Tone production

Understanding what the bow does to the string

The hair of the bow makes the string vibrate. But what does this mean, and how does the bow do it?

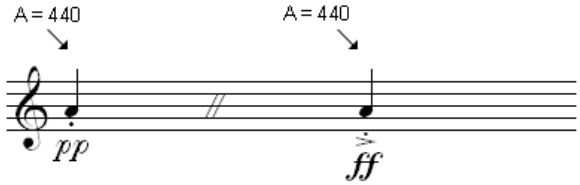
Imagine watching the bow moving along the string in ultra-slow-motion, and magnified through such a strong lens that the string and the hair of the bow are huge. You can see clearly how the friction of the bow pulls and pushes the string from side to side.

During the down-bow the hair catches the string and pulls it sideways to the right. As it does so the tension of the string increases. This sideways bending of the string can only continue for so long before the tension is so great that the string springs back in the opposite direction to the left. It is then caught again by the hair and pulled to the right again, and the next cycle begins.

The reverse happens on the up-bow. The bow hair pushes the string to the left and the string springs back to the right.

This sideways movement is called the amplitude. It looks like a blur around the string and is widest at the middle point between the bridge and the nut (or the bridge and the finger). The wider the amplitude, the more carrying the tone.

The pitch of the note remains the same, however, whatever the amplitude. The note A vibrates (i.e. the string swings from side to side) 440 times each second whether it is played *pp* or *ff*, but the distance the string swings from side to side is narrower in the *pp* and wider in the *ff*.



If the downward pressure of the bow into the string is too great, it prevents the string from swinging freely from side to side. Then, although you are pressing hard, and it feels as though you should therefore be getting a lot of volume, in fact you get more sound if you release the pressure slightly. This is very easy to demonstrate:

- Play the note E on the D string. Using quite a fast bow midway between the bridge and the fingerboard, see how widely you can make the string vibrate. Watch the string midway between the first finger and the bridge.
- Now slow the bow a little, and slightly over-press. Notice how the width of the string vibration becomes narrower as the bow-pressure constricts the string. Notice how the tone, now slightly less pure and more jagged, is actually smaller than it was before.
- Move the bow a little more quickly and lightly again. Notice how the width of the string vibration increases, as the string can move from side to side more freely again. Notice how the tone is now purer and sweeter, and seems to travel much further.

When you press the bow too hard it is like trying to drive the sound down in the direction of your feet. When instead you lighten the bow and use speed of bow to create the sound, there can be a perception of lifting the sound out of the string. Therefore, speed of bow is always the first consideration in drawing sound and expression from the violin.

This doesn't mean that you end up playing everything too lightly and sweetly. You often have to sink the bow into the string as heavily as possible. The principle of 'speed not pressure' simply means that even when the bow is near the bridge, deep in the string, and moving slowly, you still draw the tone and the expression out of the violin with horizontal movement of bow, rather than pressing it out with downward pressure.

The quality of the sound: upper partials

When you raise or lower the volume control on your television or music player, the quality of the sound does not change. The sound gets louder or softer, but in itself it stays the same. It is different when you play more loudly or softly on the violin. When you move the bow closer to the bridge or further away, the sound not only gets louder or softer but the quality changes as well.

This is because a musical note is not a single note, but a whole series of notes known as partial tones. All except the prime tone are called upper partials. Upper partials are faint compared to the prime tone which gives the pitch to the note; but the quality of the sound is determined by the number and relative intensities of the partials.

Playing further from the bridge diminishes the number of upper partials; playing nearer to the bridge adds to the number and audibility of very high ones, when in extreme cases only upper partials (or harmonics) are heard. This means that playing nearer to the bridge produces a tone that has more 'edge', and is brighter and more penetrating, than when playing nearer to the fingerboard.

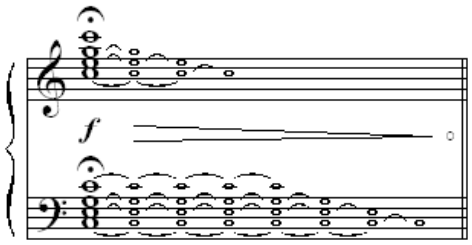
Playing nearer to the fingerboard is similar to playing with a mute on the bridge, in the sense that both actions reduce the quantity of upper partials in the sound.

The sound you hear is not the same as the sound the audience hears

One of the most essential things to keep in mind is that what you hear as a player, with the instrument close to your ear, is quite different from the sound that the audience hears from a distance.

This is because the upper partials in the sound are the first to 'drop off', while lower partials travel further. In the same way a low note played on a large, booming horn, in a range of hills or mountains, may travel and be heard for several miles, whereas a high note played on a piccolo would be lost after a far shorter distance.

You can observe a similar phenomenon (though in this case as much to do with the length of the vibrating strings as to do with the shorter life of upper partials), if you play a widely-spaced chord on the piano, striking all the notes at the same time, and holding the keys down without releasing them:



At first you can hear every note in the chord. Then the top note fades and disappears, then the next note down from the top fades, then the next note, and so on. The lowest notes are the last to go.

If you play near to the bridge, where more and clearer upper partials are produced than when playing nearer the fingerboard, the sound next to your ear may seem very edgy; but because those upper partials do not travel as far as the audience, the sound they hear is mellow and sweet.

The danger is that if you try to produce too mellow and sweet a tone directly under your ear (i.e. if the sound you hear is actually the exact sound you want somebody many metres away from you to hear), then the sound that reaches them may end up sounding nothing but too weak.