I have recently started using 3d programs like Poser or the free DAZ Studio to illustrate concepts in linear algebra. It all started when I experienced the phenomenon of Gimbal lock (know from the movie Apollo 13). A rotation, $R(V, s)$ by $s$ counterclockwise around vector $V$ can be written as $R(Z, a)R(X, b)R(Y, c)$, where $a$, $b$ and $c$ are the Euler angles corresponding to rotations around the global $Z$, $X$ and $Y$ axes.

When experimenting with Poser, I discovered that when I change the $Z$-angle $a$ to $a + d$, I get a global $Z$-rotation of $d$, but if I change the $Y$-angle $c$ to $c + d$ I get a local $Y$-rotation of $d$. If I change the $X$-angle from $b$ to $b + d$, I get a global rotation of $d$, but not around the $X$-axis but around the axis that results when you apply $R(Z, a)$ to the $X$-axis.

This combination of local and global axes can lead to gimbal lock. If you start with a rotation by $\pi/2$ around the $X$-axis, the local $Y$-axis and the global $Z$-axis coincide. This means that I now only have two rotation axes to use, and I will not be able to represent all rotations.

When experimenting with the program or reading the manual, this seems very strange. However, when I interpreted it in terms of matrix multiplication, it all made sense, and became a very instructive exercise in linear algebra, suitable for a first course. (Received October 04, 2006)