Introduction

Previous research has shown a strong connection between music emotion and timbre, and that musical instruments have strong emotional characteristics. Timbre is the quality of the sound of an instrument, what makes it unique and distinct.

We set out to investigate the range of emotional characteristics within the bowed string instrument family, and in particular, the effect of varying pitch and dynamics on the emotional character. We conducted listening tests to compare the effects of pitch and dynamics on the emotional characteristics of the conventional bowed string family – consisting of the violin, viola, cello and double bass.

We compared these instruments against each other for 10 emotion categories:

- **Valence** indicates the positivity of an emotional category;
- **Arousal** indicates the energy level of an emotional category.

![Graph showing the relationship between Valence and Arousal for various emotional categories.](image)
The graphs show how often each instrument sound was significantly greater than the others. Loud sounds are connected by solid lines, and soft sounds by dashed lines. Violin sounds are represented by triangles, viola sounds by crosses, cello sounds by circles and double bass sounds by squares.
Conclusions

Here are some of the conclusions we can draw from our investigation.

Regarding pitch in the bowed strings:

- Nine out of ten emotional categories were strongly affected by pitch (all but Shy).
- Happy, Heroic, Romantic, Comic and Calm increased with increasing pitch for most instruments.
- Mysterious, Angry and Sad tended to decrease with increasing pitch, though in different ways.
- Scary showed the most dramatic pitch changes and was strongest for the lowest and very highest pitches.
- Shy was the emotional characteristic relatively unaffected by pitch.
- Heroic, Comic, Calm and to a lesser extent Romantic were strongest for middle pitches, and weaker for the highest and lowest sounds.

Regarding dynamics in the bowed strings:

- Nearly all emotional categories showed some strong effects due to dynamics (Scary was the least affected).
- Heroic, Comic and Angry were stronger for loud sounds.
- Romantic, Calm, Shy and Sad were stronger for soft sounds.
- Perhaps surprisingly Scary was least affected by dynamics.
- Heroic, Comic, Calm, Shy and Angry showed consistently large changes with dynamics.

Loud, mid-to-high pitch string sounds are best for Superman!