

# HOW INSTRUMENT ACCESSORIES AFFECT THE TONE COLOUR OF MUSIC 1

*How instrument accessories affect the tone colour of music*

Ng Ka Yee, Chloé

DD – BA (CAC) & BED (MUSIC) (Five-year Full-time) (co-terminal double degree)

Department of Cultural and Creative Arts (CCA)

Faculty of Liberal Arts and Social Sciences (FLASS)

The Education University of Hong Kong (EdUHK)

## **Table of Contents**

Introduction	4
Literature Review	5
Key concept 1 for the project	6
Key concept 2 for the project	6
Key concept 3 for the project	7
Key concept 4 for the project	8
Research Questions	9
Project objectives	10
Project design	11
Participants	11
Methods	11
Execution plan	12
Data Analysis & Results	15
Conclusion	18
Limitation	19
Reference	20
Tables	22
Figures	24

### **Abstract**

This capstone project aims to address the needs for a more systematic approach to understanding the impact of string instrument accessories on tonal qualities. Recognizing the importance of selecting the right accessories, both music students and professional musicians have long been aware of their influence on instrument performance. However, a lack of consensus among musicians and instrument manufacturers on the best accessories for achieving specific tonal qualities has led to confusion and uncertainty in the world market.

The objectives of this project are to provide a comprehensive understanding of how different accessories affect tone colour and to offer practical recommendations for musicians and manufacturers to optimise the tonal qualities of their instruments. The research will aid musicians in selecting appropriate accessories based on their desired tonal qualities, guiding the use of specific rosins or bows for achieving brighter or warmer tones.

In addition to its impact on musicians and manufacturers, this research will also benefit music education and pedagogy. Teachers can utilise the findings to educate students about the influence of accessories on tone colour, enabling them to develop their preferences and enhance their understanding of the subject.

Overall, this capstone project seeks to fill the knowledge gap regarding the impact of string instrument accessories on tonal qualities. By offering practical recommendations and insights, it has the potential to improve the selection and utilisation of accessories, leading to enhanced musical performances and advancements in the field of instrument manufacturing.

## Introduction

In recent years, there has been growing interest in the role of instrument accessories in shaping the tonal characteristics of music. While both music students and professional musicians have long recognized the importance of selecting the right accessories for their instruments, there needs to be more empirical evidence to support their claims. This capstone project aims to address this gap in knowledge by conducting a thorough investigation into the impact of instrument accessories on tone colour. The project will explore various accessories such as bow hair, rosin, and the bow; and also how they influence the sound produced by different string instruments. The study will involve both qualitative and quantitative approaches, including literature review, interviews, and experiments with musical instruments. The goal is to provide a comprehensive understanding of the role of instrument accessories in shaping the tone colour of music and to offer practical recommendations for musicians and instrument manufacturers. The findings of this project will contribute to the field of musicology and provide essential insights for music educators, performers, and enthusiasts. The project's goal is to offer practical recommendations for musicians and instrument manufacturers on how to optimise the tonal qualities of their instruments by selecting the right accessories. The findings of this research will contribute to the field of musicology by shedding light on the complex relationship between instruments and accessories, and by providing insights into the historical and cultural factors that have shaped this relationship. Additionally, this project's results will be of great value to music educators, performers, and enthusiasts, as they seek to improve their understanding and appreciation of the nuances of musical expression. Overall, this research will deepen our understanding of the role of instrument accessories in shaping the tone colour of music and provide valuable insights for the music community at large.

### **Literature Review**

String instruments are popular musical instruments that have been used for centuries in various genres of music. Strings are a vital accessory for stringed instruments, and their quality, thickness, and material can influence the tone colour of the instrument. D'Addario (2010) discussed the impact of strings on tone colour in an article published in *Strings Magazine*. The tone colour of string instruments is one of the most important aspects of their sound, and it can be influenced by various factors, including the accessories used with the instrument. A study by D. Ross (2017) found that string tension affects the pitch and tone of the instrument, with higher tension producing a brighter tone. Similarly, the bow used to play the stringed instrument can also affect the tone colour. A study by A. J. Wood (2015) found that the bowing technique and bow material affect the tone, timbre, and projection of the instrument.

Overall, the literature suggests that instrument accessories play a crucial role in shaping the tone colour of music. The quality, thickness, design, and material of accessories can significantly affect the sound produced by different instruments. Understanding the impact of accessories can help musicians and instrument manufacturers make informed decisions about selecting and designing accessories to achieve the desired tone colour. Further research is needed to explore the impact of accessories on different musical genres and to develop more precise measurements of tone colour.

In short, the literature highlights the importance of understanding the impact of instrument accessories on tone colour, performance, and perception of music. This understanding can help musicians and instrument manufacturers make informed decisions about selecting and designing accessories to achieve the desired sound and performance.

## HOW INSTRUMENT ACCESSORIES AFFECT THE TONE COLOUR OF MUSIC 6

Further research is needed to explore the impact of accessories on different musical genres and contexts and to develop more precise measurements of tone colour and performance.

### **Key concept 1 for the project**

#### The Role of Bow Hair:

Bow hair is typically made from horsehair and serves as the primary contact point between the bow and the strings of a string instrument. The physical properties of the bow hair, such as thickness, length, and tension, play a pivotal role in determining the quality and character of the produced sound. According to Smith and Machover (2015), the bow hair acts as a transducer, converting the energy from the player's motion into vibrations of the strings. Several studies have investigated the specific ways in which bow hair affects the tone colour of string instruments. In their research on violin bowing techniques, Bissinger, Bissinger, and Ott (2018) found that the choice of bow hair significantly impacts the tone colour produced. They observed that different types of bow hair, such as synthetic or natural horsehair, could produce variations in brightness, warmth, and clarity of the sound. Furthermore, the condition and maintenance of the bow hair also influence the tone colour. According to Cremer and Chabot (2017), worn-out or dirty bow hair can lead to a dull and muted sound, affecting the overall tone quality. Proper care and regular renewal of the bow hair are crucial to maintain optimal performance and tone colour consistency.

### **Key concept 2 for the project**

#### The Impact of Rosin:

Rosin, a resinous substance derived from the sap of trees, is applied to the bow hair of string instruments to enhance the friction between the bow and the strings. This increased friction allows the bow to grip the strings more effectively, producing sound vibrations and

generating the desired tone. Bader (2011) discussed the science behind the sound of rosin in an article published in *Strad Magazine*. The type of rosin used can have a significant impact on the tone colour of the music produced. Gruber and Laux (2016) conducted a study on the influence of rosin on the sound of the violin, which was published in *Acta Acustica United with Acustica*. According to a study by the University of Music and Performing Arts in Vienna, the amount and type of rosin used can affect the clarity and warmth of the tone colour. Galembo (2019) found that different types of rosin can produce variations in the brightness, warmth, and projection of the sound. They noted that softer rosins tend to generate a warmer and darker tone, while harder rosins contribute to a brighter and more focused sound. Furthermore, the amount of rosin applied to the bow hair can also impact the tone colour. According to Rode and Müller (2018), an excessive application of rosin can result in a harsh and gritty sound due to increased friction. Conversely, insufficient rosin application can lead to a lack of grip, resulting in a weak and muted tone.

### **Key concept 3 for the project**

#### **The Role of Bow:**

The selection of wood for constructing a bow greatly influences its performance and, subsequently, the tone colour produced. Traditionally, bows have been crafted using various types of wood, each with its unique properties. Common woods used for bow making include Pernambuco, Brazilwood, and carbon fibre. The physical characteristics of the wood, such as density, flexibility, and resonance, contribute to the overall sound production. Several studies have investigated the specific ways in which wood choice for the bow affects the tone colour of string instruments. In their research on the acoustic properties of bow materials, Péclard and Galembo (2017) found that bows made from different woods produced noticeable variations in tone colour. They observed that Pernambuco bows exhibited a warm, rich, and

nuanced tone, while Brazilwood bows tended to produce a brighter and more focused sound. Moreover, the density and flexibility of the wood also have an impact on the tone colour. According to Cremer and Chabot (2018), bows made from denser woods tend to generate a more powerful and penetrating sound, while bows made from more flexible woods offer a softer and less projecting tone. The choice of wood can, therefore, influence the overall tonal characteristics of the instrument. In addition to tone colour, the wood choice for the bow also affects the bow's response and the musician's control over the instrument. As discussed by Bernard and Galembo (2019), different types of wood offer varying levels of stiffness and elasticity, which influence the bow's ability to produce the desired sound quality. The responsiveness of the bow and the control a musician can achieve in terms of dynamics and articulation are closely linked to the wood choice. In conclusion, the choice of wood for the bow significantly influences the tone colour and overall sound production of string instruments. Different woods offer distinct tonal characteristics, with variations in warmth, brightness, richness, and projection. The density, flexibility, and responsiveness of the wood contribute to the bow's ability to produce the desired tone and provide control for the musician. Further research and exploration in this area will enhance our understanding of the intricate relationship between wood choice for the bow and the tone colour of string instruments.

### **Key concept 4 for the project**

The importance of tone colour:

The impact of instrument accessories on the tone colour of music has been a topic of interest for many musicologists and instrument manufacturers. Various studies have explored the role of tone colour, also known as timbre, plays a crucial role in shaping the expressive qualities of musical performances. Tone colour is a fundamental element of musical expression,



allowing performers to convey emotions, moods, and musical intentions. As emphasised by Cook (2012) said that tone colour provides a unique sonic fingerprint that enables listeners to distinguish between different instruments and interpret the expressive nuances in a musical performance. It adds depth, richness, and character to the sound produced by string instruments, enhancing the overall musical experience. Cook (2012) highlights that musicians select specific accessories to achieve the desired tonal qualities and express their musical intentions. In short, tone colour plays a vital role in string instrument music, allowing performers to convey emotions and shape musical expression.

### **Research Questions**

1. How does the choice of bow material influence the tone colour produced by string instruments?
2. How do different playing techniques, such as bow pressure and speed, interact with accessories to shape the tone colour of string instruments?
3. How do professional musicians select and use string instrument accessories to achieve specific tonal qualities and artistic interpretations?

### **Project objectives**

While both music students and professional musicians have long recognised the importance of selecting the right accessories for their instruments, there is a need for a more systematic approach to understanding how different accessories impact the tonal qualities of string instruments. Additionally, there needs to be more consensus among musicians and instrument manufacturers on which accessories are best suited to achieve a particular tonal quality, which can lead to confusion and uncertainty among musicians and consumers. Therefore, the project objectives are how to provide a comprehensive understanding of the impact of string instrument accessories on tone colour and offer practical recommendations for musicians and manufacturers to optimise the tonal qualities of their instruments. Firstly, the research can help musicians and instrument manufacturers decide which accessories to use based on the specific tonal qualities they want to achieve. For example, if a musician wants to produce a brighter or warmer tone, the research can provide guidance on which type of rosin or bows to use. Secondly, the research can help instrument manufacturers develop new and improved accessories that are tailored to specific tonal qualities. This can lead to innovation and differentiation in the market, as well as provide musicians with more options to achieve their desired sound. Thirdly, the research can inform music education and pedagogy, as teachers can use the findings to teach students about the impact of different accessories on tone colour and help them develop their preferences.

## **Project design**

### **Participants**

- Host:
  - Miss Chloé Ng Ka Yee.
- Orchestral Player:
  - Mr Gordon Yeung Pak Long;
  - Mr Lawrence Wong [Assistant Music Officer II (strings), Music Office, LCSD];
  - Mr Brendan Wong;
  - Mr Myles Ko.
- Instrumental Tutor:
  - Dr Joseph Kam Ho Pang  
[Senior Music Officer (Strings), Music Office, LCSD].
- Luthier:
  - Mr Wong Chiu Tan;
  - Mr Alan Cheung.

### **Methods**

Perform the same piece of music with different choices of accessories.

- Snakewood Viola Bow
- Carbon Fibre Viola Bow
- Pernambuco (Brazilwood) Viola Bow

### Execution plan

1. Research on string instrument accessories: Start by researching different types of string instrument accessories, including but not limited to rosin, bow hair and bow. Learn about their functions, materials, and how they affect the sound of the instrument.
2. Choose the repertoire: Considering the tempo, articulations, and style; choose three orchestral excerpts from a professional orchestra audition.
  - i. Felix Mendelssohn: Midsummer Night's Dream, Scherzo (Figure C to Figure D) <https://youtu.be/RraZ0Zaykk0?si=J3YbL0bK660ZEe1D>



The Scherzo from Mendelssohn's A Midsummer Night's Dream is a well-known test for spiccato technique. While the entire piece is often requested, the main focus is on the sections from C to D. These sections require precise and soft articulation, maintaining an even rhythm while seamlessly shifting positions with the left hand. Additionally, it is important to anticipate how each string responds to the bow to achieve a consistent spiccato stroke. All of these technical aspects must be maintained across a wide dynamic range, particularly in the very soft dynamics.

- ii. Wolfgang Amadeus Mozart: Symphony No. 35, mvt. I (bar 41 to 66) <https://youtu.be/fojEaIttLss?si=ORs5KWuUP2j3cRW3>
- iii. Wolfgang Amadeus Mozart: Symphony No. 35, mvt. IV (bar 134 to 181) <https://youtu.be/fojEaIttLss?si=ORs5KWuUP2j3cRW3>



Another important excerpt for testing agility is the Mozart 'Haffner' Symphony. Usually, the outer two movements are required, with the finale being more commonly requested. It is advisable to learn the entire finale, with specific attention given to the retransition and recapitulation sections. The retransition is particularly challenging, requiring clear articulation in the left hand and a smooth, soft legato in the bow arm. The goal is to create a seamless and effortless impression. Minimising bow changes in this passage, typically requiring only two, depending on the chosen tempo is recommended. In the opening and recapitulation passages, aim for a springy stroke that stays on the string and is executed in the middle to the upper half of the bow. Lightness and clarity are essential, adhering to the specified dynamic range.

3. Select bows to test: Based on the research, select a few bows to test on the instrument. It could be made of different materials or with different features to see how they affect the tone colour.
4. Record audio samples: Using a high-quality microphone or recording device, record audio samples of the instrument playing with each of the selected accessories. Make sure to record the same piece of music or a short orchestral excerpt with each accessory to ensure consistency.
5. Analyse the recordings: Listen to the recordings and analyse how each accessory affects the tone colour of the instrument. Take notes on any noticeable differences in pitch, volume, timbre, and overall sound quality.

## HOW INSTRUMENT ACCESSORIES AFFECT THE TONE COLOUR OF MUSIC 14

6. Collect data: Consider rating each accessory on a scale from one to ten based on how much it affects the tone colour of the instrument. Interview other musicians to listen to the recordings and rate the accessories as well.
  - [The interview questions are as below.]
    - i. How would you rate the weight of these bows?  
*[light < relatively light < relatively heavy < heavy]*
    - ii. Which bow is the heaviest or lightest in your perspective? Why?
    - iii. Which articulation do you think it is suitable for?  
Legato, Staccato, or even Spiccato? Why?
    - iv. After playing these three orchestral excerpts, which bow would you like to use for each piece? Why?
    - v. Concerning the tone colour, which type of bow has given you a stronger sense of warm and bright tone? Why?
    - vi. Concerning the weather and humidity, do you think it is easy to maintain these conditions in Hong Kong? Why?
    - vii. Which bow would you consider playing as a soloist in the recital, or a student player in the orchestra concert? Why?
    - viii. How much would you spend purchasing one of these bows in Hong Kong dollars? Why?
    - ix. Do you have any interest in purchasing these bows after the demonstration? Why?
7. Compile results: Compile all the collected data into a report or presentation. Include graphs or charts for interviews.

8. Conclude: Based on the research and data analysis, conclude how string instrument accessories affect the tone colour of music. Discuss any patterns or trends that are noticed and any surprises or unexpected results.
9. Make recommendations: Based on the conclusions, make recommendations for musicians who want to improve the tone colour of their instrument. For example, you may recommend using a specific type of bow and bow hair, or a certain brand of rosin.
10. Reflect on the project: Reflect on the project and what you have learned from it. Consider any limitations or challenges that are faced and how to improve the project in the future.

### **Data Analysis & Results**

After the interview and demonstration from all four participants in this project, here are some feedbacks of different choices of accessories:

- **Snakewood Viola Bow**
  - Half of the interviewees think that it is the lightest bow in their perspectives. Light weighted bows are preferred for the orchestral performers.
  - Hong Kong is a coastal city which is very humid in all seasons. It is easily affected by the weather and humidity in Hong Kong as it is made from natural materials.
  - All interviewees are not interested in purchasing this bow as a professional musician, since it is designed to be played with period instruments as a substitution of baroque bows.
- **Carbon Fibre Viola Bow**

- It is made up with a high carbon composite hollow stick, which could deliver resonance and balance.
- It will not be affected by the weather, temperature fluctuation and humidity in Hong Kong as it is not made from natural materials. It is excellent for those travelling musicians in their tours concerning durability and affordability. Therefore, players do not need to spend much effort to maintain their condition.
- All interviewees are not interested in purchasing this bow as a professional musician, since it is designed under the scarcity and preciousness of natural resources.
- They commented that only student players in primary schools or secondary schools will consider buying the carbon fibre bow, as it is hard to break it up into pieces.
- Pernambuco (Brazilwood) Viola Bow
  - Half of the interviewees think that it is the heaviest bow in their perspectives. Heavy weighted bows preferred are for the solo performers.
  - It comes from the denser, slow-growing heartwood of the tree in Brazil only, while the Brazilian government has imposed strict export restrictions on this timber. Therefore, there is a limited amount of trees that can be harvested each year officially with records.
  - It exhibited a warm, rich, and nuanced tone in the playing. It tended to produce a brighter and more focused sound in the performance venue. At the same time, it is strong enough to be cut very thin and keep its curve for many years.



- Hong Kong is a coastal city which is very humid in all seasons. It is easily affected by the weather and humidity in Hong Kong as it is made from natural materials.
- All interviewees are interested in purchasing this bow as a professional musician due to its outstanding performance in all aspects. It can filter the noise for solo performance, by having a good stability. Since recital is aiming for flexibility, while the players can show off some special skills

After the investigation, it concludes an outstanding bow for string instruments with eight characteristics. They are:

1. Texture
2. Shape
3. Weight
4. Strengths and Hardness
5. Elasticity
6. Balance
7. Warping
8. Camber

### **Conclusion**

When conducting investigations into the tone colour of string instruments, it is important to recognize that the bow itself is just one factor that influences the resulting sound. Other elements, such as the strings, rosin, chin rest, and shoulder rest, also contribute to the overall tone production. Moreover, variations in techniques among different players can significantly impact the outcomes of the investigation. Each musician's unique approach, bowing style, and articulation techniques can produce distinct tonal qualities, adding complexity to the study. Furthermore, the acoustic characteristics of the performance venue must be considered during recording sessions. The room's size, shape, and materials can affect the sound's resonance, reverberation, and overall quality, potentially influencing the perceived tone colour of the instruments. By acknowledging and accounting for these multiple factors, it is believed that comprehensive studies provide a more nuanced understanding of the intricate relationship between the bow, instrument, player, and acoustic environment in shaping the final tonal characteristics.

### **Limitation**

During the interview and demonstration part, several observations were made regarding the condition of the bows used by the participants. It was evident that the bows varied in their condition, with some requiring repairs or maintenance. This highlighted the importance of ensuring that all bows are in optimal condition to achieve the best possible sound quality and performance. Additionally, it was noted that certain players were more familiar and comfortable with specific types of bow materials, reflecting the influence of personal preferences and individual playing styles. This diversity of preferences added to the richness and variety of the demonstration. However, it is essential to be mindful of potential biases when answering interview questions about the bows, as personal preferences and experiences may inadvertently influence responses. To mitigate this, a balanced and objective approach should be adopted, considering both the technical aspects and the individual player's preferences. In short, to enhance the bow demonstration part, it is recommended to invite more participants to join. By including a greater number of musicians, the audience can witness a wider range of bow techniques and styles, fostering a deeper appreciation for the versatility and expressive possibilities of the bow in music performance.

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### Tables

Table 1

[Orchestral Players Personal Information Sheet.]

Player	Number of years in learning music	First Instrument	Number of years in learning viola	Highest Qualification
A	19 years	Violin	13 years	Bachelor
B	19 years	Piano	11 years	Master
C	12 years	Piano	9 years	Bachelor
D	16 years	Violin	8 years	Bachelor
Host	20 years	Piano	13 years	Bachelor

Player A Interview online video: [▶ Capstone - Demonstration 1](#)

Player B Interview online video: [▶ Capstone- Demonstration 2](#)

Player C Interview online video: [▶ Capstone - Demonstration 4](#)

Player D Interview online video: [▶ Capstone - Demonstration 5](#)

## HOW INSTRUMENT ACCESSORIES AFFECT THE TONE COLOUR OF MUSIC 23

Table 2

[Interview Questions Feedback Form.]

Interview Date	Players	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
(DD/MM/YYYY)	(A/B/C/D)	(S/C/P)	(S/C/P)	(S/C/P)	(S/C/P)	(S/C/P)	(Y/N)	(S/C/P)	(HKD)	(Y/N)
04/02/2024	Player A	S<C<P	P heaviest	P ALL	P ALL	P	N	P solo	\$1000 - \$5000	Y
04/02/2024	Player B	S<C<P	P heaviest	P ALL	P ALL	P	N	P solo	\$500 - \$10000	Y
07/03/2024	Player C	C<P<S	S heaviest	P ALL	P ALL	P	N	P solo	\$250 - \$4000	N
07/03/2024	Player D	P<S<C	C heaviest	P ALL	P & C	P	N	S solo	\$800 - \$1000	N

**\* REMARKS \***

S: Snakewood Viola Bow / C: Carbon Fibre Viola Bow / P: Pernambuco Viola Bow / Y: Yes / N: No / \$: Hong Kong Dollars

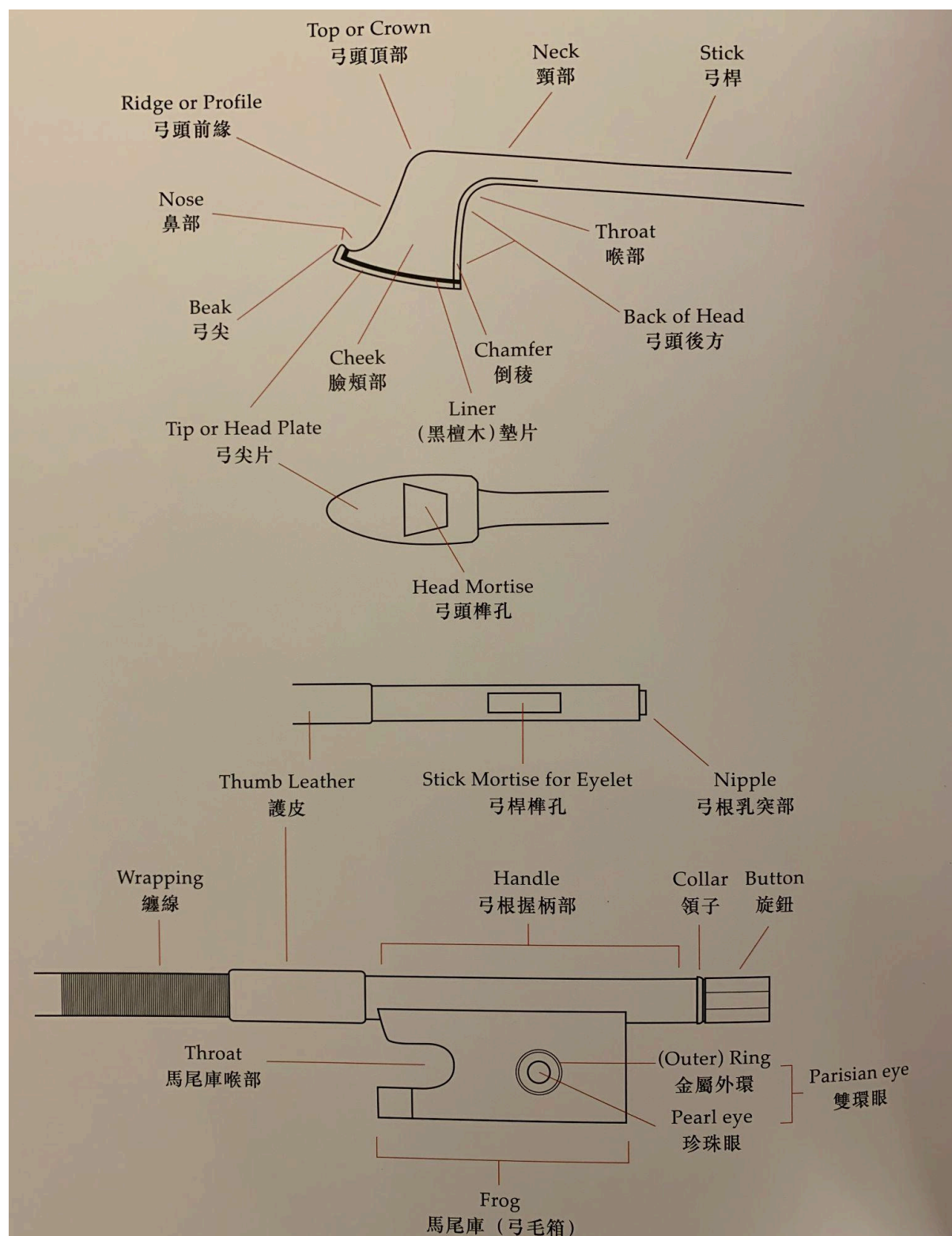


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## Figures

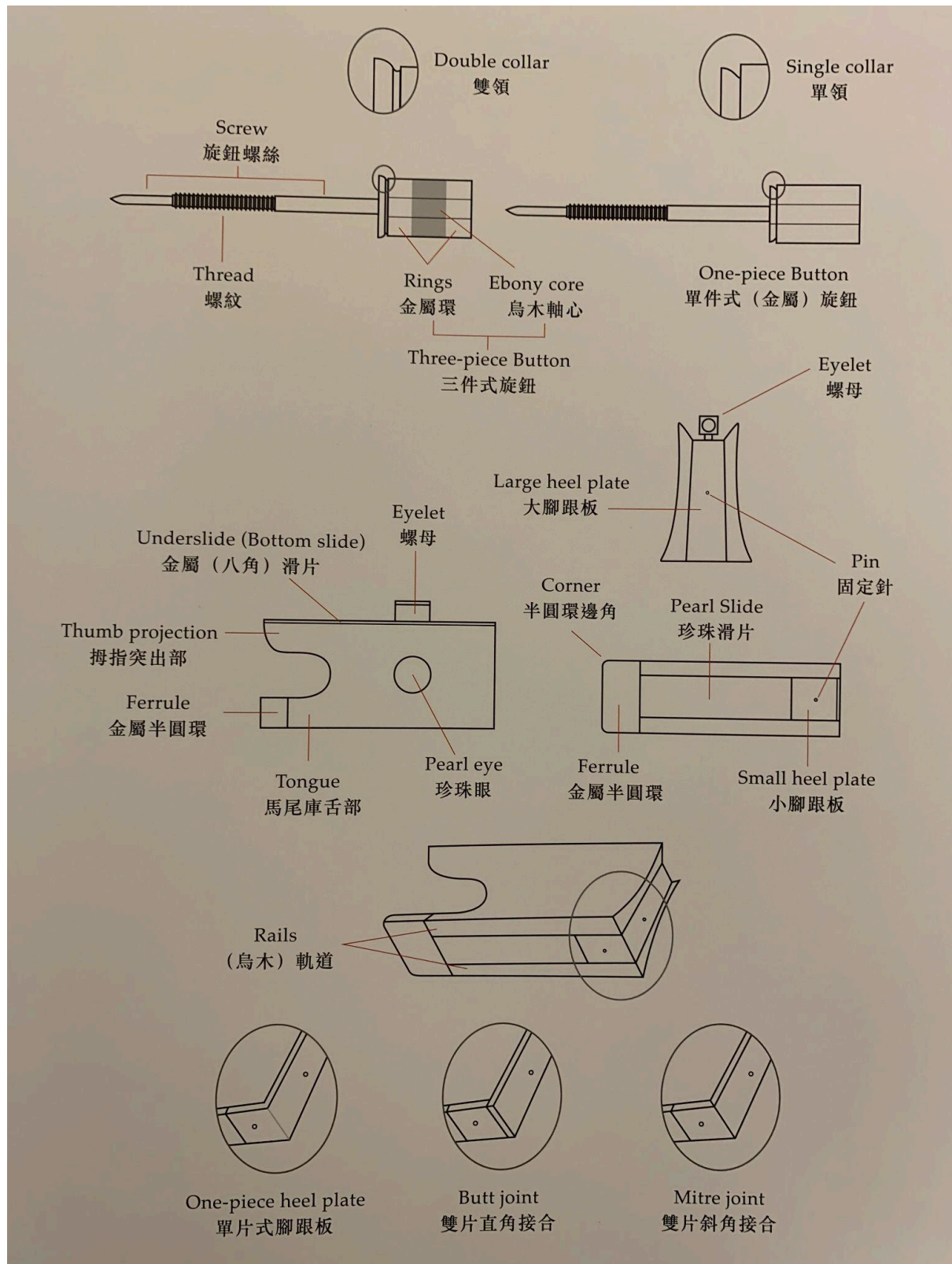
Figure 1. [Overview of French Bow (1).]



Lu, A. (2018). French Bow Maker A Concise Guide. Chuan Yin Music Publishers, Co., 17-21.



Figure 2. [Overview of French Bow (2).]



Lu, A. (2018). French Bow Maker A Concise Guide. Chuan Yin Music Publishers, Co., 17-21.