15.3.12 Parameters that affect the string's spectrum

This section offers an overview of parameters that influence the sound spectrum when playing within the Helmholtz regime. Notice that only one parameter is changed at a time.

Table 15.2: Parameters capable of changing the string's spectrum during playing

	Parameter value increased:	***Effect on tone color – spectral profile:***
1	Bow force ("bow pressure")	Increased sharpness/brilliance
2	Bow speed	Decreased sharpness/brilliance
3	Tilting of bow-hair ribbon with respect to the string (only if tilted the correct way, i.e., toward the fingerboard)	Increased sharpness/brilliance (moderate effect only)
4	Width of bow-hair ribbon	Decreased sharpness/brilliance (moderate effect only), and increased noise due to partial slipping across the hair ribbon during "stick" intervals (particularly when bowing near the bridge)
5	Length of string (with constant bending stiffness and impedance, but with the fundamental frequency decreasing)	Increased sharpness/brilliance (relative to the fundamental frequency)
6	Finger-pad damping	Decreased sharpness/brilliance
7	Relative bowing position (β)	Only local spectral deviations – No general trend except increased slipping noise due to the increased slipping intervals

Comments to Table 15.2:

1. Increased bow force sharpens the rounded corner and moves the working point upwards in the Schelleng diagram (Fig. 15.4). The brilliance increases.
2. Increasing the bow speed implies a movement down in the Schelleng diagram, because in absolute force values the diagram is shifted upwards. The Helmholtz corner gets more rounded.
3. Tilting the bow-hair ribbon boosts the higher partials slightly and gives a "freer sound" [i]. Even more importantly for violin and viola is that tilting allows for more gentle onsets and onsets closer to the bridge.
4. Width of bow-hair ribbon is closely linked to bow-hair tilting. What causes the slight corner rounding when a 7-8 mm wide hair ribbon lies flat on a violin string is not clear, but the effect is probably related to frictional properties rather than "signal averaging", which would suggest a higher roll-off frequency.
5. When making a downward glissando, the section with the rounded corner becomes a relatively smaller part of the vibrating string, so although the cutoff frequency remains the same, its harmonic number increases. On a violin the relatively widest kink is experienced when playing high positions on the comparably thick G-string.

6. A soft finger pad (or more pads on a double bass/cello) will contribute to further corner rounding and put greater demand on the bow's sharpening function.
7. The bowing position has less spectral influence than one would imagine. Bringing the bow closer to the bridge does not sharpen the corner and thus lift the upper part of the spectrum. The necessary adjustment in terms of increased bow force does. However, in pizzicato, where the string takes a completely different wave form, the spectral envelope is very much influenced by the plucking position [ii].

---

[i] E Schoonderwaldt, K Guettler and A Askenfelt, Effect of the bow hair width on the violin spectrum. Proc SMAC'03 (2003), Stockholm, Sweden. 91-94.

[ii] K Guettler, E Schoonderwaldt and A Askenfelt, Bow speed or bowing position-which one influences the spectrum the most? Proc Stockholm Music Acoustics Conference (SMAC'03) (2003), Sweden 67-70.