Dear Authors,

Thank you for the opportunity to review your paper "Window films increase bird collision avoidance but only when applied to external 2 compared with internal surfaces of windows." In this paper you investigated the potential effectiveness of two window treatments when placed inside or outside of windows. This is a crucial question as most consumers will want to place these treatments on internal surfaces; however, there are no (or few) data to suggest this would work. In fact, there are many good reasons to assume that placing window films inside of windows will not work. Thus, birds would still be at risk and funding used by home owners and businesses to mitigate these risks would be wasted. You found that both films were effective when placed outside of the windows, but placing the decals inside windows had little effect.

The findings above have large applied implications, and could immediately help reduce loss of avifauna. They also have important implications to the underlying mechanisms, i.e., why birds strike surfaces. While I do not think that you need to get into the sensory mechanisms that result in strikes in this manuscript, your work could set the stage for such work more clearly. That said, I do think you have provided a good foundation for this information to be integrated. At places, I was also confused by the description of your experimental design and data.

Overall, while I think your work could have large implications, I do think that you may have a little more work to do to really make those findings shine. Below, I have outlined a few areas of major criticism and other minor areas of criticism.

Thank you,

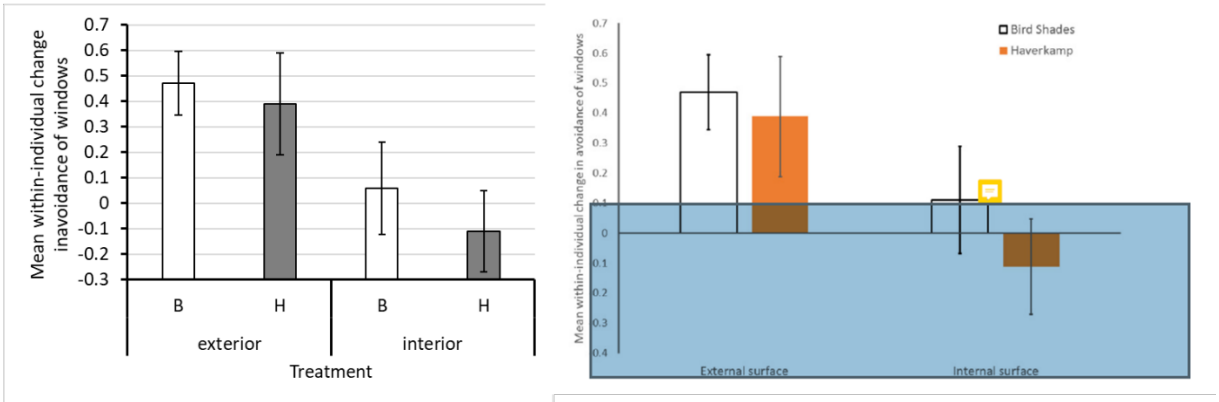
Daniel Hanley

Visual information that gives rise to strikes: If feel that you have done a commendable job to lay the groundwork of this, but you could take this a bit further. Specifically, you outline that because most glass does not transmit UV light a UV decal placed on the inside will have little value (light is absorbed on the way in, will be absorbed by the decal and surrounding glass, any available to reflect back will be absorbed on the return journey, etc.). By contrast, the decal on the outside will be visible because light will interact with it, and the surrounding glass directly. But, why didn't the Haverkamp film, which reflects visible light, work when placed on the internal surfaces? The above mechanism couldn't explain that and this isn't well described (lines ~350-370). The reason is because the optical effect that leads to confusion is likely the specular glare (i.e., reflected scene). Either film on the outside will disrupt that by variably absorbing light over that scene. When placed on the inside, the film will not obstruct the specular glare much because it will either be hardly visible (BirdShades) or its visibility will be greatly reduced (Haverkamp). What is happening is that ~15-25% of the light is reflected from the surface at an angle, depending on the intensity of light inside vs outside the bird would also see some transmitted light. When decals are placed on the external surface the "scene" is no longer visible, but when on the inside the visibility of the decal must transmit (just like the other objects that are overshadowed by the specular glare).

Information about the films and glass: I would have appreciated more information on the films and the glass. While I do not think you necessarily need transmission and reflectance spectra, I do

think you may benefit from a clearer description (i.e., "disrupt" is OK but not particularly specific). It would seem that the BirdShade film absorbs UV light, but it would be good to know that. If you could refer to reflectance and transmission, or similar terms, then it will be easier for readers to follow the logical development. Often these manufacturers will have those data available, but I am not sure you even need to get that specific. If you just want a quick test to see whether UV light is transmitted, you can shine a blacklight through the glass at standard printer paper. The printer paper will fluoresce strongly in that light, but most windows will cut this almost entirely because the excitation bands do not pass. Glass will cut the ultraviolet, but to varying degrees.

Data: I had trouble understanding the results of your binary tests. For example, (line 249) you say that 10 of 18 birds collided with windows, but I was expecting to see the numbers that hit the control or treatment relative to the total. In this case, your figure shows 1/10 vs 9/10, which doesn't correspond with the ratio you provided in the methods (out of 18). Here the 10 appears to refer to the number of birds that did not fly around the window structure, but instead hit the control or the treatment window. Only 1 hit the treated window, while 9 hit the control window. That's quite different than 10/18. Similarly, for the Haverkamp film you state that 12 of 18 birds collided with windows. Again, the construction was similar 12 of 17 didn't fly around the structure and of those 3 hit and 9 did not hit the treated window. One bird didn't fly so the total wasn't out of 18, either. For your avoidance trials (on figure 3), it would appear that the BirdShades internal surface bar is mis-plotted as roughly equal to 0.1, when it should be lower. I think the absolute value of the Haverkamp (which is ~0.1) is plotted accidently. The BirdShades should be 0.059, which is notably lower than 0.1. See the plot from our data on the left, and the plot from the paper on the right (I selected this to line the bars up to the axis).



More generally, I wonder why you didn't examine the number of strikes for Birdshade external treatment, of 18 trials 8 missed windows entirely (44%), 9 hit the control (50%), while only 1 hit the treatment (5.6%). I admit that I do not run binary choice trials; however, this would seem like a fairer treatment than saying that the strikes for the control were 90% and the treatment was 10% (which seems to elevate the proportion of strikes). In this way, you only really need on of the numbers because they are perfectly inverse. In fact, a truly effective window treatment should increase *avoidance,* which is entirely ignored by removing the birds that avoided the windows (your data consider only those that struck the control or the treatment). For example, the BirdShade decal may tip the bird off that they are flying at a wall. Your goal is to reduce the strikes on either window. Thus, those avoidance counts (those listed as 0.5) are important. Also, a bird may simply see the

window due to the film but then strike the other window because there is only time to adjust their flight plan slightly. Ignoring the avoids (0.5) means that you lose data on those that avoided the hitting anything. In your own data, 44% of the birds avoided hitting anything when there were Birdshades on the external surfaces, but only 29% succeeded in *not hitting* a window when the Haverakmp was used on the outside.

Furthermore, by excluding the birds that avoided the wall entirely can impact how we interpret your proportions. For example, let's say you ran 18 birds and 12 of those birds hit either window (experiment 1). If 2 of those hit window A (then 10 hit window B), we would have 16.6% and 83.3% collisions with window A and B respectively. However, let's say you ran 18 birds and only 4 of those hit either window (experiment 2). Now, calculating as you did, if 2 of those birds hit window A so we would have 50% and 50% respectively. These proportions are strongly impacted by their denominator. By contrast, using the same numbers since both cases had 18 trials, if we always divided by the total number of trials you would produce identical strike risks for Window A (11.1% for each experiment). In this study, it seems that you worked very hard to try to keep your design balanced (which is great); however, your proportions do not benefit from all this hard work as much as they could (i.e., if your denominator was the number of trials).

Again, I will reiterate that I do not deal with choice trials and may be entirely out of line. However, as an outsider, this seemed peculiar to me.

Animals: I appreciated that you provided detail about how the birds were kept, handled, and used. PeerJ did, in addition, request that you list where the animals were obtained from, and also details on any experimental interventions and euthanasia (or if either were not needed). The full list of criteria is on #4 on this link: https://peerj.com/about/policies-and-procedures/#animal-research

I was a little surprised that the birds' experience was not mentioned explicitly. If each captive bird is reused, and routinely flown at a wall my working assumption is that it is only a matter of time before that individual learns to fly to the left or right to avoid the wall. This may be particularly the case if the bird can never just fly strait out of the tunnel (another form of control, similar to running a "blank"), or through the wall (i.e., no window mounted), or some other treatment, such that the birds do not get conditioned

Minor:

Line 29: longer wavelength (to better contrast with shorter). Also, to accommodate that, it would be better if the order BirdShades and Haverkamp were reversed here and throughout.

Line 38: This is OK but much depends on whether the rooms were lit or darkened, and whether (and from which direction) light was oriented on the outer surface of glass. Both of these you addressed, but the reader would not know at this point. I would be careful with the presentation of this information.

Line 48: Suggested rewording here, my insertions or deletions are in brackets "decals that [should increase the] visual[] conspicuousness [of windows] to birds and [are more] easily [differentiated from] suitable habitat. "

Line 89: This is very vague, I take this to mean that the films absorb (i.e., do not pass light).

Line 98: It would be fair to say that all birds do (with two major distinctions in how far into the UV they see)... I wouldn't say "many" is the appropriate word here. Here's an example, of how I would describe this "Since birds are tetrachromatic and can see ultraviolet light, the BirdShades film contains vertical stripes of ultraviolet-disrupting patterns that appear striped to birds but transparent to us."

Line 99: "birds that can see but is invisible to us" or similar.

Line 104: why two, why these two?

Line 109: not shorter (since it isn't tinted to your eye - generally) you mean ultraviolet light doesn't pass.

Line 110: The film doesn't experience the reduction... the birds (or windows, depending on your perspective) do.

Line 125: Where was the light relative to the outer vs inner surfaces of the glass, this can make a huge impact on appearance (as would time of day)

Line 135: What does somewhat arbitrary add? You say that you selected birds that fly well (which is not arbitrary). What makes this arbitrary or somewhat arbitrary? What value does saying this add to the non-arbitrary (but obvious) selection criteria you used?

Line 158: Why? Windows in buildings do not have this angle ...

Line 206: I'm not sure if it is worth specifying, but since you stated earlier that the experimenters DID know the treatments (Line 166), you may want to clarify that the videos were not labeled in such a way to reveal their treatment.

Line 208-214: I think this requires more details, I'm not following how avoidance was quantified. Flight path? Just a comparison of the numbers of strikes?

Line 248: Based on figure 2, it seems that BirdShades on the external surfaces made birds less likely (than control) to collide; however, this sentence says that more than half collided (10/18) which makes little sense. Based on the data in the figure, it looks like this should say 2/18 not 10/18... But ultimately, it is challenging to relate these lines of text to figure 2a. Your data show only 1 bird hitting the window (i.e., = 1) in this treatment (9 did not hit (0) and 8 flew around (0.5). I think something may be mixed up in this area (perhaps it is just me).

Line 253: I apologize, I'm very confused. You said that hit = 1, flew around = 0.5, and did not hit = 0. In your dataset you have 5 that flew around, 9 that did not hit, and 3 that hit. Moreover, for the HaverkampOutside data one bird has data excluded (didn't fly) so the total on the dataset is out of 17. How do you get 12/18 that colliding?

Line 254: I would reword "were observed to collide with a" to "collided with a". If this is not what you mean, I would revise the sentence.

Line 256: If 12/18 birds collided with the window, I expect a bar in figure 2b to be ~0.666

Line 304-328: While it is great if you can connect your data to the ABC "standard" I found this entire section a little bit distracting. Your main goal is to provide clear, easily interpretable data. I think you did that. Trying to fit this within into a different classification scheme seems unnecessary, and overly complex. While I do see value in inter-industry comparability, I would argue that you have achieved that by explaining your results and sharing your data. Even if your explanation convincingly linked your data to the ABC criteria, I struggled to see what value this added to your manuscript overall.

Line 305: I don't think "select a collision" is quite fair to the bird. The birds were 9 times less likely to strike the window when they could see it.

Line 307: I think this area could be worded more clearly, as you use "numerical" difference to differentiate that from a statistical (i.e., actual) difference, but these types of edits in this area make this portion of the paragraph challenging to read. Because this is crucial and a little complicated, you may benefit from very simple language in this area.

Line 328 (area): How much of this is just that the bird is making the best of a bad choice. Let's say the bird first seems the BirdShades window, and dart to the right they then "hit" the Haverkamp window instead... Within a binary choice, the more conspicuous pane will always have a priority effect, while the other will always have elevated numbers. Birds -may- learn to always fly right or left, but that would only be if they truly got used to the setup.

Line 361-362: "At this time of day the relative proportion of shorter compared with longer wavelength light is at its greatest" cite this claim

Line 376: "Even those the Pella replacement windows we used are reported by the" I think that a word is missing or added accidently in this sentence.

Line 378: disrupt in which way? The vast majority of glass (particularly thicker double paned) block UV light. Thus, anything that is on the inside would be relatively dim. This is particularly true when you also are back lighting it....

Line 379: I wish there was more information about the films and glass. While, I cannot say for certain without that information, here's what I think is going on. When you say "disrupt" you mean absorb. So the BirdShades film absorbs UV (UV dark). The glass also absorbs UV. However, unlike an opaque sticker, glass transmits and reflects. So since it absorbs UV light but passes other light it is UV dark. BUT, light can reflect strongly from its surface. This -specular- reflectance can actually be strongest in the UV (despite the fact that glass doesn't transmit UV). So, when you put the UV dark BirdShades film on the window on a surface that would otherwise reflect a natural scene (like sky) the bird sees UV dark markings all over the surface.

Line 386: To my understanding, glass manufacturers mostly factor in transmission.

Line 389: Reasonable assumption, though the UV light with be substantially cut there too (since glass does not TRANSMIT) UV light, just because we can see through it does not be that light will pass through (multiple layers) for all the avian visual channels.

Line 399: This is an odd conclusion. I'm new to thinking about this topic... but wouldn't it be obvious that when testing avoidance birds should be able to avoid (the window)?

Line 402: If you are forcing the birds to hit the glass, wouldn't your data overestimate how likely birds are to strike the glass (not avoid it)?

Figure 1: Wouldn't most if not all birds, learn to fly left or right after a trial or two? Are there data on how far (laterally) your birds can shift within 1 m? The assumption here is not at all? I would like to see lines that will indicate where on the mist net (perhaps relative to the trajectory of the bird) would be designated as a strike and where would be a miss. Without this it is hard to visualize. That visual will help to see alongside your description. For example, I drew 4 trajectories. Bird 1 was likely going to miss the window, but where it hit the mist net may make it a "strike". Bird 2 definitely would it and bird 3 would definitely miss. Bird 4 would like be classified as a miss, but was turning in and may have hit. These same questions apply to which window they would have struck or the area between windows. Some visual representation would be useful (though the lines, like I drew would not be the way to do it, those are just examples that I was wondering about).

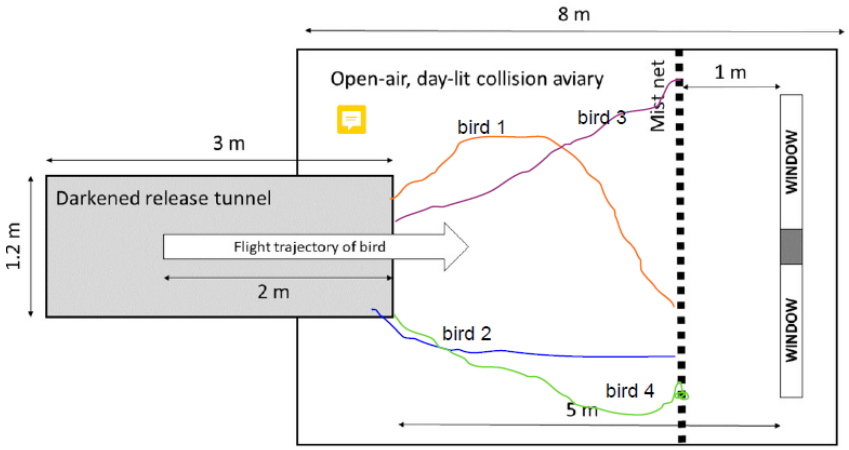


Figure 2: throughout much of the paper You refer to avoidance; however, conspicuously you quantify only differences among birds that 'struck' the glass. Why do you not compare the proportion that struck to total flights? The subset of birds that hit the glass may have done so for a range of reasons (perhaps a coin toss - your null) between these groups. I would imagine the key group of birds is that group of birds that detected your stimulus and avoided collision altogether. Naturally, they had both choices, ... but the number of strikes on treatment 1 relative to total flights vs strikes on treatment 2 relative to total flights seems to make more sense.

Also, I suggest changing "panels b and d) compared with collisions with" to "panels b and d) or with"

Figure 3: Your BirdShades (interior) sample should be 0.0588 but is above one on this graph.