It is a little bit more complicated than just "1st order versus 0th order", but I will try to explain. Given the complexity, it is no problem at all if you would like another explanation in the future. We could have a conference call to discuss it if it would be helpful.

If you shine a laser beam onto a wall, you will see a spot. If you then measure the power of that spot with a detector, that will give the optical power of the beam. Next, replace that detector with an SLM. Now you will likely see multiple spots (on the other wall of the lab, since the SLM is reflective). The spot in the middle, which is hopefully the brightest spot, is the 0th order spot. This is the "usable" light which can be shaped or steered by writing phase patterns on the SLM. If you use the detector to measure this spot, and divide that number by the original laser power measurement, you will get the 0th order diffraction efficiency. This number will be less than 100% due to 2 primary factors—light loss, and unwanted diffraction. We minimize the light loss by using an antireflection coating on the top of the window, using index-matched ITO inside the SLM, and using very low absorption LC & alignment layers. We minimize the unwanted diffraction with the dielectric mirror. In fact, when looking at the reflected light from an SLM of ours with the dielectric mirror, one cannot typically even see more than the one 0th order spot (meaning, the mirror is very effective at reducing the unwanted diffraction). This number, this -0th order diffraction efficiency, is the maximum amount of light that can be used by the customer in their system. As such, it is a very important number to know.

So, how does this relate to 1st order diffraction efficiency? Well, with a low spatial frequency hologram, the 1st order efficiency will (theoretically) be as high as the 0th order, but cannot be higher. As the spatial frequency of the hologram increases, this 1st order diffraction efficiency will decrease, due to 2 primary factors—SLM pixel-to-pixel optical crosstalk, and quantization efficiency. While this is equally true for all phase patterns, it is easiest to explain & understand using simple ramps. A phase ramp will simply steer the 0th order spot away from its default position. When that spot is steered, it immediately becomes the 1st order spot. So, you can think of the 1st order spot being the same as the 0th order spot when there is no phase ramp applied, and then as the phase ramp is "increased" (in the case of LCOS, this means the number of steps in the ramp is decreased and therefore the number of repeated ramps across the face of the SLM is increased), this spot continuously a) moves away from the 0th order position, and b) gets dimmer. The crosstalk is, of course, a function of the specific type of SLM, but the quantization efficiency is a simple physical limit. So if one is going to specify 1st order efficiency instead of 0th order, one needs to decide which phase pattern to use and why that is the best choice. To be fair, one of our competitors shows this decreasing 1st order efficiency versus increasing phase pattern spatial frequency on their website, which is good, but they do not show the also-important 0th order diffraction efficiency number. This means that the customer cannot know the *actual* 1st order diffraction efficiency of their SLM until they use it (they only know the efficiency relative to the 0th order, but don't know what the 0th order is). We are discussing internally the best way to show all of this in our documentation, but have not yet arrived at a consensus.