



May a bow buckle when playing violin?

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The playing qualities of a violin bow, which are basically determined by the mechanical properties of the wood and the taper of the stick, may be strongly affected by the adjustment of camber (concave curvature of the stick). Increasing camber essentially allows the player to reach a higher playing hair tension. However, it is well known among makers that a bow may become unplayable if its camber is increased beyond a certain limit, which depends on the stiffness of the stick. On a too much cambered bow, any attempt to apply a high normal force on the string results in unwanted lateral bending of the stick, which gives the player the sensation that the bow is uncontrollable. From a mechanical point of view, this behavior strongly evokes the phenomenon of buckling. Considering that a bow stick is a slender structure subject to a high compressive force once tightened, it is obvious that the critical buckling load of the stick has to be higher than the typical playing tension of the bow. However, the possible occurrence of buckling during playing has not been clearly demonstrated until now. In this paper, it will be shown experimentally and numerically that a bow may buckle, even it is played at a tension lower than the critical buckling load of the stick. A remarkable result is that this phenomenon occurs when the bow is loaded by a transversal force, although the critical buckling load is associated to compressive loads.