



## The Sigma “120-300mm F2.8 DG OS HSM | S” -- A Focus-Breathing Lens That Is Not Truly 300mm ?

September 2016

I came across a YouTube video ([https://www.youtube.com/watch?v=5HZ2pvfmT\\_s#t=00m49s](https://www.youtube.com/watch?v=5HZ2pvfmT_s#t=00m49s)) by photographer Tony Northrup reviewing the “Sigma 120-300mm F2.8 DG OS HSM | S”. In his review, Tony reports two issues: That the lens has a focus breathing problem, and also that it is far less than a true 300mm focal length when using it at close focusing distances like those he and many portrait photographers shoot at. This is a lens I own, and that I purchased to largely replace the long and trusty service of my Nikkor 70-200mm f/2.8G ED-IF AF-S VR I (VR version “one”).

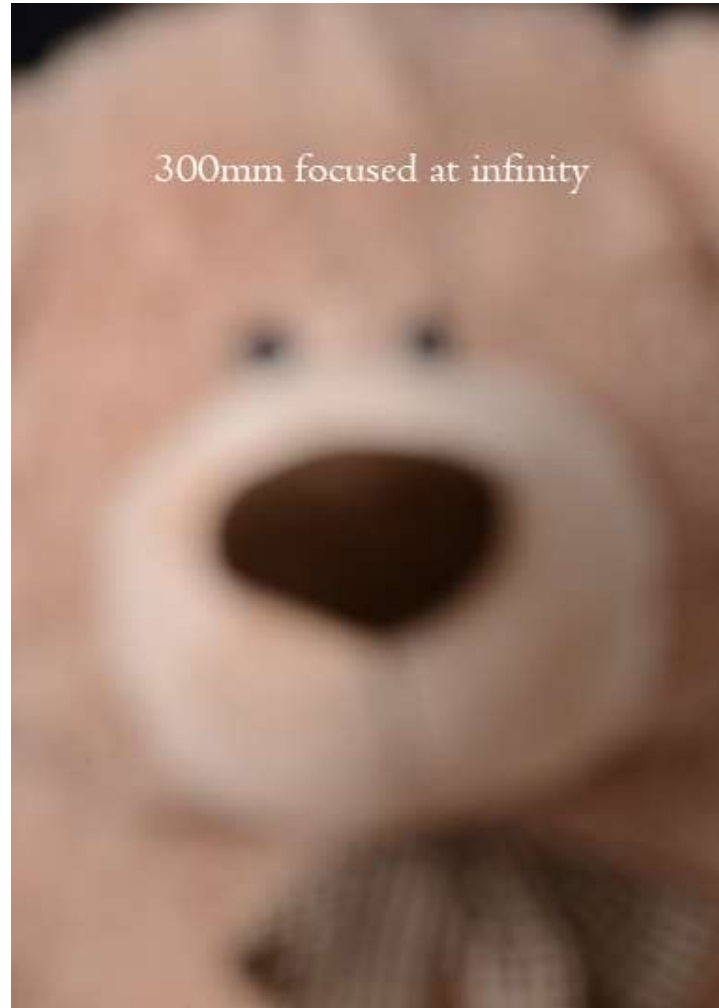
So of course Tony Northrup’s focus-breathing experience with the Sigma 120-300 was of interest to me, but not a characteristic (at least a significant one) that I have noticed. In simple terms, focus breathing is when the focal length of a lens changes when the focus distance of the subject changes. It can cause two issues that are related. First, it can cause the need to re-compose the framing of a subject. Second – and what Tony reported about the Sigma 120-300 – focal length or “reach” is lost when photographing subjects that are close to or at the minimum focus distance of a lens. This can be particularly important and bothersome to portrait photographers like Tony and myself.

I did a first test of my own shortly after watching Tony’s review, but was not able to reproduce what he reported. I posted a comment to his YouTube video’s page about my test, along with some fairly specific information about my test setup. I asked Tony if he could post specifics about his test, and if it was \*possible\* that what he was experiencing was a difference in effective focal length between the Sigma and his Canon EF 70-200mm f/2.8L IS II rather than actual focus breathing. He did not respond, though there have been other comments above mine to which he has responded.

Craig Wassel Photography  
<http://www.craigwasselphotoart.com>  
[craig@craigwasselphotoart.com](mailto:craig@craigwasselphotoart.com)  
630.326.9908

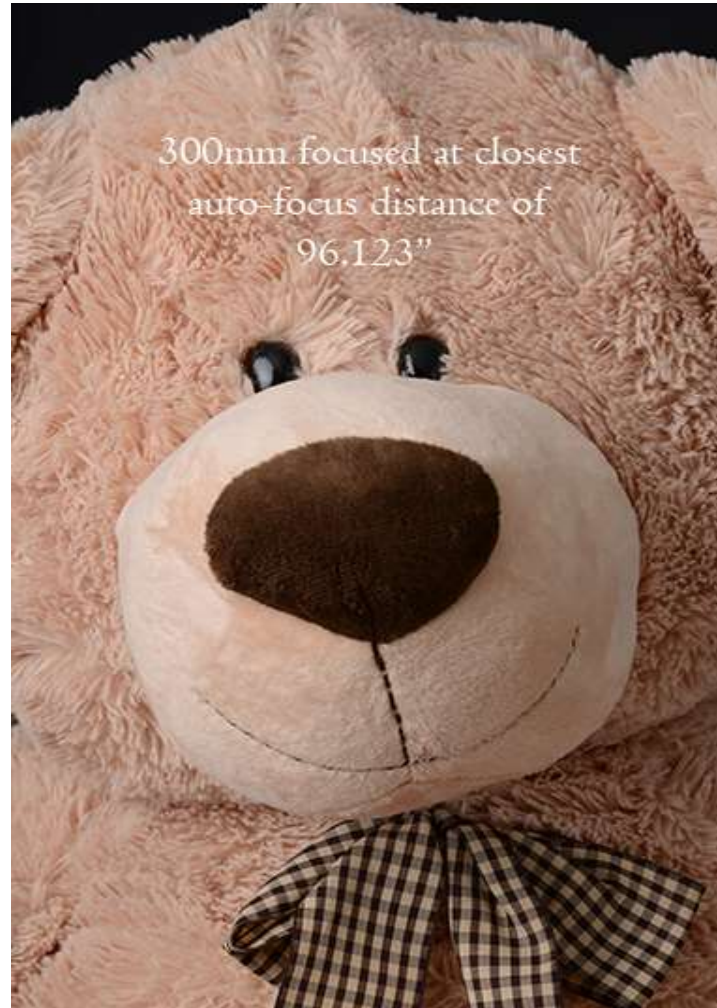
In light of that I decided to re-test and even more thoroughly document my methods and measurements. I was not passionately invested in whether my re-test results would support Tony's review or alternately support my first test. I have not felt the effects of focus breathing with the Sigma 120-300mm F2.8 DG OS HSM | S, and it has lived up to reviews I read – and – more importantly – my expectations as a portrait lens. Really, I wanted an even more formal test to tell me whether what Tony says makes sense or not. With that, on to the specifics and results of my re-test.

1. The first step is to find out the exact minimum auto-focus distance of the Sigma 120-300mm F2.8 DG OS HSM | S at 300mm. This is crucial. I asked Tony what his focus distance was, and with no reply we do not know what it was for his test. My "model" is a 42" child-sized bear with a head measuring 9.5" tall and 11.5" wide. My Sigma was purchased at ProCam in Chicago in May of 2016. I mounted the lens on a Nikon D800, zoomed it to 300mm, set the lens to auto-focus, and mounted the rig on a tripod. At F/16, I then moved toward my "bear in a chair" model until the eyes would no longer focus. I then measured the distance from the focal plane of the D800 to the eyes of the bear: 96.123".
2. Next, I removed the camera from the tripod, left it zoomed to 300mm, and auto-focused on a subject beyond the hyper-focal distance of the lens.
3. Now it is time to shoot. I set the Sigma back to manual focus so that it would not be allowed to re-focus as I take my first photo of my "model". Now, this first shot is out of focus and it has to be so. To show the worst focus breathing a lens might do, we need to go from hyper-focal focus to closest possible focus. All images are uncropped .jpg's straight from camera.



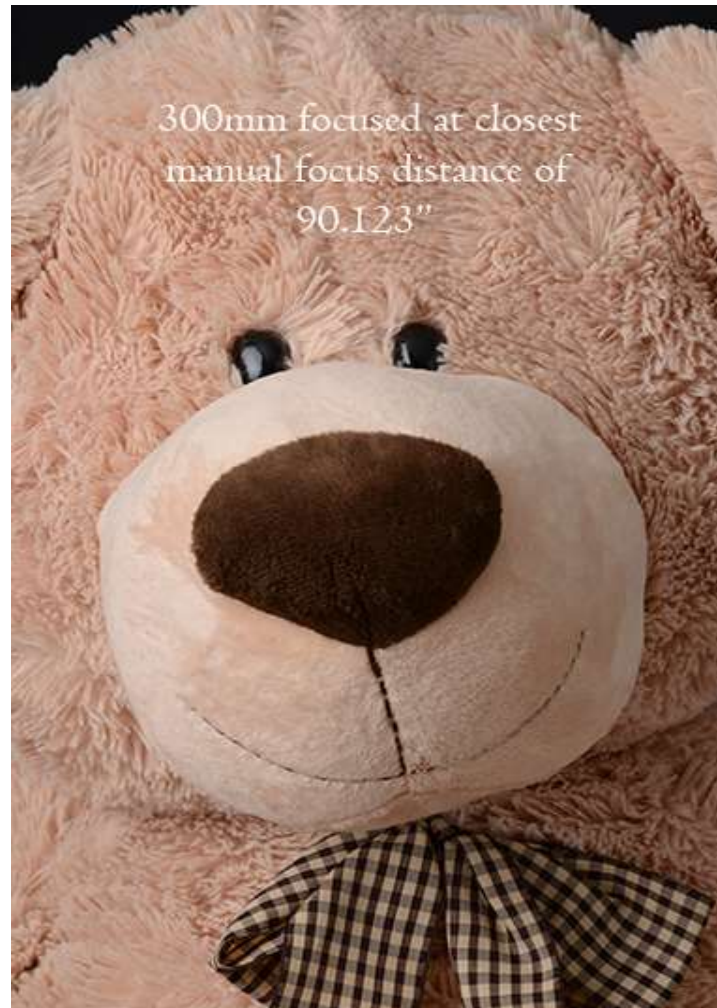
Craig Wassel Photography  
<http://www.craigwasselphotoart.com>  
[craig@craigwasselphotoart.com](mailto:craig@craigwasselphotoart.com)  
630.326.9908

4. Now let's see what happens when we put the lens back into auto-focus. If the framing/composition of the photo changes significantly and there is an increase in negative space around our model, then we can say the lens is focus breathing.



Craig Wassel Photography  
<http://www.craigwasselphotoart.com>  
[craig@craigwasselphotoart.com](mailto:craig@craigwasselphotoart.com)  
630.326.9908

If the Sigma 120-300mm F2.8 DG OS HSM | S truly focus breathes significantly, we should see a meaningful change in the angle of view and framing between shot #1 and shot #2. We can indeed see there is a little bit more of the black backdrop visible in the second shot compared to the first, but it is little enough that it is really not meaningful, and it is quite a bit less than what Tony showed in his review. Interestingly, I switched to manual focus and turned the focus ring all the way to its stop. This allowed me to move 6 inches closer to my “model”, and I took another shot:

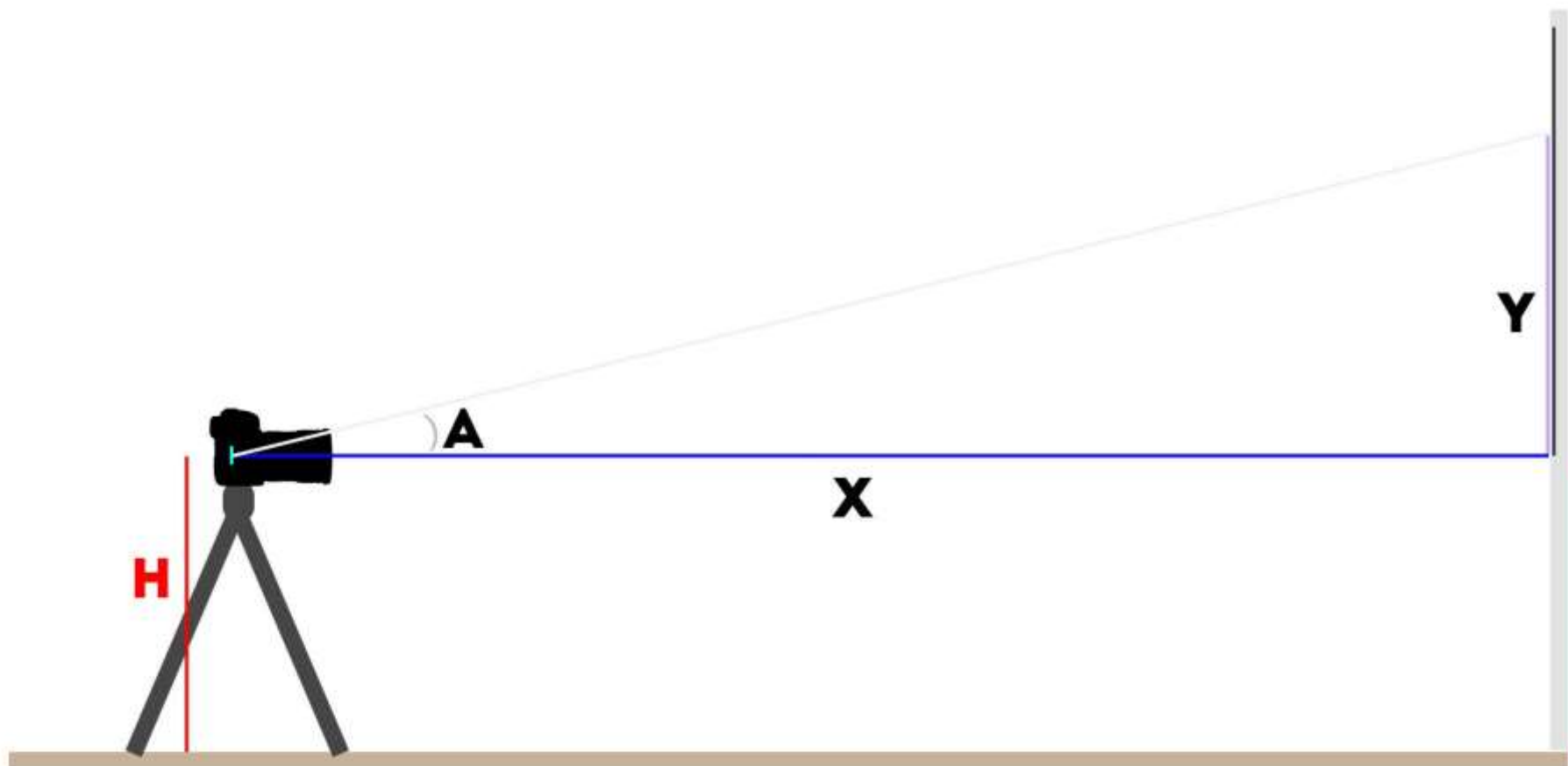


Craig Wassel Photography  
<http://www.craigwasselphotoart.com>  
[craig@craigwasselphotoart.com](mailto:craig@craigwasselphotoart.com)  
630.326.9908

Any “reach” and magnification that was lost by the little bit of focus breathing that did occur was recovered 😊

So if the Sigma is focus breathing only just a bit in this very carefully prepared test, why did Tony experience that it had significantly less telephoto “reach” – even at its full 300mm – than his Canon at its full 200mm? Again, Tony has not provided his focal plane distances or the details of his test, and those details are crucial to find out if his statements are accurate and to know what is really going on. I do not have a Canon 5D and EF 70-200mm f/2.8L IS II available for comparison as part of my re-test, so one possibility is that the Sigma’s focal length is not being accurately reported by the manufacturer. Let’s check that out.

A pre-requisite to accurately calculating the true, effective focal length of the Sigma when zoomed to 300mm AND when shooting at minimum focus distance is to first accurately measure its angle of view in this scenario. My measurement setup and formula comes from <http://www.lightandmatter.org/2015/tech-photography-articles/how-to-calculate-a-lens-focal-length-slightly-simplified/> :



**Measurements and Setup:** The Nikon D800 and Sigma 120-300 were mounted on a Manfrotto tripod. The tripod mounting plate was leveled for both north-south and east-west tilt. A plumb bob was taped to the side of the D800 to give an accurate location on the floor of the focal plane of the D800. That allowed me to start accurate measurements, beginning with “X”.

**X:** 96.123", which reflects the distance in inches from the focal plane to the wall, with the lens zoomed to 300mm. This is the absolute minimum distance from the wall the Sigma 120-300 can be and still achieve auto-focus. Note this is slightly closer than the 98.4" in the tech specs for the lens at <https://www.sigmaphoto.com/lenses/telephoto-lenses/120-300mm-f28-dg-os-hsm-s>

**H:** 35", which reflects the distance in inches from the center of the lens mount (and sensor) to the floor. This also reflects the height from the very bottom of the tape measure (as it is affixed to a vertical wall) to the floor. This measure is not used in any equation, but it does help in getting the measure tape placed on the vertical wall at the correct height. The correct height is such that the bottom edge of the tape is exactly in the center of the sensor and the viewfinder.

**Y:** 4.375". With the **X** and **H** measurements and this setup, we know everything is square and we are ready to take a photo of the wall-affixed measure tape. In the photo below we see 4.375" of the tape from the center of the sensor to the top of the frame.



Craig Wassel Photography  
<http://www.craigwasselphotoart.com>  
[craig@craigwasselphotoart.com](mailto:craig@craigwasselphotoart.com)  
630.326.9908



**A:** 2.61°. This was calculated by the equation:  $A = \tan^{-1}(Y/X)$ . With substitution, that yields  $A = \tan^{-1}(4.375"/96.123")$ . Solving, we get 2.61°. Now that we know the angle **A** is 2.61°. Though we won't use this in the equation below, it does tell us the vertical angle of view of the Sigma at 300mm at minimum focus distance is twice that, or 5.22°. Now we are ready to calculate the real, true, effective focal length under our minimum auto-focus distance/maximum zoom scenario.

The equation to calculate the effective focal length is  $f = d / (2 * \tan(\alpha/2))$ , where...

**f:** is the focal length

**d:** the vertical size of the sensor, in millimeters

**( $\alpha/2$ ):** is the angle we calculated above. Note that the angle above (**A**) replaces this entire expression, not just the " $\alpha$ ".

So, calculating the focal length using a Nikon D800 which has a sensor of 36 x 24mm, the equation should look like this:

$$f = 24\text{mm} / (2 * \tan(A))$$

By substituting the variables we know and/or have calculated, we get:

$$f = 24\text{mm} / (2 * \tan(2.61^\circ))$$

By following proper order of operations and solving the equation:

$$f = 24\text{mm}/0.091029202$$

... and the focal length is ... drum roll, please ...

**f = 263.65mm when the lens is at absolute minimum auto-focus distance and fully zoomed to the 300mm mark.**

So, yes, the "Sigma 120-300mm F2.8 DG OS HSM | S" is approximately 12.1% short of 300mm when fully zoomed AND the subject is at or around the minimum focus distance of 96".

One final note before I move on to conclusions: If you look at the measured angle of view from Sigma for the 120-300 at the page <https://www.sigmaphoto.com/lenses/telephoto-lenses/120-300mm-f28-dg-os-hsm-s> you will notice they claim 8.2°. If we were to re-calculate the formula above using half of that (4.1°) instead of the 2.61° I very carefully measured, we come up with an answer/focal length of 167mm. That would definitely explain Tony experiencing the Sigma to have so much less reach – even fully zoomed to a supposed 300mm – than his Canon 70-200. ***But I don't think that is the case based on four things:***

1. The measurements I took would have to be SIGNIFICANTLY off, and off by FAR more than +/- 5% margin of error.
2. I repeated this test several times in “X” distances ranging from a minimum manual focus distance I measured of 90.123”, to a minimum auto-focus distance I measured of 96.123”, and also to Sigma’s stated minimum focus distance of 98.4”. The angle of views I calculated stayed between 5.2° and 5.5° every single time.
3. I believe Sigma is stating the horizontal angle of view (which is much more commonly given), whereas I calculated and used the vertical angle of view.
4. Tony Northrup’s video seems to show that the focal plane of the Canon 5D was closer to the model than that of the Nikon D810 by at least a foot. Please see the Addendum at the end of this document for an additional test I ran which is just as enlightening.

### **Conclusions:**

Focus Breathing: The “Sigma 120-300mm F2.8 DG OS HSM | S” does focus breath a bit at and around the minimum possible auto-focus distance, but in my opinion and experience it is not enough to not cause re-framing or re-composing issues. At 300mm if you switch to manual focus and adjust your position until you regain focus, you get right back anything you lost from focus breathing. Greater focus breathing than this is also not at all uncommon in telephoto zooms of this length. Further, it would be interesting to see a comparison of the Canon EF 70-200mm f/2.8L IS II at 200mm and at its minimum focus distance of around 48”. Here is the Sigma 120-300mm at its minimum focus distance at 200mm, which I measured to be 50.5”:



Craig Wassel Photography  
<http://www.craigwasselphotoart.com>  
[craig@craigwasselphotoart.com](mailto:craig@craigwasselphotoart.com)  
630.326.9908

Effective Focal Length: If Sigma is mis-stating the real, true, effective focal length of the 120-300mm, it is by around 12.1% when fully zoomed AND when shooting at the absolute minimum focus distances of 90" to 98.4". In this range, I measure its real, true, effective focal length as 263.65mm. As you can see here by my testing, though, I had to go looking for the missing millimeters to really notice them. It's not significant.

Tony Northrups findings: I can't offer any conclusion at all without being able to exactly compare his test setup and measurements with those I used. I still welcome his response. My intent is not to prove him wrong; it is only to understand. When something does not make sense to me, I want to know why even if that means I learn there is something I mis-measured, mis-calculated, or flat-out did not understand as well as I thought. For anyone discounting the Sigma 120-300 as an alternative to a Canon or Nikon 70-200 based on Tony's experience – I wouldn't. Without his test details, they are not sufficiently substantiated. [If you look closely at the video at the 1:02 mark](#), it appears the front of the Canon is even with the front of the lens hood of the Sigma. If this is the case, this is absolutely not the same as insuring that the focal planes of the cameras are the same distance from the model, and if they are not this would lead to a completely inaccurate report. It's also possible that there was something off about the copy he used which I don't believe was his own. At this point though, I see no reason why this lens could not be used in the studio for the tight style of headshots like Tony discussed.

The best way for you to be sure is to rent a copy from a place like LensRentals.com and test the focus breathing, focus distances, and focal length yourself, as well as know if the lens is a fit for you, especially at its cost, size, and weight. Those factors would be the greater barrier to using this lens on a Nikon body as opposed to a Canon with an EF 70-200mm f/2.8L IS II at 200mm.

Feel free to email me at [craig@craigwasselphotoart.com](mailto:craig@craigwasselphotoart.com) if you have anything you would like to share with me.

Craig

### **ADDENDUM and FOLLOW-UP**

It's been about a week and a half now, and Tony has since responded further to others commenting on his review but he has not provided further information on his test methods or measures. Even more so, he has not responded to how the focal planes of the two cameras could have been the same distance from the subject. It is very difficult to see how they possibly could have been when looking at [Tony's video at the 1:02 mark](#). For those not familiar with where the focal plane is on a DSLR, with a +/- of about ½" it is in the vicinity of the shutter button.

With that, I decided to do one more test to see how much of a difference it would make shooting the Sigma at 300mm with the focal plane 100" away from a subject, and then shooting a Nikkor AF-S VR Zoom-NIKKOR 70-200mm f/2.8G IF-ED at 200mm – BUT MOVING THE FOCAL PLANE 15" CLOSER. I am estimating that is the difference in distance of the focal planes of the two cameras in Tony's test. Here are the two shots (poorly lit as they are 😊), and in that order:

Craig Wassel Photography  
<http://www.craigwasselphotoart.com>  
[craig@craigwasselphotoart.com](mailto:craig@craigwasselphotoart.com)  
630.326.9908



Sigma at 300mm  
with focal plane  
100" away

Craig Wassel Photography  
<http://www.craigwasselphotoart.com>  
[craig@craigwasselphotoart.com](mailto:craig@craigwasselphotoart.com)  
630.326.9908



Nikon 70-200 VRI  
at 200mm  
with focal plane 85" away

Craig Wassel Photography  
<http://www.craigwasselphotoart.com>  
[craig@craigwasselphotoart.com](mailto:craig@craigwasselphotoart.com)  
630.326.9908



So, setting the Nikon to 200mm BUT moving the focal plane 15" closer gives a tighter composition. There is less negative space above the head, the nose is a bit bigger, and the right ear is completely cut off. This does NOT mean, however, that the Nikon has more "reach" or more "magnification" at 200mm than the Sigma does at 300mm. This cannot be said because the focal planes were not the same distance from the "model". Is the difference as dramatic as what Tony Northrup showed? No, but we still do not know how much closer the focal plane of the Canon 5D was to his subject than that of the Nikon D810.

The point of all this testing I have done is not to show one lens is better than another or that anyone should choose one manufacturer over another because of what lenses in one manufacturer's line can or cannot do. The point is to put detailed information out to for people to compare against a review that is very likely providing inaccurate information because of probable, significant issues with the testing method.

Again, feel free to email me at [craig@craigwasselphotoart.com](mailto:craig@craigwasselphotoart.com) if you have anything you would like to share with me.

Craig

Two production portraits done with the Sigma 120-300mm F2.8 DG OS HSM | S



Craig Wassel Photography  
<http://www.craigwasselphotoart.com>  
[craig@craigwasselphotoart.com](mailto:craig@craigwasselphotoart.com)  
630.326.9908



Craig Wassel Photography  
<http://www.craigwasselphotoart.com>  
[craig@craigwasselphotoart.com](mailto:craig@craigwasselphotoart.com)  
630.326.9908