THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY | DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

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Emotional Characteristics of the Erhu and Violin:

A Comparative Study of Emotional Intensity in Musical Excerpts

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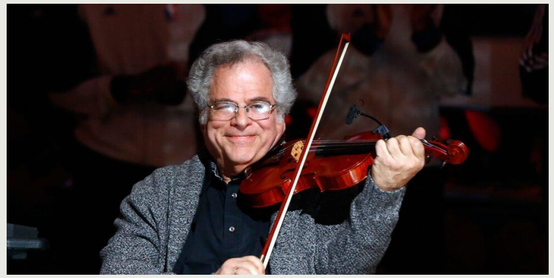
What is the erhu and violin?

- ***Erhu***: A traditional **Chinese** two **stringed**-instrument
- ***Violin***: A **Western stringed** instrument

Chinese Erhu
(Erhu Master: Guo Gan, ©ytimg)

Why compare these two instruments?

- Musical instruments evoke **emotions**
- Different instruments have distinct **timbres**
- **Cross-culture:** emotional perception across traditions
- Previous studies (***single piece/performance***)
  - Violin: **bright (happy)**
  - Erhu: **nasal (sad)**



Western Violin
(Violinist: Itzhak Perlman, ©musiclesson.in)

[1] D. Lee, W. Song, and A. B. Horner, “A head-to-head comparison of the emotional characteristics of the violin and erhu on the butterfly lovers concerto,” in ICMC 2021-Proceedings of the international computer music conference 2021, 2021.
[2] X. Wang, Y. Wei, L. Heng, and S. McAdams, “A cross-cultural analysis of the influence of timbre on affect perception in western classical music and chinese music traditions,” Frontiers in Psychology, vol. 12, p. 732865, 2021.

Research Question:

- **Does the violin sound happier and erhu sadder more generally, when considering:**
  - **Multi-pieces** in different cultures, **multi-performances**
  - **Familiarity** with music and instruments

Objectives:

- **Instrument** selection (important)
  - *H1: **Emotional intensity** differs **significantly** depending on the type of instrument.*
  - *H2: The **violin** generally conveys more **positive** and **energetic** emotions, while the **erhu** is perceived as **sadder**.*
- **Performance** differences (minimal effects)
  - *H3: Different **performances** of the same excerpt on the same instrument (i.e., five different erhu performances of the same excerpt) do **not** result in **significant** differences in emotional intensity.*
- **Familiarity** with the instrument
  - *H4: **Familiarity** with the instrument leads to **higher** emotional ratings for the **violin** compared to the erhu.*

Test Materials

- 14 excerpts:
  - 5 Chinese music pieces (e.g., “*Erquan*”).
  - 9 Western music pieces (e.g., “*Czardas*”).
- Each has various performance versions.
- Totaling **146 stimuli**.

Selected excerpts with piece name, cultural origin, and the number of performances for both erhu and violin.

Excerpt Name	Culture	No. of Performances (Erhu/Violin)
Erquan	Chinese	5/5
Spring in Xinjiang		4/4
Singing the Night Among Fishing Boats		5/5
The Sun shines on Tashikuergan		5/5
Wonderful Night		5/5
Zigeunerweisen, Op. 20 - 1	Western	5/5
Zigeunerweisen, Op. 20 - 2		5/5
Zigeunerweisen, Op. 20 - 3		5/5
Introduction and Rondo Capriccioso		5/5
Serenade/Schubert		6/6
Hora Staccato		5/5
Czardas		5/5
Flight Of The Bumblebee		6/6
Meditation		7/7

[3] W. Song, Z. Huang, and A. B. Horner, “A comparative analysis of violin and erhu: Differences and similarities through statistical analysis of multiple musical excerpts,” in 185th Meeting of the Acoustical Society of America, Sydney, Australia, 2023, p. 035007.

Experiment Settings

Experiment 1
Familiarity Rating

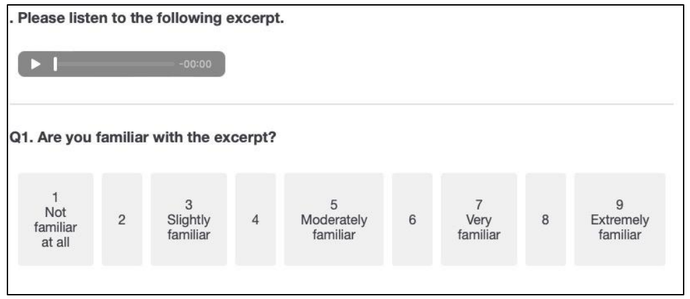
- ❑ Rate **familiarity** with **excerpts** and **instruments**.
- ❑ Listening Test:
  - Excerpts (*9-point scale, Y/N culture-selection, #14 questions*)
  - Instrument (*Erhu/Violin, #146*)
- ❑ #25 participants

Experiment 2
Emotion Identification

- ❑ Determine the **primary emotion** of each music **excerpt** from listeners.
- ❑ Listening Test (#146):
  - **Categorical** model (*4 labels, single-choice*)
    - *Happy, Agitated, Sad, Calm*
  - **Valence-Arousal** model (*9-point scale*)
- ❑ #25 participants

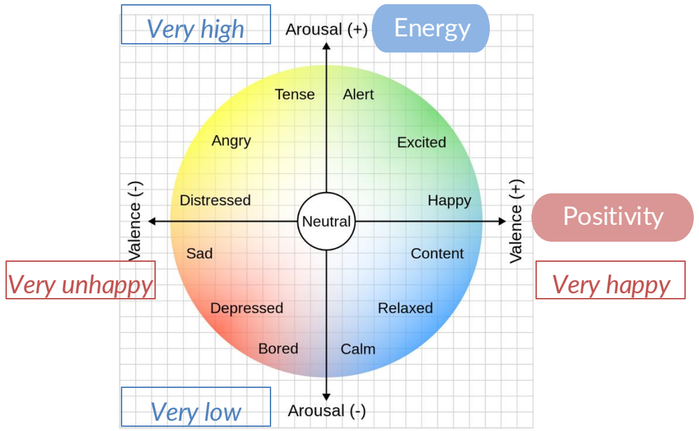
Experiment 3
Emotion Intensity Rating

- ❑ Investigate the effect of **instrument** type and **performance** on **emotional intensity**.
- ❑ Listening Test (#146):
  - Emotion Intensity (*9-point scale*)
- ❑ #20 participants



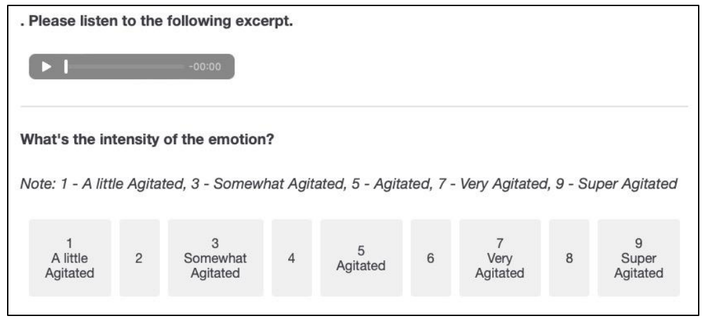
Listen to the excerpt →

9-point scale rating on familiarity with the excerpt



Valence-Arousal model of emotion developed by James Russell

(Image by mrAnmol, CC BY-SA 4.0)



Listen to the excerpt identified as agitated →

9-point scale rating on agitated intensity with the excerpt

Result - Emotion Labeling on 14 excerpts

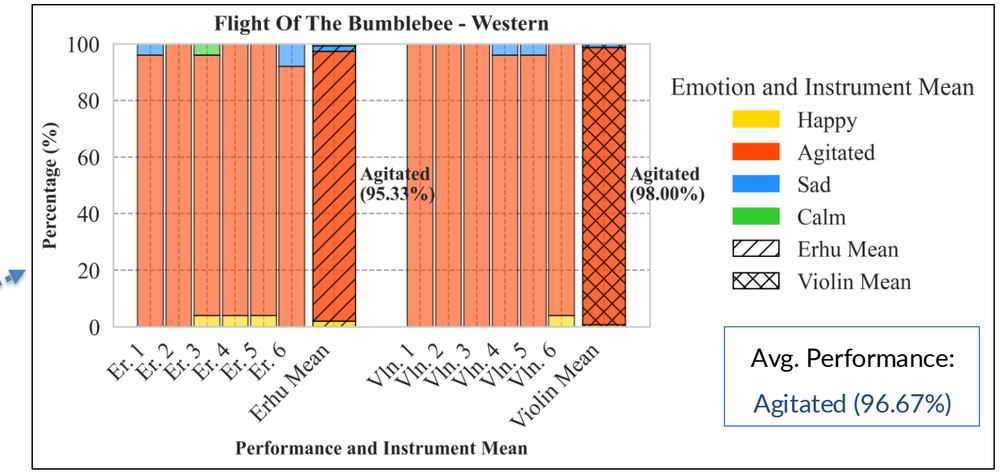
Table 1: Emotional label determinations for each excerpt.

Excerpt Name	*Culture*	*Emotion Label*
Spring in Xinjiang	Chinese	Happy
Singing the Night Among Fishing Boats		Happy
The Sun shines on Tashikuergan		Agitated
Erquan		Calm
Wonderful Night		Calm
Hora Staccato	Western	Happy
Czardas		Agitated
Flight Of The Bumblebee		Agitated
Zigeunerweisen, Op. 20 - 1		Sad
Zigeunerweisen, Op. 20 - 2		Sad
Zigeunerweisen, Op. 20 - 3		Sad
Introduction and Rondo Capriccioso		Sad
Serenade/Schubert		Sad
Meditation		Calm

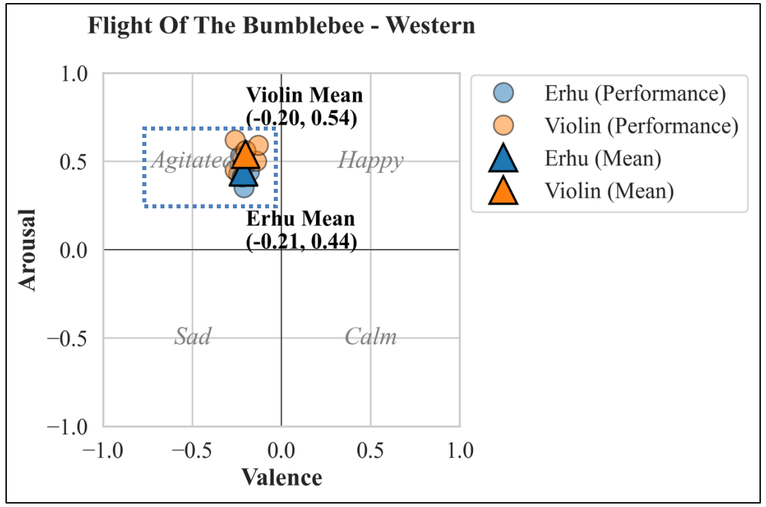
✓ 14 excerpts: 3 happy, 3 agitated, 5 sad, 3 calm

- *5 Chinese (2 happy, 1 agitated, 0 sad, 2 calm)*
- *9 Western (1 happy, 2 agitated, 5 sad, 1 calm)*

- e.g. "*Flight of the Bumblebee*" (Western) - Agitated



Categorical model (counting percentage) for all performances and both instruments.

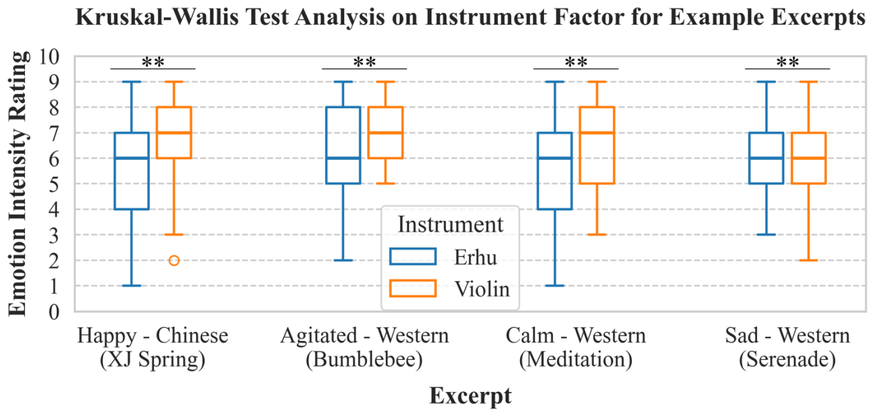


Valence-Arousal Model for all performances and both instruments.

Avg. Performance:
Mean (V, A) = (-0.21, 0.29)
In Agitated quadrant

Result - Emotional Intensity Analysis

❑ Influence of the Instrument



*** indicates statistically significant differences ($p < 0.05$) between two instruments.*

- *Kruskal-Wallis Analysis:*
  - ✓ The **instrument** factor shows a **significant** difference on most **happy** (3/3), **agitated** (2/3), and **calm** (2/2) excerpts.
  - ✓ The **violin** conveys more **positive** and **energetic** emotions than the erhu.

Table 3: Ordinal probit regression results for emotional intensity by instrument (violin to erhu). Bolded values are $p < 0.05$ meaning statistically significant differences.

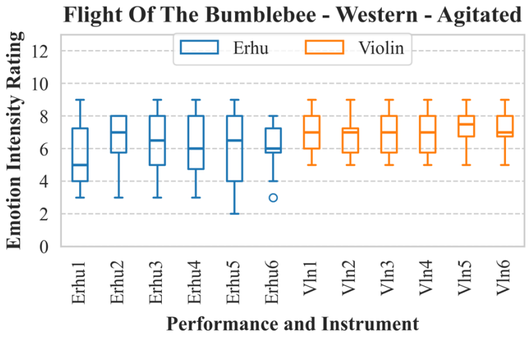
Excerpt Name	Culture	Emotion Label	Coefficient *(Instrument: violin → erhu)*	P Value
Spring in Xinjiang	Chinese	Happy	0.7391	**0.000**
Singing the Night Among Fishing Boats		Happy	0.8733	**0.000**
The Sun shines on Tashikuergan		Agitated	0.2659	0.067
Erquan		Calm	0.2867	**0.049**
Wonderful Night		Calm	0.1526	0.293
Hora Staccato	Western	Happy	0.4285	**0.004**
Czardas		Agitated	-0.0920	0.525
Flight Of The Bumblebee		Agitated	0.5932	**0.000**
Zigeunerweisen, Op. 20 - 1		Sad	-0.0382	0.791
Zigeunerweisen, Op. 20 - 2		Sad	-0.0234	0.871
Zigeunerweisen, Op. 20 - 3		Sad	0.3503	**0.016**
Introduction and Rondo Capriccioso		Sad	-0.0762	0.597
Serenade/Schubert		Sad	-0.3726	**0.005**
Meditation		Calm	0.6461	**0.000**

- *Regression Analysis:*
  - ✓ For most sad excerpts, the **erhu** is a bit **sadder** than the violin.

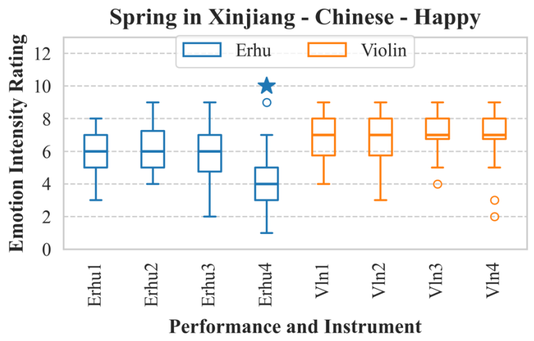
Result - Emotional Intensity Analysis (Cont.)

❑ Influence of the Performance

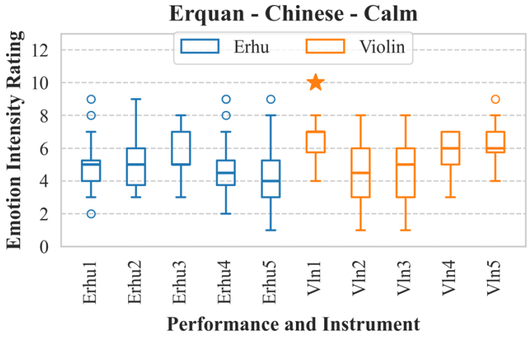
☆ *represents the most significantly different performance compared to others within the same instrument group.*



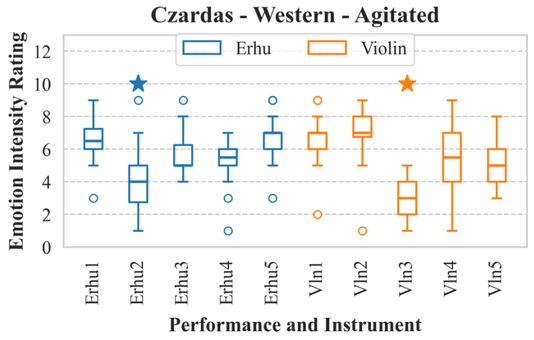
Case 1: No performance differences (**most excerpts**).



Case 2: Performance differences within erhu group.



Case 3: Performance differences within violin group.



Case 4: Performance differences within both instrument groups.

✓ **Performance** differences were generally **subtle**.

- *Significant: 7/28 groups (28=14 (excerpts) * 2 (instrument))*

✓ Possible Causes:

- Individual performer interpretation.
- Influence of accompaniment factors.

Result - Familiarity and Emotion Ratings

❑ Participants

- #25
- w/ music training: 14/25

❑ Familiarity with Excerpts

Table 5: Familiarity and recognition accuracy of Chinese and Western excerpts by participants' musical training.

	Mean Familiarity			Accuracy (%)		
Music Training	Yes	No	**Total**	Yes	No	**Total**
Chinese Excerpts	2.91	3.02	2.96	44.3	38.2	41.6
Western Excerpts	3.79	3.32	3.59	81.8	70.7	76.9

✓ Generally unfamiliar with most excerpts

✓ More familiar with Western-style excerpts

- **Regardless** of musical training

❑ Familiarity with Instruments and Valence-Arousal (VA) Ratings

Table 6: Accuracy of recognizing performances by instrument (erhu and violin) for Chinese and Western excerpts.

Instrument	Erhu	Violin
Chinese Excerpts	0.84	0.74
Western Excerpts	0.67	0.84
Total	0.73	0.81

✓ **More accurate** in identifying violin performances

✓ **Accuracy** was **higher** when the excerpt matched the instrument it was originally composed for.

Table 7: Linear regression results comparing valence and arousal ratings by familiarity with the instrument. Bolded values are $p < 0.05$ meaning statistically significant difference.

Instrument:Familiarity	Coefficient	P Value
Valence	-0.1711	0.2640
Arousal	0.7475	**0.0000**

✓ **Familiarity** with the **violin increases arousal** (positivity) ratings.

Discussion

Key Findings

- **Emotional Intensity Differences by Instrument**
  - Significant emotional expression differences between instruments.
  - The violin convey more positive and energetic emotions, while the erhu is sadder.
- **Familiarity as A New Discovery**
  - Participants familiar with the violin gave higher arousal ratings.
- **Limitations of Performance Influence**
  - Occasional significant differences were observed (minimal impact).

Future Research

- **Performance filtering.**
- **Cultural impacts on emotion perception.**
  - Broaden participant diversity.
  - Find more excerpts with different cultures.
- **Familiarity and emotion perception.**

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Thank You

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Q&A