough to meet a researcher who happened to be closely acquainted to neuromusicology and music pedagogy. By her knowledge, she acted as an « interpreter » and helped me to create a link between biological aspects and what it means concretely for us as musician learners and teachers. Interviewing as a research method was appealing to me because it could give me direct and easy access to answers I was seeking. As we will discuss later, I also chose to observe some instrument lessons, interview the teacher and the students as so I found these to be relevant to my research. However, because of the very different positions and knowledge of the interviewees (teachers, students, professional researchers), I had to think of different ways of organising and conducting the interviews depending to whom I was talking. The interviews were semi-structured. I chose this type of interview because I needed some organisation in the answers. I needed to be able to direct the questions and have pre-established topics in order to get the most accurate and relevant answers, but I also wanted the interviewee to be able to add anything they feel would be appropriate. With semi-structured interviews that include asking open-ended questions, it « is then up to the subject to bring forth the dimensions he or she finds important in the theme of inquiry » (Kvale & Brinkmann, 2009, p. 34). In 2009, in their book *InterViews*, Kvale and Brinkmann describe well the role and value of this type of interview:

A semi-structured life world interview attempts to understand themes of the lived everyday world from the subjects' own perspectives. This kind of interview seeks to obtain descriptions of the interviewees' lived world with respect to interpretation of the meaning of the described phenomena. It comes close to an everyday conversation, but as a professional interview it has a purpose and involves a specific approach and technique; it is semi-structured— it is neither an open everyday conversation nor a closed questionnaire. It is conducted according to an interview guide that focuses on certain themes and that may include suggested questions. (pp. 31-32)

I have included the Interview guides I used for the researcher and the teacher in the **Annexe II**. Because, as we will discuss promptly, I observed also a group lesson, I thought directing a group interview could be helpful. I decided to wait until the end of the observations before addressing it. I thought interviewing the students in a group, in a dialog format, could give them confidence and raise extra ideas, similar to that of a brain-storming session. This interview was almost not structured, even if I had a few questions in mind, in order to let as much space as possible for the students to express themselves.

As I mentioned earlier, I observed along with the interviews some instrument lessons (both individual and in group). The observation method was more than relevant for this inquiry because as Wilson (1977) explains, by observing, we can collect a rich pool of data like what a subject says, how he answers, reacts to others, what he does, etc... With this method we also have access to the realm of what is not said, the atmosphere of a place or the body language of somebody for instance. This has full pertinence since « human behavior often has more meaning than its observable « facts » » (Wilson, 1977, p. 253). As Wilson says in 1977, « the participant observer cultivates an empathetic understanding with the participant that is nearly impossible with quantitative methods » (p. 257). The subject we are studying here involves very subjective and sensitive aspects as well, like emotions for example which requires, if we want to grasp them, our whole body of senses and comprehension. Denzin and Lincoln mention in 1994 that « although we sometimes think of observation as involving only visual data gathering, this is far from true; all of the senses can also be fully engaged in this endeavor, from smell to hearing, touch, and taste. Observation thus consists of gathering impressions of the surrounding world through all relevant human faculties » (p. 378). Consequently, we notice that once more, the observation method serves this research well. During my study, I did not want to disrupt or disturb the flow of events. I wanted to place my observations under the concept of *noninterventionism* which would give me a certain level of detachment in order to witness the scene from the “outside”. However, if the teachers and students felt confident enough and wanted to share with me something (make me do an exercise with them, for example ), I wanted to have the possibility to do so. Consequently, I defined my role in this research

somewhere between being an *observer-as-participant* and a *complete observer* (Denzin & Lincoln, 1994, p. 379). My original idea was to observe lessons from a viola teacher and from another instrument (preferably non-stringed instrument) teacher to be able to grasp two different ways of teaching. Both teachers I had in mind are known for their pedagogy skills and expertise. However, this year was interrupted on many levels by the pandemic of the Covid-19 virus. So I did not have the possibility to observe the lessons of the viola teacher and the orchestra which she leads. However, even during this unfortunate and disappointing turn of events, I am confident in the fact it did not harm this research. It forced me, in a positive way, to interpret much of what I observed myself with the other instrument teacher into terms relevant for the viola. Thus, I observed one group lesson and 4 private lessons with this other instrument teacher for one hour each. The lessons were given partly in Finnish but mostly in English, and the observations took place in a classroom setting. According to the neuroscience and neuropedagogy literature, I prepared a list of criteria (see **Annexe IV: Observations guide**) that could possibly have an impact on students' learning. Then I went in the classroom and observed the lessons while keeping these criteria at the forefront to see if the teacher would use them.

I notated freely on a notebook my observations so as not to be restricted by the list but able to add anything I would find relevant even if it was not part of the criteria I prepared. To enhance the clarity of this section, allow me to present a table as a summary of the technical information concerning the different datas.

	Duration	Place	Language
Interview with the researcher	45 min	Skype meeting	English
Interview with the teacher	1 hour	Skype meeting	English
Group interview	2/3 min at the end of the lesson	Classroom	English
Observations	- 1 Group lesson of 1 hour - 4 individual lessons of 1 hour	Classroom	Mostly English, and few interactions in Finnish

### 4.3 Data analysis methods

After conducting the different parts of this research, I had at my disposition the different notes and data collected during my interviews and observations. The group interview happened at the end of the group lesson and was extremely short so I included these remarks in the observation notes. I transcribed in its entirety the recordings from the interviews with the researcher and teacher and used a thematic analysis method (Braun & Clarke, 2006) to find emerging themes from this information. I tried then to regroup if possible these themes under bigger or more general ideas and pointed out the themes which were common to both the researcher and the teacher.

Concerning the observations, I first tried to put the notes I wrote in a table designed with the list of criteria I prepared to guide my observations (see **Annexe III**). However, I realised it was not the clearest way to organise them and this system would omit important connections. For example, one remark could be relevant for different categories, which would not be seen in a table without making it unreasonably difficult to read. So I used a concept-driven coding (Kvale & Brinkmann, 2009) by allocating to each note the predefined criteria relevant to that matter. Rather than using a table, I organised the notes in 3 groups: the teacher interaction, the exercises or tips she gave and the rest of the notes. I then associated each note to a theme with a colour code, (see **Annexe IV**) each colour corresponding to a different criterion. One remark can have different colours and thus be relevant for different categories. I also wanted to know what was the most present in the lesson, so I did a graphic showing the part each criterion plays in the lessons (See **5. Results chapter**).

### 4.4 Researcher position

I am a master viola student at Sibelius Academy. This study topic is very close to me and is at the heart of my pedagogic reflection. What is a good teacher? How to teach? How to learn? Which methods to use? Can we get inspiration from other fields? Can we get help and guidance from science? Synthesising the knowledge learned at the Sibelius Academy and making it my own is definitely the goal of my studies. As I am

trying to form my own viola teaching approach for the future with the help of this research which is very important to me. I have held different roles and positions during this study depending with whom I was interacting. In the eye of the researcher I interviewed, I was a student she did not know beforehand who asked for her help and expertise. I was very dependent on her good-will and knowledge. During the different observations, I was both a student, friend or colleague of the participants. Denzin and Lincoln inform us how crucial is the decision we make on how to present ourselves: « The decision of how to present oneself is very important, because after one's presentational self is « cast » it leaves a profound impression on the respondents and has great influence on the success (or failure) of the study » (1994, p. 367). Considering in this study I was there to receive the knowledge, craft or skills of the participants, the best and “truest” way to approach them in my opinion, was to present myself humbly as a learner and someone passionate of pedagogy.

The challenge with the researcher was to look serious and competent enough for her to allow me to interview her and give me detailed information. I wanted to avoid a too broad or generic interview where only preconceived ideas and well-known phenomena about music and brain would be discussed. I am not a scientist but I wanted to present myself in a legitimate manner so as to get specific data, if needed. In the case of the observations, I needed to make the students and teacher feel comfortable and free in my presence, to act as natural as possible. I reminded the students that I was not researching about them but about the teacher and its methods. Actually, certain students integrated me to their lesson. They were talking to me, explaining me things, or making jokes. Concerning the teacher, I knew her beforehand and we share a strong mutual appreciation, which makes it both easier and more permeable to bias. However, the nature of this study was simplified in some aspects the observations since the eventual power play and status which could take place in that situation does not change the methods used by the teachers in their lessons.



## 4.5 Ethics

This study is made under the concept of “informed consent” (Nijhawan, L., Janodia, M., Muddukrishna, B., Bhat, K., Bairy, K., Udupa, N., Musmade, P., 2013) which means the participants are aware they are being researched and they know what about. The fact that any of them could withdraw partly or entirely from the study at any time was also made very clear. The present study did not require deep observations of the subject’s everyday-life culture or intimacy/privacy. So, contrary to some ethnology researches for example, which require some level of hiding the truth (in order to get the most accurate and authentic data, some researchers might need, with the consent of the ethical board, to hide or lie about the true nature of their study for example), I could conduct my research very openly. I tried to proceed with as much transparency as possible. I did my best to not betray the answers and opinions of the subjects. I added my personal reflections and inputs but while transcribing the participants data, I tried (that I agreed with the opinion or not) to be as faithful to the original as possible and to describe it in a way that would not harm their reputation or privacy. I also provided the possibility to the interviewees to read and modify, if they wanted, the transcriptions and any part where I would use their statements. Concerning the observations, I tried to lead these in an ethical way by making my identity, position and role clear to all participants. All observations were held in public places as it happens in a music university. The data collected was protected in a file locked by a password in my computer and I destroyed this file once this final research paper was handed to my teacher and approved. I am the only one who had access to the full information and when I had to show the data collected to my research tutor or classmate for the sake of this paper, I made the identity of the participants anonymous.

## 5 FINDINGS

In this chapter I will report the most important themes addressed in the interviews with the researcher and teacher after which I will offer the content of what I could witness during the observations.

## 5.1 The interviews

During the interviews, the language used by the researcher was straight-forward and very published research facts orientated, while the teacher's way of speaking revolved around personal development and artistry. However, the analysis of both interviews outline time to time some common themes. I will expose here the most important topics which are a) the search to know if music enhances academic disciplines or if it happens the other way around, b) the crucial role motivation and quality practice play in the learning process, c) the need of a healthy lifestyle and d) the central position occupied by emotions in music and learning

### 5.1.1 Music vs academic disciplines

One important answer coming from the researcher is that there has not been until now a scientifically proven study which would expose the benefit of an academic skill on music learning. She says: « There are not many published studies about how an academic discipline can enhance music learning » (Researcher, personal interview, 2020). Nevertheless, some languages like mandarin, by their nature, require a sensitive auditory system. Thus usually the persons speaking this language score well to auditory recognition tasks.

There are a couple of new studies where they compare musicians to non musicians and how they differentiate foreign language phonemes. It has been seen that musicians are better at that than non musicians. Probably because they practiced detecting frequencies changes, duration, etc... This is a way how music training probably benefits this. But then there are also for example Chinese, Chinese who speak mandarin in China, because mandarin is a tonal language, so they have the meaning of the word changing according to the melody contour. So they are as good as musicians as in detecting frequency changes for example. So some language skills may be enhancing your hearing skills because you are tuned to detect some small changes in frequencies or durations or whatever it could be in your language that is important. (Researcher, personal interview, 2020)

However, the question isn't to know if there are some academic subjects which could enhance music learning, or if music learning could enhance some academic disciplines, but rather acknowledging that music, as other disciplines, requires executive skills like attention, for instance. Practicing a subject that involves this skill would be beneficial for any other discipline that demands the same skill. So, for example, archery requires focus as does music. Therefore, archery could eventually enhance music learning on the same level that playing music could enhance archery. The researcher explains:

There is also this fact we have to remember that typically, children who are good at music and are good at school, there typically are —their executive functions, which basically means attentional skills and inhibition skills and working memory— they are typically good at these. So it might be that the factor is not music skills towards academic skills or academic skills toward music, but the executive function skills that contribute to the both of these. However, there are a couple of new and quite convincing studies suggesting that music activities actually do improve executive functions in school children. (Researcher, personal interview, 2020)

### **5.1.2 The crucial role of motivation and quality practice**

Another point the researcher stressed is that, in her opinion, everybody is musical on some level. What makes the difference between professional musicians and amateur musicians, is motivation. Motivation is an aspect that both researcher and teacher spoke about:

Musically is a faculty or a skill that is very general in human-beings, and not like the musicians are the ones that are musical and the other people are not. I don't believe that at all. But who become musician I think it's a mixture of genes of course, (...) rehearsing, it's the amount and quality of rehearsing but it's also some people get more kicks out of musics, and kicks out of rehearsing. So it comes down to motivation in a sense, and this is something we don't know, who is motivated and why? (Researcher, personal interview, 2020)

As the teacher pointed out, a student absolutely needs motivation to practice and improve: « First of all, the student has to have the motivation to practice, and practicing

is a skill. You don't make any progress by being talented, you need motivation to practice » (Teacher, personal interview, 2020).

As both the interviewees said, an efficient way of practicing is to space the learning. This concept is true for any discipline, and musicians already know well that it is better for the brain to practice 15 minutes every day than 1 hour per week. The teacher showed here the difference of time it could take to learn a skill depending on how the practice is organised: « For example, we have an exercise we call « lip trills ». The right way to rehearse it is to practice 3 min everyday for a year, but if you practice it 1 hour every week, it could take you 10 years to learn it » (Teacher, personal interview, 2020). The researcher supported this way of rehearsing:

Now of course there are studies showing that this spaced learning method is good but this is something that musicians typically do already. You shouldn't practice 8 hours one day and then have several days without practicing but it's better to practice even 15 min a day and each day. (Researcher, personal interview, 2020)

The teacher was really insisting on the importance of quality practicing. Practice is also a skill we need to learn and different techniques exist to help us achieve that goal. For her, an efficient practice saves time and nurtures our memory.

I believe you have to teach the body to do it the right way. But if instead of repeating 1000 times and every second time the playing is a little bit wrong, (so the income in the brain is 500 right, 500 wrong), we can repeat only 500 times but using techniques and focus to do them right. So then we save half of the time. (Teacher, personal interview, 2020)

The teacher described also how she asks to her students to practice:

The practicing techniques I very often use are actually for the memory. I am not speaking of memorising a piece but imagine that you practiced a passage, you rehearsed and improved, and the next day when you practiced again you realised you went back to square one... The progress didn't stay. To avoid this I use a practice system. I tell my student to practice a few bars for few minutes and then ask themselves: how did it feel? How was it different? Which thoughts helped? How did it

sound? What did I do with my body etc... then they move to another spot, and another, and another. After half an hour, they come back to the first spot they rehearsed, and before they play, they have to practice: do I still remember? What was I thinking? How did it sound? How did it feel? to catch the right way of playing before playing, and then they play and practice again. You can do this practice loop as many time as you want to check out: « do I still remember? ». It helps informations to get stored better in the memory and it is faster for them to get it to the long-term memory. (Teacher, personal interview, 2020)

Practicing means changing some habits as well which can be difficult to do. This is why the teacher thinks one of her tasks is to make the students open to change:

My job as a teacher is to work with the students and keep their mind open to the learning process that they think learning is the fun part. (...) The challenge in teaching practice is that you have to make them change their habits and that's one of the hardest things to do: change your routine. It is again about trust. Also the students have to trust you enough to try and then notice the difference in their learning. (Teacher, personal interview, 2020)

Practicing is closely related to practicing strategies and teaching strategies. Another aspect the teacher pointed as essential is to have a wide variety of tools and approaches. Creativity also in the teaching techniques is important and in her opinion a teacher needs to renew his methods constantly:

My job is to find out which way they learn the best. In the lessons we try different approaches: auditory, visual, kinaesthetic, describing, let the student use their words to give a feedback on an exercise... so it's about trying to understand what is happening, and catching some point to hold on to: « this thought, this emotion maybe play differently », « what changed and how will I reach it again? », « how can I get the tools in the lesson I can re-use once I am alone at home? ». So it's a live research, and that's my job to offer so many different ways that they will find out and understand. It took me a while to understand how much I need in my tool box. At the beginning I thought I had enough but then I realised I needed much more and I had to invent more methods all the time, every week even. I refresh my system regularly. So being a teacher is also about being creative. (Teacher, personal interview, 2020)

### 5.1.3 « A good night sleep »

Both interviewees underlined the need of having a healthy life-style, especially having sufficient sleep at night. Memory consolidates itself during our sleep, thus we have to pay close attention to give ourselves enough sleep to allow this process to happen. According to the teacher, « to learn a skill you need repetition and a good sleep afterwards because we know learning happens in the end of your sleep » (Teacher, personal interview, 2020).

This idea was approved by the researcher as well:

What is really important when you are learning motor things, like playing for example, is to have a good night sleep afterward because that's the time these functions and memory consolidate in your brain. So if you don't sleep well, then your skills don't improve that good. (Researcher, personal interview, 2020)

Sometimes taking a little « power-nap » can be beneficial too:

well according to some studies it seems to be enough in some cases. I am not an expert on sleep, so... but I think a small nap can be a very good thing, but of course you have to be careful to not mix your day sleeping time. (Researcher, personal interview, 2020)

Physical exercise is also crucial to brain well-being, and thus our learning:

Also one should exercise, because when you exercise sport or physical activities, you grow new neurons. Even adults grow new neurons and exercise is one thing to help them grow. And then in order to keep these new neurons and connections between them alive then you need to learn something. In a way to it would be great to go for a jog of something and then, learn a new song or tune or compositions and then go to sleep so that everything would be kept in your head. (Researcher, personal interview, 2020)

#### 5.1.4 The central position of emotions

During her interview, the teacher spoke a lot about emotions. For her, music is meant to bring joy and touch people. It is a communication tool and skill. It is something that is drawn from you, within you, and to be given to others:

It is about training them to be high skilled professionals, who can by their technicality, musicality and performance skills touch other people and bring them joy. (...) It's speaking through music. It is also having a nice intimate connection with the music which can operate within us and then flow to other people. So music is a communication skill at many levels. (Teacher, personal interview, 2020)

Music is a very personal thing. This is also why even if she recognises the need and place of imitation in the learning process, she encourages her students as soon as possible to not copy anybody, but develop their own personal ideas and style:

Of course at the beginning when you teach the students different styles, they are more copying, learning the limitations or other principles of the style, but it's important that in the end they are bold enough to ask themselves: « what do I want? ». (...) I think the personal touch is so crucial. When I go to a concert, I am not expecting to hear a piece performed in the same way than everybody has been playing it. I expect to be surprised, to get a fresh feeling, to fall in love with the piece again because of the personal touch. (Teacher, personal interview, 2020)

Emotions are also at play within the teacher-student interaction. The foundation and starting point of her teaching is trust. She knows that if she is able to trust her students, the students will trust her, and from there, the learning process can happen smoothly:

The most important thing for me is to see the potential in the student. Because when I see the potential, I am positive, I trust them and I believe they can feel it and trust me in return. I can't fake it, I have to be honest. I am really working with the new students to really see it, so they can open themselves to me and trust me. (Teacher, personal interview, 2020)

As a consequence of the learning process, she explains how it is important for the student to also trust themselves:

It is important that they can trust their skills. They can have a very bright future because they don't see anything stopping them. It is only a matter of time when they develop rather than « if » they develop. So it is a big difference in the mindset. (Teacher, personal interview, 2020)

Additionally, one reason why music is so special, as the teacher said, is because music requires us to be fully involved with all our being, and music in return has an impact on every aspect of our life.

When doing music, our whole life is involved. It is about getting the skills and understanding (as in math for example), it involves creativity, it is also about growing as a person, being mature, going further as an artist. So when I think about teaching it is about helping the student to grow up, to be their own individual, and strengthen their personality. (Teacher, personal interview, 2020)

When asked about her opinion regarding good teaching, her answer was very broad and encompassing because it included aspects from different parts of our being, body, mind and spirit. This claim that music would encompass many different areas of our entity is supported by the researcher. In a slightly different way, she declares music is different from other disciplines in the sense that it activates multiple areas in the brain and requires a wide range of skills:

So the extra think about music compare to many other skills is that it activates so many areas, motor areas and hearing areas, and focus your attention to different things at the same time. (...) And of course there is this emotional involvement that you talked about earlier, which is an interesting thing as well. (Researcher, personal interview, 2020)

I would like to end the synthesis of these interviews by stating that the teacher mentioned she is well aware of neuroscience recommendations towards education and takes great care of this in her teaching even though she is not using consciously this



scientific knowledge in her lessons. However, even unconsciously, her reflection around pedagogy has helped her shape lessons in a way I will describe below.

## 5.2 The observations

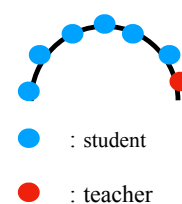
I will begin to report the information collected during the observations by the attitude the teacher adopted during the lessons and the class atmosphere it created. Then, I will dissect the exercises the teacher used to understand which big principles and concepts they are drawn from before looking at how through different strategies, the teacher made her students actors of their learning.

### 5.2.1 The teacher attitude

It seems appropriate to unfold the events and details which happened during the observations by starting with the teacher's attitude. The atmosphere of the class was quite similar both during the group and the individual lessons. Of course, the individual lesson's setting induces a more intimate configuration but, for both, she was very open and made them feel safe. It was a very warm and friendly atmosphere. The students were then also very open, accepting and did not judge each other because the teacher induced this mood. She was able to do that by gaining their trust and by becoming one of their own, in a sense. She was part of their group without hierarchy.

She was sitting with the group, was playing all the exercises with them, so she was a legitimate part of the group. There was no distance between them. During the individual lessons, the room was quite large with a lot of space. She chose to take a chair and sit very near the student with a very open and benevolent body language.

The eye contact was important and always very focused on the student.



### 5.2.2 The exercises' content

For a better comprehension of what follows, I will use a capital letter every time I am referring to a criterion of my pre-established list. In order to be precise, I will give quite extensive descriptions of the lessons, so to get a summary and/or envision better the situations I am referring to, I suggest you to read first the report and analysis of the observations located in the **Annexe IV**.

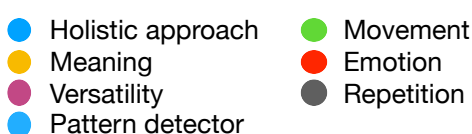
When looking at the notes concerning the exercises the teacher gave, the first obvious thing we can notice is they combine several, if not all, of the criteria. For instance, an exercise including Movement, usually included Emotion as well. This portrays the use of a Holistic approach, a will to consider the student as a whole, which is connected to Versatility by using variety of teaching tools. We can understand through this example how an exercise can contain most of the criteria at the same time. Some of them are also interconnected. For example, it is very difficult to make a distinction between Emotion and Meaning. Indeed, when we do something in order to obtain some meaning out of an exercise, (so if we imagine a story, create a mental image to make the exercise meaningful for us), it is very likely that some emotions will be connected to the meaning. This is why Meaning and Emotions are closely co-dependant as much as sometimes Movement and Emotions are co-dependent because Movement is a vehicle for Emotions. We can follow the same logic when thinking of Versatility. Being versatile in that case represents being able to use a wide range of teaching tools and styles of exercises. By doing so, the teacher acknowledges that a student might need to work on something through different angles and take into account the entirety of the student. Consequently, we can see that almost every time Versatility is involved, it goes hand-in-hand with a holistic approach.

We saw in the theoretical framework chapter how much repetition is crucial to the learning process. However, when working on an exercise, the teacher never made the student repeat something just for the sake of repetition. It was always connected to a certain meaning. It was never a plain, « dull » repetition of something. The exercises were meant to be meaningful to the student. They almost always aimed at making the

student understand what he was doing and imagine what it means for him, on a personal level.

Concerning the presence of Movements within the exercise, the teacher could use it to guide the student on a conscious or unconscious level. Sometimes the teacher worked with Movement and Emotion in order to create meaning. She wanted the student to realise something and feel it for himself. The process was then conscious. However, occasionally Movement and Emotion were directly linked but without aiming to create meaning. For example, she was moving and gesturing while the student was playing in order to guide him and induce better phrasing. In that case, the student is feeling the emotion through movement but at an unconscious level because meaning is not part of the equation.

I made a graphic for purpose to show approximately how much the different criteria were used during the lessons. This graphic is quite subjective since it is only based on my perception of the events. It is also difficult to know exactly how many times the teacher used movement or added meaning to the exercises. So, I based the percentages on how often the criterion was used, how important it was for the teacher and student, and the general feeling I got from watching the lessons. Again I stress the fact this graphic purpose is not to be exact but rather to show the general feeling and perception I got from these lessons.



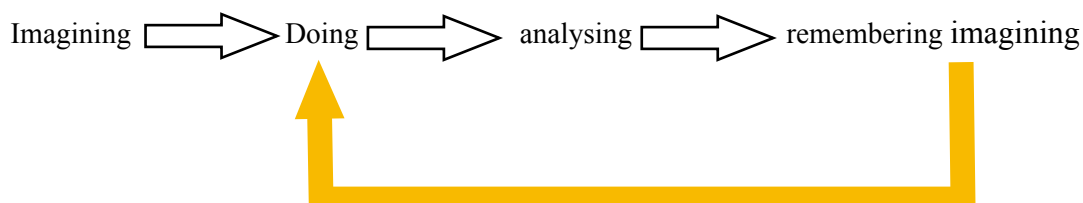
### 5.2.3 The student actor of his learning

When looking through the notes, one thing which did not come out enough with the colour code I used is the importance of verbalising. It was not one of the criteria I thought of before going to the lessons but by looking at how she teaches, I can see how it has a huge importance and how it definitely has a central place in her teaching. Verbalising is closely linked to meaning because it makes the student understand and realise things himself, and makes them meaningful for him as an individual. This is why feedback is omnipresent in her lessons. Once more, feedback is connected to meaning. She is always, and I stress it again, always, asking after the exercises: how did it go?, what did you do? Did it help or not? Was it weird? What will you do differently next time?... So in the end, the solution comes from the students. They realise through feedback what went well, what was different and what there is still to do. She is there to give some advice and guide them, but through feedback, they can understand for themselves, with their mind, their own emotional references, their individual bodies what it means for them, and how they have to practice in the future.

Another point that comes out from the notes is the tremendous energy and engagement coming from both parties, teacher and student. The teacher causes the student to be engaged. By asking him questions all the time, by referring continuously to meaning, by asking them to find for themselves some meaning, by making them verbalise, by using a wide variety of tools and techniques, she makes the student the principal actor of his learning. Therefore, it makes them engaged, very focused, and very active while using all their senses.

The teacher is also taking care of the memory of the students by asking them to recall things from the past. She asked, for instance, how a masterclass which happened the previous week went and what did they learn. She tries to consolidate the memories of an exercise or position by asking them regularly to recall the details and physical sensations of the exercise. Concretely, it means after an exercise she asks them: how did it go? What did you think to make it work?... And after their answers, she asks them to remember these thoughts and sensations before trying again and practicing more.

So she is creating a practicing loop:



## 6 DISCUSSION

The previous observations and interviews highlighted some themes neuroscientists already revealed to be decisive for the learning process. We can group them under two large categories, those which come under the learning *context* and those which help building a *quality practice*. Blakemore and Frith (2005) expose the benefit of having a rich environment and context to study, as for the practice subject, we can't count the numerous studies describing the imperial need of repetition and practice. However, researchers such as Walter and Walter in 2015 emphasise the importance of the quality element within practice. I will develop first what I mean by *quality practice* and how some executive skills, meaning, movement and variety can contribute to reach this goal. I will then display how the context of a healthy life style, a positive reinforcing teaching attitude and the role played by emotions can influence substantially the learning experience.

### 6.1 A Quality Practice

During her interview, one of the points the teacher accentuated the most was the absolute necessity of having a practice of quality. This idea is supported by Walter and Walter (2015) and their extensive explanation of *deliberate practice*. In the past, much of the focus in high music education, and music in general, has been primarily on repetition. The famous « practice makes perfect » is at the heart of conservatories. However, nowadays researchers and teachers alike realise more and more the importance of being both fully conscious and focused while we repeat something. We need to repeat only the desired actions, not the « bad », « failed » attempts (Walter & Walter, 2015). Thus repetition remains necessary in order to learn (Huotilainen, 2020),

but it is more about the *how* we repeat than the *how much*. To do so, here are few strategies I would like us to consider.

The student needs to be focused on the task. Concentration is part of the executive skills of the brain, and as any skill, it can be trained. The opinion of the researcher I interviewed coincided with the lack of literature proving an academic discipline could improve music learning. However, she made us realise that music and academic disciplines both require focus, and the students that do these things well display good executive functions. Thus, we can imagine that in order to train our concentration and reach a better quality while practicing, we could learn in addition to music, any discipline we like which also involves great focus. Over time, both music and this discipline will benefit from this « learning-tandem ».

Nevertheless, concentration is not the only component required to achieve quality practice. The student needs to understand what he is doing (Rosenshine, 2012). To accomplish this, as the teacher demonstrated, verbalising actions and body feelings can be very helpful. The goal here is not to give dry verbal instructions, but rather make the student aware of those sensations already embodied in order to obtain meaning and comprehension. In this way, the student will be able to repeat the action exactly the way he or she wants. This approach is supported by Rosenshine (2012) who recommends asking the student a large body of questions to check their understanding and guide their practice. Hodges (2010) is an American professor and scholar coming from the music education field. He also reported how the relevance and importance of using teaching strategies can make the task of learning more meaningful. He reminded us that the brain for instance, takes pleasure in thinking through the embedded puzzles and patterns of a musical piece. He declares « we have an inborn desire to discover patterns in the environment. Reflection, (...) is a search for connections and for unity » (2010, paras. 9). I can compare this idea with the sight-reading session which happened during the group lesson I witnessed. The teacher, without revealing the answers, asked the students before playing to look for similarities, patterns and change of tonality within the music. After taking the time to do a quick skim through of the material and mental analysis, the first-played version of the music was quite successful. Hodges (2010) also tells us that

Learning information that is personally meaningful to the learner is also critical. Students may not automatically understand why it is important to learn a particular fact or skill. Teachers can facilitate learning by connecting new learning challenges to students' personal interests. Why should a seventh-grade general music student learn what a rondo is? Creative and successful teachers find ways to connect such a seemingly archaic and irrelevant term to the adolescent's life. (paras. 4)

The teacher I observed approach is resonating in the scientist Illeris' vision. As we saw previously, the teacher emphasised the importance for the student to seek the personal meaning of the exercises or musical pieces, while she encouraged them to develop their own ideas and taste. Such theoretician as Illeris would applaud I think this strategy since for him, « The endeavour of the learner is to construct *meaning* and *ability* to deal with the challenges of practical life and thereby an overall personal *functionality* is developed » (Illeris, 2009, p.10). Using imagery is one ways to adapt a concept and make it more meaningful and relevant to each individual. The reason for this is because the student can imagine himself what the concept and music means for him. Creating a mental image of what we want to achieve primes the brain for success. The teacher understood this well and asked her students to imagine the sound they wanted before the exercises, what it represents, what story, which colour, which feeling, etc... Wilfried Gruhn, the german professor and scholar coming from the music education field, claims these mental representations are crucial, and some studies prove that « pupils who could develop a genuine musical representation by procedural strategies were more successful in the listening task than those who were verbally trained » (2004, p. 4). Furthermore, Gruhn points out « the learning of meaning must be closely related to the sensitive phases when the brain is best prepared to process and store new information » (2004, p. 6), which opens another line of thought for future research: when are we the most ready to learn? Certainly mental representations are different for each individual and it is up to the students himself to develop them. However, « as educators we are responsible to arrange stimulating learning settings and to present new elements in a partly known and attractive context which is meaningful in itself and catches students' interest » (2004, pp. 6-7). To go even further, Peter Jarvis, who was a scholar dedicated to education and in particular, adult education, gives us an interesting insight about how people construct meaning out of something. He says: « we transform these sensations into the language

of our brains and minds and learn to make them meaningful to ourselves – this is the first stage in human learning. However, we cannot make this meaning alone; we are social human beings, always in relationship with us, and as we grow, we acquire a social language, so that nearly all the meanings will reflect the society into which we are born » (2009, p. 25). Consequently, Jarvis place the learning process within a social context. There would be a lot to discuss about with this subject, but for the purpose of this study, we can maybe retain that group pedagogy and lessons which offer interactions and reflections between several students, could help to extract meaning from exercises and develop, thanks to the group dynamic, the personal identity of the students. In addition, Hodges (2010) and Jarvis (2009) claim that meaning comes through our senses:

The stimulus for this learning is our experience of the world – the point at which we intersect with the world (both physical and social). The only way that we can experience these moments of intersection is through our senses – we see, hear, feel, smell and taste. These then are the beginning of every learning experience, so that the bodily sensations are fundamental to the whole of the learning process. (Jarvis, 2009, p. 30)

Kenney (2010) supports this affirmation by commenting how children need to be interested in what they do and the repetition of a task should be meaningful for them. According to her, very often what children understand and are interested in is movement.

As we saw previously, movement is not only an intrinsic part of music but of life in general. Lee (2005) advocates « movement is central to understanding development » (as cited in Flohr, 2009, p. 16). He explains:

without movement we—by which I mean the animal kingdom—would not be able to eat, avoid harm, reproduce, or communicate by sound, gesture, or facial expression. We would not be able to perceive, because perception is an active process. Consequently, we would not be able to think, because there would be nothing to think about. We would not even be able to breathe or pump nutrients around the body. In short we would be dead. (Lee, 2005 as cited in Flohr, 2009, p. 16)



Here Lee connects thoughts and movement. Actions begin with a thought and these thoughts are shaped by our previous experiences. Hodges (2010) tells us « we learn by doing » (paras. 2). As children, we explore our environments and we prove learning has occurred when we are able to repeat something intentionally. As we grow, « abstract thinking involves mental movement. We can rotate a figure in our minds, silently recite a poem or hear a song, or imagine moving in space » (Hodges, 2010, paras. 2).

Furthermore, Illeris reflects on Piaget's idea of the body and brain being united as an inseparable whole. He writes: « learning begins with the body and takes place through the brain, which is also part of the body, and only gradually is the mental side separated out as a specific but never independent area or function (Piaget 1952) » (Illeris, 2009, p. 11). Thus, body, and by extension, movement and mind are intertwined to allow the learning process to happen. The researcher I interviewed explained how music activates many area of the brain, including those affecting motor control. In a musician, motor skills are combined with other complex processes as reading music, for instance. The person reads a note and has to translate this visual information into the appropriate movements. Even without reading music, the gesture is always connected to intention. We play a « forte » down bow on the viola for example because we want a specific sound and character. Thus, the motor functions for a musician are always connected to his sensibility, creativity and emotions. Flohr, coming from the music education field and Trevarthen, coming from psychology and psychobiology, explain we express ourselves through our bodies but we also must first understand and feel with our bodies (Flohr & Trevarthen, 2007). Gruhn says « the brain reflects all practical embodied experiences. Therefore, students need many options to prime the brain for learning and to install the most efficient neural networks » (2004, p. 6). The teacher I observed, even unconsciously, used this idea of priming the brain by using our senses and bodies. Before playing, the student had to imagine the character of the piece, maybe its colour or smell, and then mimic it physically by moving, dancing, gesturing, with or without the instrument, but without playing. After this little « priming exercise » the student could play the piece, and the result was always more satisfactory with this type of preparation.

The teacher also felt strongly that her role was to provide as many ways of teaching needed until the student is able to understand. She used many different techniques and approaches (visual, kinaesthetic, aural...) during the lessons. During the observations, I recall she quite often explained the same idea in at least 2 or 3 different ways. The student could then pick the words that most resonated with him.

Neuroscience does recommend and support this use of a variety of teaching styles. Hodges (2010) tells us that learning new information from different points of view strengthens our global understanding. The researcher interviewed said like Curtis and Fallin in 2014, that music activates many areas in the brain (cognitive, visual, auditory, affective and motor system). It seems logical then that « students engaged in rich, multisensory experiences » are « building strong, healthy neural pathways for learning » because they provide their brain, as we saw in the theoretical chapter, with multiple ways of « knowing something » (Curtis & Fallin, 2014, p. 54).

All the topics discussed above are tools which can help us achieve a *quality practice*, to employ terms used by the teacher I interviewed, which in this case means to be able to learn, understand, own, make personal, retain and retrieve information. Retrieving, remembering are essential functions of the learning process. Nurturing memory was one of the areas focused on by the teacher. As discussed in the findings chapter, the teacher would begin the lesson by asking the students several times to recall and tell what they learned during the past week (during masterclasses, for instance). This strategy is very much encouraged by Rosenshine. Speaking of a classroom situation, she says in 2012: « The most effective teachers in the studies of classroom instruction understood the importance of practice, and they began their lessons with a five to eight minute review of previously covered material » (p. 13). Besides, her very first recommendation addressed to teachers is to « begin a lesson with a short review of previous learning » (p. 13). The teacher I observed did not only act in accordance with this advice but went even further by asking the students constantly before, during and after the exercises to imagine, recall, feel and remember the sensations needed to complete the exercise. She would say « imagine the sound you want », then the pupil would play, after which she would ask « how did you feel your tongue? » for example, « remember this feeling and play again ». By asking them constantly to analyse and

remember their sensations, the teacher builds lasting and active neural pathways. This procedure is approved by Rosenshine in 2012 who recommends to « provide a high level of active practice for all students » (p. 19). This is achieved among other things by asking « a large number of questions and check for understanding » (Rosenshine, 2012, p. 19). This strategy helps the student to own his knowledge and lead him to greater autonomy.

## 6.2 The influence of the context

The context of learning is having a tremendous impact on the learning outcomes. Teachers should try to provide as much as possible, propitious learning conditions to their students. Illeris explains in 2009 that:

In a school situation, focus is usually on the learning content; (...) However, the incentive function is also still crucial, i.e. how the situation is experienced, what sort of feelings and motivations are involved, and thus the nature and the strength of the mental energy that is mobilised. The value and durability of the learning result is closely related to the incentive dimension of the learning process ». (p 12)

Whether it is playing music or teaching music, the subject of emotion seems to take on a central role. I did not want to discuss this subject in the previous section, even though emotions are a tool we can use while teaching/practicing, but rather attach them to the learning context because, in my opinion, emotions are the medium which link everything together. Actually, science has already proven nowadays the implication of emotions in the learning process: « Many psychologists have been aware of this close connection between what has usually been termed the cognitive and the emotional (e.g. Vygotsky 1978; Furth 1987), and recently advanced neurology has proven that both areas are always involved in the learning process, unless in cases of very severe brain damage (Damasio 1994) » (Illeris, 2009, p.11). Emotion can be a tool that helps us to play better by embodying and envisioning information. It is another way of using our senses. Using the sensitive part of our makeup enables us to better feel and understand a musical piece. It is the same process as using movement or visualisation, but with emotions and the memories attached to these emotions which bring us material for

inspiration. For instance, the teacher through imagery was able to make the music more meaningful and emotionally relevant for the student. She said in the example: « in this part of the music, what is the character? What does that inspire in you? Which emotions are at play? ». Accordingly, we understand why the teacher expressed that when we play, we are communicating a message coming from our inner being to the public. Therefore, music is a communicative tool of our personal emotions. This is what she calls the *personal touch*. Whether it is between a musician and a musical piece, or within human interactions like teacher/student, emotion seems to be a great influence on the learning process. The researcher said:

And of course there is this emotional involvement that you talked about earlier, which is an interesting thing as well. (...) Because it is a cognitive skill in many ways so it activates the cortex that it also goes deep to the memory things and emotional parts of the brain that are deep in the brain (reptilian brain). (Researcher, personal interview, 2020)

Hodges also underlines the role played by emotions in education. He declares « emotion strongly affects learning. To learn something successfully is to have emotional success » (Hodges, 2010, paras 4). This is why the teacher was so attached to the concept of trust between her and her students. She wanted to establish a healthy base to these relationships that both the student and teacher could feel they could grow and learn freely together from, without anxiety or unnecessary pressure:

Because when I see the potential, I am not lying, I am positive, I trust them and I believe they can feel it and trust me in return. I can't fake it, I am honest. I am really working with the new students to really see it, so they can open themselves to me and trust me. Then I really think the interaction between student and teacher is important. (Teacher, personal interview, 2020)

The relation between teacher and student is an important theme, and every professor knows how rewarding and challenging it can be. Most of us during our school years can recall a subject we did not like a priori, but because we liked the teacher so much, we became good in that subject and we even ended up liking it. This phenomena proves once more how much human beings are an indivisible whole, how every part of our

being is connected to others. Sloboda and Davidson support also this theory, they say « Highly developed musical skills require more than practice and quality experiences; an attachment to a responsive and appreciative teacher is necessary » (Sloboda & Davidson, 1996 as cited in Flohr, 2009, p. 16). Besides, as we saw during the findings chapter, the teacher induced a warm, open class atmosphere which helped her to get good results with her students. In 2010, Hodges also addresses the importance of the environment the students learn in:

Of course, one can learn through fear or intimidation, but in those circumstances, negative emotions color the learning. Learning that occurs in a positive, affirming environment links the learned material with pleasant feelings so that recall of the information also brings back the positive affect. Music presents possibilities for both positive and negative learning. When students enjoy their musical interactions, they develop positive associations that may persist for life. Likewise, those music-learning situations in which the prevailing feeling is one of stress, fear, or failure may set up lifelong negative associations with music. (paras 4)

This quote presents how crucial are the impressions and feelings we get while learning something and teachers should always be careful as to what feelings are induced during the lessons. In 2007, Rauscher and Gruhn also agree that positive emotions are essential to develop a healthy psychological attachment to the discipline:

Educators and teachers have to make sure that the content of their lessons are associated with positive emotions in order to prevent the previously described mechanisms of active blockade of emotionally negative memories that would occur if the child associates the learning situation at school with negative emotions. (p. 44)

Even at a chemical level, studies prove that positive emotions bring more chances of success to the learning process:

Since we know that a dopamin signal causes higher activation of the ventral striatum which affects the frontal lobe and, therefore, produces a gating effect for new information, we can assume that information processing and knowledge acquisition will be more successful in a context that provides positive feelings and successful experiences. To count mistakes and insist on how bad a student behaves cannot be as

successful as a positive feedback and the experience that something has been achieved. (Gruhn, 2004, pp. 3-4)

Collins recognised in 2013 the profound importance of emotions at every level of the learning process that she declares: « This new view of the music-processing sequence has influenced my concepts of curriculum design and strengthened the need to reference meaning and emotion at every point of the process » (p. 228).

I cannot finish this section about learning context without also discussing the subject of lifestyle. The teacher, researcher and literature already written on this subject agree on the importance of maintaining a healthy lifestyle. As displayed in the interviews, sleep plays a valuable role in the consolidation of memory, and physical exercise influences directly the structure of the brain by creating new neurons:

Emerging new research in animals suggests that physical exercise may boost brain function and increase learning. Mice who had access to a running wheel over a period of six weeks became better at learning than sedentary mice who had no wheel (van Praag, Christie, Sejnowski & Gage, 1999). The number of brain cells in the hippocampus (one of the brain regions responsible for learning and memory) of the mice who had wheels was almost double the number in the inactive mice. (Blakemore & Frith, 2005, p. 464)

Thus, it might be important to make sure our « body-machine » functions normally, or even at its best, before even questioning the different teaching strategies we may use to enhance learning.

Below is a figure which summarises the themes discussed in this chapter:



## 7 FINAL REFLECTIONS

This concluding chapter will discuss first the limitations of the present study encountered while offering some suggestions and avenues for future research. For a second time, I will explain how the lens of neuroscience shaped this inquiry and how it contributed in answering the research aim and questions. Finally, I will present some examples of how to apply some of these « neuro-based » teaching strategies to the viola.

### 7.1 Limitations of the study and avenues for future research

During the realisation of this study, I faced some limitations on different levels. First, the inquiry was limited to the teacher I could observe and the researcher I interviewed. The project would have benefited from having a richer spectrum of interactions and observations with, for example, several viola teachers and neuroscientists so I could interview and/or follow in their laboratories. The observations

were also restrained to higher education students. Future developments could include every age, level and type of institution (academies, conservatories, music schools, private teaching). Besides, the study was also limited by the musical genre. Both teacher and students possess a traditional classical background, even if the teacher is heavily promoting improvisation in various forms. It might be interesting to see how instrument teachers from other backgrounds (jazz viola, folk strings, etc...) teach and if they use similar approaches as the classical music teachers. Another limitation was my own lack of expertise in the scientific field. I obviously researched extensively the subject in order to understand the main ideas but this specific subject would have benefited greatly if I could have investigated more deeply in the details of brain imagery and chemical reactions. However, the time and material needed for this kind of research is beyond the scope of this paper.

One way of developing this work would be to have access to labs and brain measuring systems to be able to test in real conditions how students and teachers respond to the different techniques and what is happening in their brain while they do the exercises. To take the topic of this study even further, I could spend more time looking at the specificities of the viola playing and ways of applying the aforementioned approaches to enhance viola learning. This project could lead to a booklet full of tips and exercises tailored for violists. I could even imagine one booklet to guide the student's practice and one booklet to guide the professor's teaching. Another interesting question connected to the subject would be to research if all musicians process music the same way depending on their instrument. For example, does a pianist process music in the same way as a musician of a melodic instrument like the flute? And if not which teaching designs are more appropriate for one or the other? As we saw in the theoretical chapter, neuroplasticity is an important phenomena happening in our brain that allows us to learn. Nowadays some companies have created headphones which prime the brain, make it « elastic » and enhance learning for one hour. It would be interesting to see if such external elements can really influence positively our learning over the long term. Finally, to keep practicing and improving as the results of this study showed, a student needs motivation. The researcher I interviewed revealed there are actually very few studies done on motivation. One way of pressing forward the research done around



music education would be to look for what influences motivation and which strategies can a teacher use to keep it alive.

## **7.2 Science, an ally of the arts**

Education is a broad subject, and many theorists have contributed in making this field what it is today. Many approaches would have been relevant to address in this study. Nonetheless, neuroscience has uniquely shaped the input and vision of this work. It allowed us to collect precise information and understand what is happening in the brain when we learn something. This neuroscience lens is also different from other theories related to education in the sense that it is quite a new field of study. It is a new but very popular discipline, which means a lot is being invested in neuroscience research. Concerning our project, this means that there is a lot of data to collect, but also that the information we get is susceptible to change depending on the future science discoveries, many on which we still don't have enough information to draw conclusions. Nevertheless, neuroscience helped us to discover some teaching strategies which are based on our natural functioning and thus, enhance our learning process. This study presented teachers describing their work and teaching as multilayered and multifaceted, involving most, if not all, of their being. Movement, emotion and imagination are intertwined to achieve the best quality while playing/teaching. This study showed how much multisensory approaches are essential and yield good results while it is crucial to also verbalise sensations, analyse and ask questions in order to understand more deeply the concepts we are trying to learn. This kind of analysis loop or feedback can happen in interaction with the teacher, but the student alone can also, by practicing this skill, become more autonomous. Furthermore, agency and developing a personal artistic identity and sensitivity can be seen as both a goal and a mean to the learning process. Finally, having a friendly and supportive environment to study is an important component of a successful educational path. Having supportive parents, friends, teachers, the possibility to access to « culture » (listen to music, go to concert, movies, theatre, visual arts...), a life-style which is in balance with the needs of the brain, staying motivated are factors influencing the instrument learning outcomes.

I think at this point, we should not forget that learning is a holistic process and concept.

In 2009, Jarvis describes:

Human learning is the combination of processes throughout a lifetime whereby the whole person – body (genetic, physical and biological) and mind (knowledge, skills, attitudes, values, emotions, beliefs and senses) – experiences social situations, the perceived content of which is then transformed cognitively, emotively or practically (or through any combination) and integrated into the individual person's biography resulting in a continually changing (or more experienced) person. (p. 25)

Acknowledging this fact should bring us to reflect on our teaching approach and pursue strategies, which consider in their entirety these human-beings that are our students.

When placing this study in its larger context which is string instrument pedagogy, I realise that the results of this project do not come as an epiphany or revolution. Actually, as Flohr says, « Research often confirms what experienced teachers find useful » (2009, p. 16), and many of the concepts highlighted by this research have been part of the teachers « toolbox » for a while. However, stringed instruments come from many different traditions, including old renown schools with effective but sometimes rather « dusty » approaches. I hope this paper could suggest some ideas to refresh the way we practice and teach. I hope it also develops creativity in our teaching and inspires teachers to renew their strategies.

### **7.3 And the viola in all this?**

The outcomes of this study have given us some interesting insights and suggestions concerning music learning. Music teachers will benefit from integrating them into their teaching; the beauty is they work for every instrument or discipline! Indeed, using multisensory approaches or imagery for instance, are tools which can improve without differentiating the subject as they are based on global concepts of how the brain works. The brain remains the same whether we learn music, guitar, saxophone, kung fu, or languages. Some books like *Quality practice* by Susan Williams or the website *From Potential to Performance, Practicing tips for musicians* are addressed to any musician without distinction and discuss about how to practice while giving

wonderful concrete tips. As a viola player, I asked myself what made the viola different from other instruments. I wondered what is essential and different in the technique and if I could approach these points from the different themes we discussed. We can see quite easily how we can use these different neuro-based tools to enhance musicality, creativity and memory, but I wondered if I could use them to help with the technical challenges of my instrument.

The most distinctive trait of the viola is probably its sound and timbre. Between the violin and cello, the proportions of the viola are false and compromised. Indeed this instrument would need to be much larger in order to resonate at its best, making it impossible to play. As a result, the sound of the viola failing to resonate perfectly, appears to many as a much more human sound. The timbre is deep and velvety, with a « je ne sais quoi » so distinctive. Achieving a beautiful tone is one of the aspects that viola players spend the most time on. Even if we want the different strings to be balanced and coordinated between themselves, each string has its proper colour and life, in the same way that each position with the fingers brings a different colour. For instance, string players know that playing the same note in first or third position will result in a different shade, with the third position giving a much more *dolce* sound. In order to discover these subtleties of the instrument and to be able to manipulate them, we can use our senses to feel these differences. For example, the viola player could play slowly string per string the notes available in the first position and ask himself: how does it feel ?, where did I feel the sound resonate in my body? My neck? My chest? Under my fingers? How did it sound? What were the properties of the sound? After this analysis, the player could verbalise and illustrate these feelings by using descriptive adjectives: the C string was very dark, like dark red, almost brown, the E first finger on D string was lighter, but still very round, etc... Remember that even if there are some common traits to all violas, the sound coming out of your viola is unique, as will your own adjectives to describe it. Once you have a good idea of how each string sounds, you could try to draw or paint what this string represents for you. You don't need to be a good drawer! The point of this exercise is just to make explicit for yourself the meaning of a particular sound and provide to your brain in different ways so as to remember it. Following the same idea, we could also imagine you would find a smell or taste

associated with these sounds. Once you are confident with the timbre of each string, you could use the same process to explore other positions. Knowing your instrument and its physical properties is important. However, a good player is one who is able to shape the sound the way he wants despite the natural tendencies of his instrument. So after doing this little exploration, the viola player could try to play, for example, in the first position but with a sound of the third position. To do so, we just have to remember the attributes and images we associated with the 3rd position and imagine doing the same while playing in the 1st position.

The viola occupies in most chamber music and orchestra works a specific central place. Forgive my directness, but to schematise the role of the different strings, the violin often plays the melody and the base section (cello, double-bass), insures the harmonic base of the piece. The viola is somewhere in between, filling most of the time the different harmonic chords. This place, far from being the « leftovers » of the music, gives the viola player a very privileged position by having in its parts, the notes creating the harmonic tensions and releases that the music requires. It is thus very important violists understand the function of the notes they are playing, and with each function comes a colour. The player who would like to improve its harmonic sensibility could use the techniques described earlier about the colour produced by the different strings and position and apply it to a tonal, modal or atonal context. For instance, the F# in F# minor or in G major does not have the same colour, and even within the same tonality (G major for example), F# does not have the same feeling whether it is preceding, following, or simultaneously played with another note of the scale. It is also different if the same F# is played against C, D, or E... The viola player would gain a lot by using tools which enable him to feel clearly the colours of each note and harmony. As we discussed in the theory chapter, improvisation is a way to enhance learning, and in this situation, the viola player could improvise freely on a certain scale or tonal reference, to explore the different colours and relationships between the notes of this scale. The violist could even choose a note and play it as a drone (with an electronic device or a friend who plays that note) and see how the other notes of the scale feel in regard to the drone.

Another crucial point of the viola technique is shiftings. The other string instruments also have to practice this same aspect but cellists and double-bassists hold their instrument in a totally different way, which is why I won't compare the techniques. However, between violin and viola the gesture is almost the same. The big difference though lies in the fact violas do not have a standard size and are bigger than violins, which means in a world where the smallest movement makes a difference in the playing and the sound, the viola player has to adapt his movements to the instrument he is playing. The body of the instrument might hinder the movement the player is doing while shifting. It appears then essential that the viola player knows and feels exactly the « route » he has to take to achieve perfectly his shift. A first step could be to be really conscious of the size and shape of his instrument. You could look at it: are the « ears » of your viola big? Is the neck thin? Thick? Place your four fingers on a string but don't press them down, keep simply the touch you would have to play a flageolet. Then, slide very slowly up and down along on this string. Don't lift your fingers, but rather keep a gentle touch on the string with all your fingers. Imagine you are following a rail, and you are blind so you can't get away from the string because you would get lost. Observe what movement your arm is doing when you slide up and down in order to go around the viola edges. Repeat on all the strings slowly so that you have time to embody this feeling. A shift is about accuracy. We want to go from one note perfectly in tune to another note perfectly in tune and to do so, again, the route we are taking is very important. Feeling the distance between these two notes is necessary. There are a few tricks which can help us in this matter. Remember, doing the same thing but in different ways helps the brain to understand better and to succeed in the task we want to achieve. So before playing your shift, sing it. Sing the interval as a lyric singer would do and feel the slide your voice and vocal cords have to do in order to reach the next note. Repeat until the sound and motion are smooth. You can also dance this movement so as to feel this distance. You can move your arms away and towards your body, shift from one foot to another or slide with your feet on the side... The possibilities are infinite and combined together they will help you to have a strong sense of the shifts you are practicing on the viola.

Another challenging technical point is playing fast passages. This difficulty is far from being exclusive to the viola but in this matter, I found it useful to draw inspiration from neuroscience but also from other instrument techniques. First, it is not because the music is fast that you have to practice fast. The brain needs time and repetitions. So practice the passage by small bits, even just one bar, slowly, focusing on the sensation of your body. Then, wait a few seconds while being focused on the task before trying again so that the brain may have sufficient time to process the information it just got. Look for patterns in the music. There is nothing more discouraging than looking at lines of fast notes which do not seem to have any meaning or to be organised. So, take the time to look for some similarities, or fingering patterns. While increasing the tempo, you can focus your attention on the sensation you get in your fingers rather than trying to control every note with your mind. There will be a tempo where it will be too fast to keep a perfect control of everything, you have to let go, and focus on concrete physical sensation may help to do so. Here is a little personal advice. There are several technique schools and they all have their pros and cons, the aim here is not to debate about these, but pick any tip which could be helpful with no regard to which school it is coming from. So actually the advice which helps me to play fast passages came from a pianist relaying on the « Liszt method ». He would « grip » the piano keys with a circular movement of the fingers coming towards him. It is a very small movement. He was not just letting his fingers fall on the keys but he was « dragging » them with the flesh of his fingers. This was giving him a beautiful legato but to my surprise, it was very helpful also in the fast passages. Of course, the movement in these prestissimo passages was much smaller but the idea behind the gesture was the same: not just lifting vertically the finger, but dragging it a little bit. I tried to apply this technique to the viola and it improved my velocity. So while playing fast, when I am putting my fingers on the string, I focus on the sensation of the contact between my finger and the string, and when I lift my fingers, I lift them while plugging slightly the string through a circular motion of the finger. It is almost imperceptible and you cannot hear it but personally I feel it much easier. Everything in our body is round, no body part movement goes in a perfect straight shape or line. It seems logical that we could

achieve ease while doing a slightly rounded motion than with fingers hammering vertically the fingerboard.

We saw the brain respond very well and quickly to auto-suggestions. Why not use this to our advantage? We can even trick our brain! For example, we spoke about the size of the viola which can be sometimes a bit problematic, everything is a bit too big, a bit too heavy, a bit too slow to respond... But what if we consciously tell ourselves the opposite? When facing a difficult passage with big stretches in the fingers, why not try to think: this is such a soft passage, it is so creamy and light at the same time! It is not about lying or changing the character of the music, but maybe by orientating your thoughts a certain way, you will be able to improve a passage you would have had psychological blockages about. So, to viola players reading this chapter, here is the beginning of a list you could put above your music stand:

- Use as many senses as you can
- Improvise, it is fun and very effective!
- Look for patterns
- Don't hesitate to verbalise, find images, and give yourself feedback about your sensations
- Be curious and explore what you like and what keeps you motivated!

There is a lot we can do with these techniques and approaches. This advice does not have pretension to be exhaustive or absolute. My goal is simply to give some examples of how we can use neuroscience to guide our instrumental teaching and practice. This paper is an invitation to use your creativity and to try and find what works for you and your students. We are all grown-up children and exploring is very often a fun part! Whether it is specific to viola players or whether it applies to every musician, the brain based strategies can help us practice more efficiently and maybe even reach more easily our goals. They can provide new thoughts and creative ways of learning. Creativity is one thing that can keep us motivated, and motivation as we saw is essential in order to improve any skill.

During this study, even if the anchor and guideline was the viola playing, I was pleasantly surprised to find how much we can learn from other instruments. Good pedagogues are good independently of their main subject, and it is fascinating to see how transferable the knowledge is from one discipline to another. While I witnessed the learning process of other persons and I recovered the intimate thoughts of my interviewees, I realised this study was invoking a change also in me. As Fontana and Frey described in 1994,

Also in learning about the other we learn about the self (Crapanzano, 1980). That is we treat the other as a human being, we can no longer remain objective, faceless interviewers, but become human beings and must disclose ourselves, learning about ourselves as we try to learn about the other. (pp. 373-374)

Thus, I started questioning even more my teaching, experimenting new things on my poor students looking at me with big eyes saying « why are you making us do this silly thing? ». But, the biggest change happened in me, in my practice, in the way I relate to music and my instrument. Writing about teaching strategies set me free from some blockages I had in my playing. I am truly glad it happened that way because I realised before trying to initiate change, it was important that I change first.



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## APPENDICES

### I. Template of the consent forms

I wrote three different consent forms depending of who I was addressing myself to: one for the teacher, one for the students and one for the researcher.

The body of the consent form remain the same but the introduction and the description of the study procedures might differ.

You will find as Appendix I the template of the consent form, whereas you can find below the text that differs from one consent form to another.

#### For the teacher:

Introduction:

- You are being asked to be in a research study about neuroscience related to music teaching.
- You were selected as a possible participant because you are a music teacher who is very interested and active in searching creative ways of learning/teaching/practicing.

Description of the study procedures:

- If you agree to be in this study, you will be asked to do the following things: 1) allowing me to observe your lessons and notate any interesting exercises or ways of being/teaching that I will find relevant for the study. I would like to observe individual lessons with a maximum of 5 different students and 1 group lesson. 2) answering questions under the form of an interview or more informal conversation. 3) allowing me to video tape some parts of the lessons.

#### For the students:

Introduction:

- You are being asked to be in a research study about neuroscience related to music teaching.
- You were selected as a possible participant because you are studying music.

Description of the study procedures:

Idem

For the researcher:

Introduction:

- You are being asked to be in a research study about neuroscience related to music teaching.
- You were selected as a possible participant because you are a specialist in neuroscience and music pedagogy.

Description of the study procedures:

- If you agree to be in this study, you will be asked to do the following things: 1) answering questions under the form of an interview 2) allowing me to record the interview and take notes.

## Consent to Participate in a Research Study

**Working Title of Study:**

**Instrumental teaching methods based on neuroscience**

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**Investigators:**

<b>Name:</b>	Laure RAMON	<b>Dept:</b>	String Instruments in the classical dept of Sibelius Academy
<b>Phone:</b>		<b>Email address:</b>	laure.ramon@unlarts.fi

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### Introduction

- You are being asked to be in a research study about neuroscience related to music teaching.
- You were selected as a possible participant because you are a specialist in neuroscience and music pedagogy.
- I ask that you read this form and ask any questions that you may have before agreeing to be in the study.

### Purpose of Study

- The purpose of the study is to see how findings in neurology can help us to create better methods for strings players, especially violists.
- Ultimately, this research will be published as part of my final master thesis.

### Description of the Study Procedures

- If you agree to be in this study, you will be asked to do the following things: 1) answering questions under the form of an interview 2) allowing me to record the interview and take notes.

### Risks/Discomforts of Being in this Study

- There are no reasonable foreseeable (or expected) risks. There may be unknown risks.



**Benefits of Being in the Study**

- I hope this study will help me to create or collect teaching methods and tools helping students to learn efficiently and naturally.

**Confidentiality**

- This study aims to be anonymous. I will not be collecting or retaining any information about your identity or the students identity. The records of this study will be kept strictly confidential. Research records will be kept in a locked file. If video tape recordings are made, I will be the only one to have access to them and they will be erased from my computer once my master thesis will be officially published.

**Payments**

- You will not receive any payment/reimbursement for participating to the study.

**Right to Refuse or Withdraw**

- The decision to participate in this study is entirely up to you. You may refuse to take part in the study *at any time* without affecting your relationship with the investigator of this study or Sibelius Academy. Your decision will not result in any loss or benefits to which you are otherwise entitled. You have the right not to answer any single question, as well as to withdraw completely from the observation or interview at any point during the process; additionally, you have the right to request that the investigator not use any of the material.

**Right to Ask Questions and Report Concerns**

- You have the right to ask questions about this research study and to have those questions answered by me before, during or after the research. If you have any further questions about the study, at any time feel free to contact me, Laure Ramon at [laure.ramon@uniarts.fi](mailto:laure.ramon@uniarts.fi) or by telephone at xxxxxxxxxx. If you like, a summary of the results of the study will be sent to you.

- If you have any other concerns about your rights as a research participant that have not been answered by the investigators, you may contact Danielle Treacy, Seminar and Written Work instructor, Sibelius Academy, University of the Arts Helsinki at [danielle.treacy@uniarts.fi](mailto:danielle.treacy@uniarts.fi).
- If you have any problems or concerns that occur as a result of your participation, you can report them to Danielle Treacy at the e-mail address above.

### Consent

- Your signature below indicates that you have decided to volunteer as a research participant for this study, and that you have read and understood the information provided above. You will be given a signed and dated copy of this form to keep, along with any other printed materials deemed necessary by the study investigators.

Subject's Name (print): \_\_\_\_\_

Subject's Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Investigator's \_\_\_\_\_

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

## II. Interviews guide:

Preview of the questions asked to the researcher:

1. Learning an instrument is a very large and never ending task but we can maybe isolate different components such as motor function, ear training, memory and emotional involvement.

What would be your advice based on neuroscience fact in order to enhance each of these categories.

*During the interview I asked then more about sleep: is it so that we need a full night of sleep to fix these skills that we learned or it is enough if as you said for example, the morning I am waking up, I am going jogging, I learned a new piece on the viola and then I take a nap. Is it enough?*

2. Some researches say we can help students to learn better academic skills (mathematics, language...) with music as an helper. Do you think we can draw from these subjects to help music learning? Using for example mathematics competences?

3. Is there something very new in the field of neuroscience that could change everything in the way we perceive learning?

(For example I was this february 2020 in a class in Duke university NC, USA and the neuroscience group argued the existence of the working memory)

*During the interview in regard of the answer, I changed then my question to: when we are speaking about learning process, what was the discovery that was the most important for you?*

4. Do you think learning music requires different competences or happens differently than other kind of learning in the brain?

5. What is for you, if you had to choose just one, the biggest asset when it comes to learning in general, and music particularly?

6. Any other thoughts you would like to share?

Preview of the questions asked to the music teacher:

1. What is teaching music for you? What does it mean?

2. In general, what makes a good teaching?

*During the interview, I asked More about imitation, if she thought imitation was still useful, if it is more for a certain type of students?*

3. What is important for you when you teach?

4. How do we learn something? According to your experience, what do we have to do in order to learn?

5. In your opinion, which attitudes, exercises or methods help induce an efficient learning for the student?

6: We know a big part of learning something is being able to remember the skill we just learned. Do you have any tips to help the memory?

7. Did you try for yourself to research about neuroscience and adapt your teaching accordingly to what you found? If not, on what do you base it on?

8. Any other thoughts you would like to share?

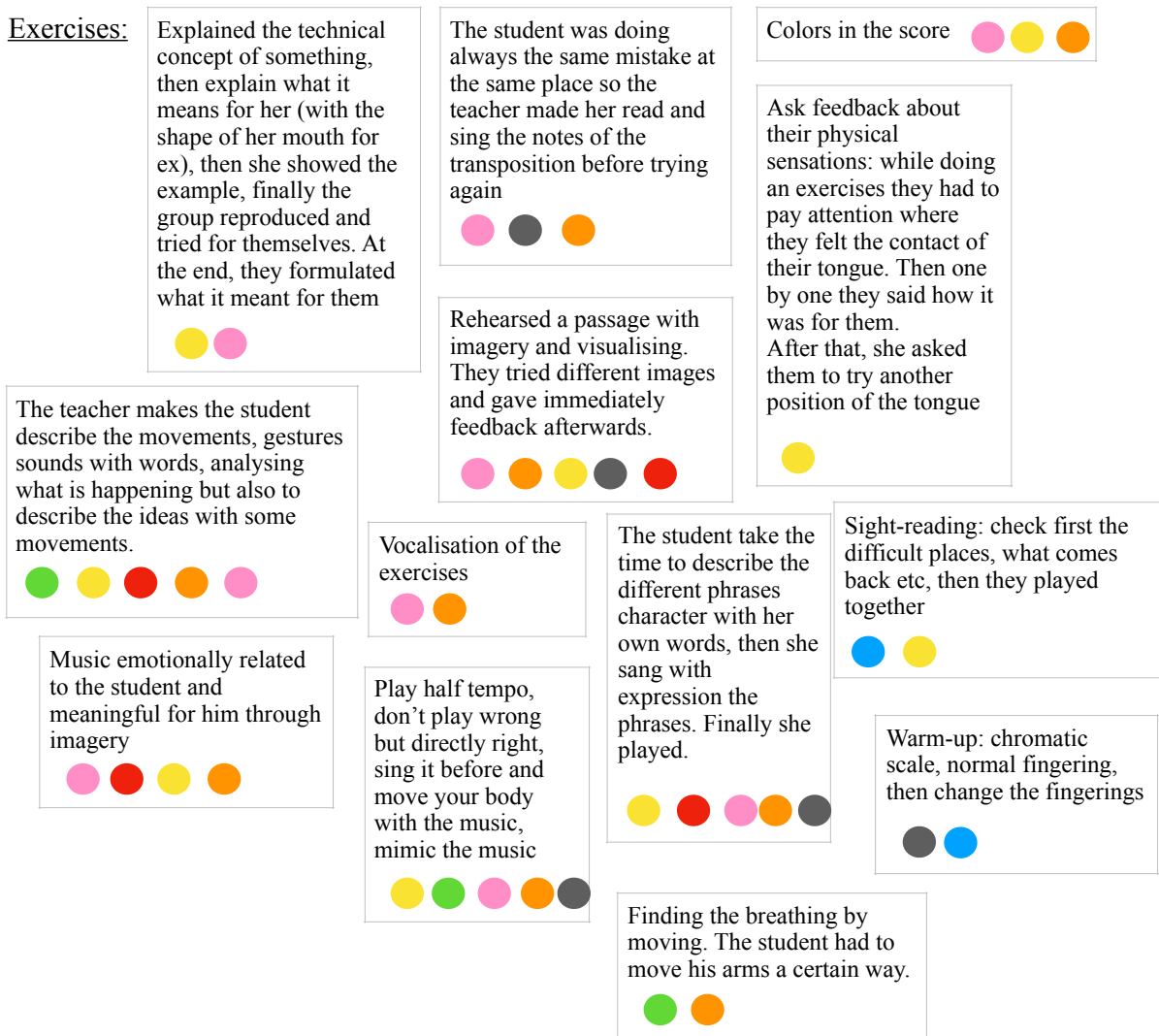
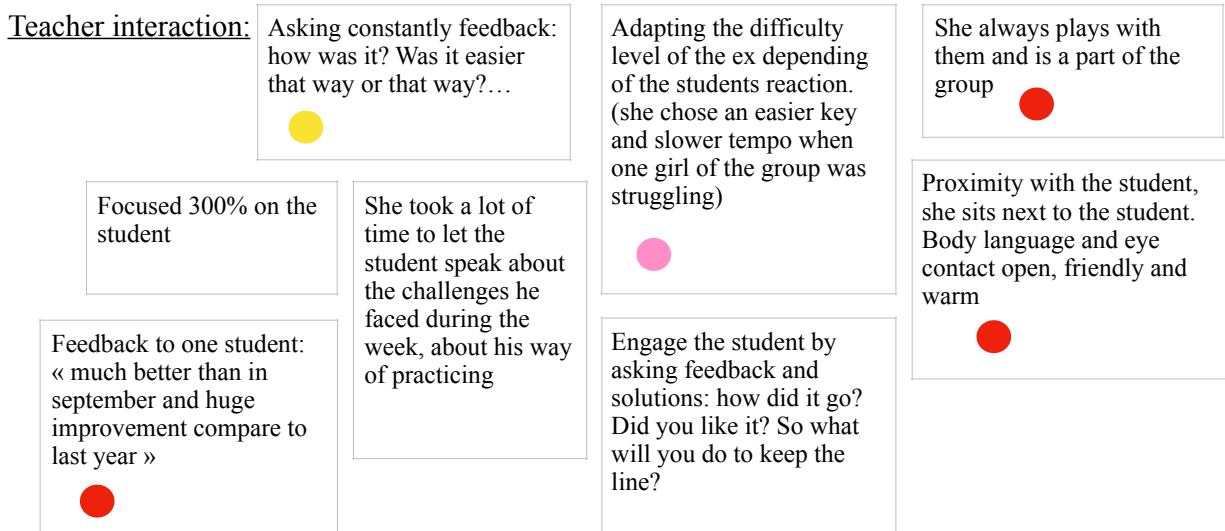
### III. Observations guide

- How the teacher interacts (choose of words, attitudes)
- Emotional level (atmosphere of the lesson/class, emotional attachment to a music piece...)
- Movement and space ( topic around body movement, exercises implying movement, space used, how students are encouraged to move or not, containing or inducing energy...)
- How much space is left for repetition?
- How and how much meaning is put into the exercises and practice?
- Good exercises and tips that the teacher gave
- Are the lessons versatile, multisensory, using different approaches?
- is the teacher using an holistic approach?
- Is the teacher enlightening certain pattern in the music to make it more understandable and underline a global structure?
- Anything else relevant?

#### IV. Encoded Data from the observations

For practical reasons, I associated the theme to a short key title to which I associated with a colour:

How much space is left for repetition?	Repetition	
Mouvement and space ( topic around body movement, exercices implying movement, space used, how students are encouraged to move or not, containing or inducing energy...)	Movement	
Emotional level (atmosphere of the lesson/class, emotional attachment to a music piece...)	Emotions	
How and how much meaning is put into the exercices and practice?	Meaning	
Are the lessons versatile, multisensory, using different approaches?	Versatility	
Is the teacher using or an holistic approach?	Holistic approach	
Is the teacher enlightening certain pattern in the music to make it more understandable and underline a global structure?	Pattern detector	



Other:

Association of different senses:  
The teacher gestures the music to guide the student while he plays



She gave advices on how to organise the homework: practice one exercise, and read a 2nd one, to facilitate next week work. So install a rotation in your work from one week to another, with one piece you work on, and one piece you begin to think of.

Lots of repetitions for each exercise



Review what has been done: « you had a masterclass, what did you learn? »

She used external tools to help/guide the student position (put a little bag of grains on the head of the student)



Constant loop between playing/analysing what happened/repeat



She took time to explain how the learning process happens in the brain until habits become automatic « we need time for the body to understand »

