**Debunking Denis Rancourt's Argument That "Masks Don't Work."**

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**David Kyle Johnson**
**Kng's College (PA)**

In June 2020, Physicist Denis Rancourt published an article entitled "Masks Don't Work: A Review of Science Relevant to COVID-19 Social Policy" in which he claims "there is no known benefit arising from wearing a mask in a viral respiratory illness epidemic." It's widely cited by the "anti-mask" movement as proof that masks don't work and thus laws requiring citizens to wear masks are ineffectual. But in reality, to put it mildly, Rancourt's argument is fraught with pseudoscience and logical mistakes, and fails entirely to even provide evidence for (much less proof of) his thesis. Indeed, his article was merely posted on his account at ResearchGate.net (not peer reviewed)--and then subsequently taken down by the website's administration because of its poor quality.

The heavy presence of pseudoscientific mistakes, as well as the low academic quality of the work, should not surprise those familiar with Rancourt or the issue at hand. As a climate change denier, Rancourt has proven himself to be incapable of recognizing and avoiding mistakes common to pseudoscientists; and as a physicist, not an epidemiologist (or climate scientist), Rancourt is completely outside his area of expertise. Still, so far I have only *said* that his argument doesn't work; and to conclude an argument is faulty solely based on its source commits the ad hominem (personal attack) fallacy. So, although I do so recognizing the danger of even giving legitimacy to his argument by engaging with it, I think it is worth the time to point out the many ways that Rancourt's argument goes wrong. Although I am not an epidemiologist either, I am a logician who teaches entire courses on argumentation and medical pseudoscience. So evaluating arguments like Rancourt's is squarely within my area of expertise.

Rancourt's argument that "masks don't work" is actually four seperate arguments.

1. Not even wearing surgical or N95 masks reduce the risk of contracting a verified illness, so how could cloth masks do so?
2. The seasonal nature of outbreaks of flu-like illnesses is due to varying humidity levels, thus masks can't help prevent their spread.
3. The particles that transmit the virus are too small to be blocked by even N95 masks, much less cloth masks.
4. A single exposure will cause you to get infected, and masks can't guarantee no exposure.

All four utterly fail. Let's tackle each in turn.

**Failed Argument 1: N95 and Surgical Masks Don't Work.**

Rancourt states the major premise of his first argument plainly: “extensive scientific literature establishes that wearing surgical masks and respirators (e.g., “N95”) does not reduce the risk of contracting a verified illness.” But there are essentially four problems with this argument.

*Problem 1: Confirmation Bias*

Rancourt gives the impression that he is doing a systematic review of the literature, but in reality he is merely selecting and citing studies that support his conclusion, and ignoring those that do not. The CDC, for example, lists 19 studies that Rancourt ignores, all of which not only contradict his conclusion but are more recent than any he lists. In logic, we call this confirmation bias--only seeking out evidence that confirms what one wants to believe. And confirmation bias is most effective in leading one astray. Rancourt engaging in it clearly demonstrates he has failed to establish that the scientific consensus comports with his conclusion, or that by “making mask-wearing recommendations and policies for the general public, or by expressly condoning the practice, governments have...ignored the scientific evidence.”

*Problem 2: The Point Is Irrelevant; He’s Equivocating*

The scientists who have advocated for universal public mask-wearing during the COVID pandemic have not claimed that the mask an uninfected person wears protects that person from becoming infected. Instead, they claim it helps prevent those who are infected from spreading their infection to others. (In other words, my mask doesn’t protect me, it protects *you from me*. Your mask protects *me from you*.)

Indeed, this is why--early on--the CDC did not recommend the general public wear cloth masks. They are mainly useful for preventing infected people from spreading their infection; healthy people don’t get that much benefit. It was only once they realized that people could so easily be infected with COVID without knowing it that they suggested that everyone, even without symptoms, wear one.

So even if it were true that masks do not protect those who wear them, it could still be true that public laws requiring masks help by mitigating the spread of COVID; they would do so by helping prevent those who are infected (especially without knowing they are) from transmitting it to others. So the evidence Rancourt provides here is actually irrelevant to the issue.

To help illustrate Rancourt’s mistake, consider an analogy. Suppose you claim that condoms help prevent pregnancy. I say you're wrong and cite a study that shows that the pregnancy rate among males who wear condoms is the same as in those who don’t. The results of that study are no doubt accurate, but they are also completely irrelevant to the issue at hand. By saying condoms help prevent pregnancy, you were saying that it helps prevent pregnancy *in women*. A study about the pregnancy rate in men is irrelevant. Similarly, if public health officials say that you wearing a mask

*helps protect others*, citing a study saying that you wearing a mask *doesn't protect you*, is irrelevant. In logic, we call this a non-sequitur.

This error actually haunts Rancourt's entire article because almost all the evidence he presents is about masks not protecting the wearer; he says very little that's relevant to whether they protect others from the wearer. Indeed, the entire article is essentially one giant equivocation. He says masks "don't work," but what does he mean by "work?" If he means cloth masks don't protect the wearer very much--yeah, we already knew that. But if he means they don't protect others, he needs to provide evidence. What "work" in the title means is the latter, but then all he really provides any evidence for in the article is the former. This is like titling an article "My Kids Don't Work" to try to motivate your biological children to get a job, and then writing an article about how your young pet goats are unemployed.

*Problem 3: The Studies Rancourt Cites Don't Actually Support His Claim*

Rancourt claims that the medical literature shows that "wearing surgical masks and respirators (e.g., "N95") does not reduce the risk of contracting a verified illness." Most of the studies he cites, however, merely show that the effectiveness of N95 and surgical masks is roughly the same. Obviously, the fact that they work equally well doesn't mean that they don't work at all (or that cloth masks don't work at all).

Now, in a way, Rancourt anticipates this objection when he states "if there were any benefit to wearing a mask, because of the blocking power against droplets and aerosol particles, then there should be more benefit from wearing a respirator (N95) compared to a surgical mask." If that were true, then the studies he cites would be relevant to whether masks offer protection. But it is not. Even if N95 masks offer no more protection than surgical masks, it would not follow that cloth masks don't offer protection. Why?

With most protective gear, as you increase the quality or quantity of the gear, there is a gradual increase in its effectiveness. But once you reach a certain point, increases in effectiveness slow and eventually become insignificant, such that there is no longer a benefit to having even higher quality. (It's a bit like, but not exactly like, diminishing returns.) So if the quality of masks levels off at a certain point, so that N95 masks don't offer that much more protection than surgical masks, that would not be surprising--and it certainly wouldn't show that cloth masks provide no protection.

To illustrate this logical error, consider bullet proof vests. A vest with kevlar that is, say, 1cm thick will clearly be less effective than one with kevlar 2cm thick; and 2cm will be less effective than 3cm, etc. But at some point, continuing to increase the thickness will be unhelpful. For example, 7cm of kevlar will likely stop all the same bullets as 10cm. So a study that showed that 7cm and 10cm thick vests offer the same protection would not be surprising; but more importantly, such a study certainly wouldn't entail that there is no protective benefit to wearing a bulletproof vest. In the same way, a study that shows N95 and surgical masks offer around the same amount of protection doesn't indicate that there is no protective benefit to wearing a cloth mask.

*Problem 4: The Other Studies Actually Prove Him Wrong.*

The other studies Rancourt cites, which are not merely comparing N95 and surgical masks, actually contradict his thesis. Now, he says they support it--but to make it seem so, he takes quotes from them out of context. Take for example his quote from a 2012 study in the journal *Influenza and Other Respiratory Viruses.*

> "None of the studies established a conclusive relationship between mask/respirator use and protection against influenza infection."

His use implies that this statement means there is no benefit to wearing masks. In reality, however, the slash in the "mask/respirator" phrase is meant to indicate a comparison between the two types of facial coverings. The study is not lumping them together and declaring them both ineffective; the study actually concludes that masks and respirators are equally effective. Several of the sentences before and after the one he quotes demonstrate this.

> "Eight of nine retrospective observational studies found that mask and/or respirator use was independently associated with a reduced risk of severe acute respiratory syndrome (SARS)."

The quotes that Rancourt uses to summarize the other studies comparing masks with respirators are equally misleading, and the conclusions of other studies he quotes (e.g., Cowling et. Al, 2010) just outright contradict his thesis.

> "There is some evidence to support the wearing of masks or respirators during illness to protect others, and public health emphasis on mask wearing during illness may help to reduce influenza virus transmission."

So, of the eight studies Rancourt cites, none of them provides any evidence to support his claim that masks do not work in reducing the spread of viruses, and several of them provide evidence that they do. I'm not sure whether (a) he didn't read them carefully, (b) expectation bias caused him to see something that is not there, or whether (c) he knows what they concluded but just lied in hopes that his readers wouldn't look closer. But I (and another colleague) did, and his limited survey of the scientific literature not only doesn't not support his claim, it decidedly contradicts it.

**Failed Argument 2: Humidity Causes Seasonal Variation, So Masks Can't Help**

Everyone knows that colds and the flu "go around" more in the winter. This is one reason flu shots are given in the fall. But explanations for this seasonal variation vary widely. Your mother perhaps told you that "being cold makes you get a cold." This is why you were instructed not to go outside with wet hair, or why if someone comes in from the cold on TV, the TV mother will say "you will catch your death out there." Since, of course, we now know that tiny organisms like viruses cause disease, we know that "being cold" does not. Other proposed explanations vary from "people are indoors more in the winter," to "soft tissue irritation," to "lack of sunlight (which causes a vitamin D

deficiency).” But in 2010, Shaman et al. suggested something else: variations in humidity. Air is humid in the summer, dry in the winter, and (so the theory goes) viruses spread more easily from person to person in dry conditions.

Now, I don’t know whether Shaman’s hypothesis has gained a consensus in the scientific community; I have not reviewed all the relevant research. What I do know is that, even if Shaman is right, it does not follow that masks don’t help prevent the spread of viral contagions. What’s more, Rancourt’s argument suggesting it does is fundamentally flawed. There are essentially two main problems to point out.

*Problem 1: Oversimplified Cause*

The first mistake is not easy to explain. Rancourt claims that, if Shaman’s humidity hypothesis is correct, then COVID’s basic reproduction number (R0) (i.e., how fast it spreads) is “highly or predominantly dependent on ambient absolute humidity.” Consequently, “all the epidemiological mathematical modeling of the benefits of mediating policies (such as social distancing [or masks]), which assumes humidity-independent R0 values, has a large likelihood of being of little value” because “the seasonal infectious viral respiratory diseases that plague temperate latitudes every year go from being intrinsically mildly contagious to virulently contagious, due simply to the bio-physical mode of transmission controlled by atmospheric humidity, irrespective of any other consideration.”

That sounds convincing, but it’s not. Why? That last phrase is key: “irrespective of any other conditions.” Not quite. Even if humidity has been the most causally efficacious factor when it comes to how fast viral infections in the past have spread, it does not follow that there are no other causal factors. Consequently, it does not follow that guarding against other factors can’t reduce the infection rate--especially if we have not taken such precautions in the past. Let me explain with an analogy.

Suppose I have a steep driveway that gets really slippery when it snows--so slippery, in fact, that my car can’t make it out onto the road. Clearly, the main reason for this is the snow; and if I removed the snow, I could get to the road. But let’s say I can’t remove the snow; my shovel and snow thrower broke. That doesn’t mean I can do nothing to enable my car to reach the road. Why? Because the snow is not the only causal factor. There are other issues too. For example, my car only has regular weather tires. If, instead, I put “snow tires chains” around the wheels, I could make it out of my driveway with no problem. Yes, the main cause of the problem is the snow, but that doesn’t mean I can’t solve the problem by addressing other issues.

Or take a first time skier. He goes out the first day, and comes back soaked to the bone. Undeniably, it’s the snow that made him wet. But if he just shrugged his shoulders and said “Well, if I’m going to ski, there is going to be snow, so I guess I’ll just have to be soaked every day” we would call him a fool. A simple pair of rubber ski pants will keep him dry.

I am not, here, trying to compare snow with viruses; I am demonstrating Rancourt's logical mistake. The fact that some thing X is the main cause of a problem Y doesn't mean that the only way to solve Y is by removing or changing X; usually the problem can be mitigated by taking some other precaution or action Z. For example, the fact that a river's physical attributes are primarily what determine its speed, doesn't mean that you can't stop it by building a dam. Likewise, even if a lack of humidity in the winter has been the main cause of winter viral spread in the past (and you can't change the humidity), that doesn't mean that you can't mitigate the spread of the virus by taking some other precaution (like mandating masks).

To use a more direct analogy, suppose we tried to mitigate the spread of the flu by locking everyone in the world in their home, in separate rooms, for two months. This would of course be overly draconian, and a really bad idea for multiple reasons--but it undoubtedly would stop the spread, and indeed mostly likely wipe out the disease. It would run its course in all infected persons, either killing them or being killed by their immune systems, and then be done. Right? Of course!

But notice how stupid someone would seem if they came out and said "such efforts will have *no effect at all* on the spread of the disease at all because islating people won't affect the humidity." Even if humidity is normally a major factor in transmission, and explains seasonal variation, there are other things at play: like how we are exposed to others who are infected. If we limit that exposure by locking everyone in their room--or, less drastically, we simply encourage people to social distance and wear masks--we will lessen the spread--even if the humidity levels are unaffected. So Rancourt's argument here suffers from the most basic of logical flaws: he simply failed to recognize that there is more than one causal factor when it comes to viral spread. In logic, we call this the fallacy of oversimplified cause.

*Problem 2: What's Happened Since: Wide Spread in Humid Months*

The second problem with Rancourt's humidity argument is what has happened since he wrote his argument in April of 2020. The infection rate in states that ignored social distancing and mask guidelines have skyrocketed in the hottest most humid times and places (e.g, Florida and Texas in July). This not only indicates that mask mandates and social distancing works (because the places that have utilized them haven't seen these kinds of increases), but also either means that

(a) Shaman's humidity hypothesis, and thus the basis for Rancourt's entire argument, is false
(b) humidity doesn't affect COVID-19 like it does other coronaviruses (and thus, again, the basis for Rancourt's entire argument is false) or
(c) humidity does affect the infection rate for COVID-19, but it's so infectious that it still spreads like wildfire even in humid months.

My guess is (c). And if (c) is true, we have even more reason to mandate masks (and social distancing), because the upcoming fall and winter months are going to be monumentally worse in regards to potential spread. In any event, however, Rancourt's "it's the humidity stupid" argument utterly fails.

**Failed Argument 3: Particles that transmit the virus are too small to be blocked by masks.**

The major premise of this argument is that the COVID virus, or more specifically the droplets that carry it, are too small to be blocked by cloth masks and thus masks cannot provide protection. Indeed, Rancourt claims that they can't even be blocked by N95 masks; so how could cloth masks possibly provide any protection? But, as you might have guessed, there are serious flaws with this argument too--flaws so severe that each renders it impotent. I will explain four of them.

*Problem 1: Dubious Assumptions*

The first is a result of how this argument relies on Shaman's humidity hypothesis. If humidity affects the transmission of viruses, it's not clear how it does so. Two possibilities that Rancourt mentions are "viable decay" and "physical loss." If it is *viable decay*, flu spreads less in the summer because humid air deactivates viral-pathogen-carrying droplets more quickly than dry air. If it's *physical loss*, then the humidity physically removes such drops from the air (by, say, making them drop to the ground more quickly).

The reason this matters is because, as Rancourt himself admits, his argument about how masks can't block certain size droplets only shows masks to be ineffective if the "physical loss" explanation is right.

> If my view of the mechanism is correct (i.e., "physical loss"), then Shaman's work further necessarily implies that the dryness-driven high transmissibility (large R0) arises from small aerosol particles fluidly suspended in the air; as opposed to large droplets that are quickly gravitationally removed from the air.

But there is no good reason to think the physical loss explanation is right.

(a) The author of the study that Rancourt himself cites (Harper, 1961) argues for the "viable decay" hypothesis, and regards the physical decay hypothesis to merely be possible. (By the way, the fallacy of thinking that something being possible entails that it is true is cleverly named the "appeal to possibility" fallacy.)

(b) Rancourt doesn't actually provide any evidence for the physical loss theory. He merely states that it "seems more plausible" to him, and that he finds it "difficult to understand" how the viable decay hypothesis could be true. Needless to say, the fact that Rancourt can't understand something is not a good reason to think that it is false. And unless the viable decay hypothesis is false, Rancourt's argument doesn't work. (By the way, thinking something is false because you can't understand it is called the "appeal to personal incredulity" fallacy.)

*Problem 2: A Mistake in The Math*

Rancourt's argument is not well organized and difficult to parse sometimes, but it seems that he has made a fundamental mathematical mistake that completely invalidates his argument. Recall, one of the major premises of his argument is that not even N95 masks can block viruses. To establish this, however, he argues that the pores in N95 masks are too big to block the virus.

Now, in doing so, he doesn't make the common mistake of thinking that the pores of the mask need to be smaller than the virus itself. Rancourt understands that the virus is never in the air, "by itself." It's contained in droplets (water particles). And a person gets infected when (what we might call) "infected droplets" expelled by an infected person enter another person's mouth or nose. But Rancourt thinks that the pores in an N95 mask are too big to block droplets containing the virus. He says.

> "...indoor airborne virus concentrations have been shown to exist (in day-care facilities, health centers, and on board airplanes) primarily as aerosol particles of diameters smaller than 2.5 μm [microns]...Such small particles (< 2.5 μm) are part of air fluidity, are not subject to gravitational sedimentation, and would not be stopped by long-range inertial impact…[so] the filtration material itself of N95 (average pore size ~0.3−0.5 μm) does not block virion penetration, not to mention surgical masks."

Initially when I read this, I was confused. Clearly, a 2.5 μm particle is much bigger than a 0.3 (or 0.4, or 0.5) pore. So how can he possibly be claiming that the 0.3 μm pores in N95 masks are too big to block 2.5 μm particles? Am I missing something?

And then it dawned on me.

Yes, 2.5 is greater than 0.3--but it's less than 3! And that's the only way what he says here makes any sense. He thinks that a 0.3 μm pore won't block a 2.5 μm particle because 3 is a greater number than 2.5. He didn't notice the decimal! (Because of expectation bias maybe?) Such a basic mathematical mistake casts a dark light on the rest of his argument.

*Problem 3: Rancourt Doesn't Understand How N95 Masks Work*

There is another problem with Rancourt's argument: he doesn't understand how N95 masks protect their wearers. It's not just by having pores that are smaller than "infected droplets." Indeed, N95 masks are even better at capturing droplets that are smaller than their 0.3 μm pores. How so?

The first reason has to do with what is known as “Brownian Motion” which refers to the erratic way that such small particles zig-zag around. The fact that they do this, but larger particles do not, actually makes them more likely to be captured by N95 masks. The second reason has to do with electrostatic absorption. The masks actually carry a static electric charge, and as a result draw nearby particles to the mask fiber and trap them more readily. In a way, the charge forms a kind of Star Trek like “shield” that is difficult for any matter to pass through.

Indeed, N95 masks are so named because they have been proven to block 95% of the particles that they are *least efficient* at filtering--and those are the particles that are around that 0.3μm range. So not only have N95 masks been proven effective, but contrary to Rancourt’s claims, their pore size is not the only thing that determines their effectiveness.

That said, the fact that N95 masks block viral particles doesn’t mean that cloth masks do. Indeed, the pores in cloth masks are significantly larger than 0.3μm. But that brings us to the next problem with his argument:

*Problem 4: Rancourt Doesn’t Understand How Cloth Masks Work*

As I made clear earlier, my mask doesn’t protect me, it protects you from me. So masks are not mandated because they protect the person that wears them; they are mandated because they protect others from the wearer. So Rancourt’s argument that your cloth mask masks cannot prevent viral droplets already in the air from entering your mouth, kind of misses the entire point.

Still, one wonders: if the mask I am wearing can’t filter out viral droplets already in the air because the pores are too big, then how can someone else’s mask filter out the viral droplets they are exhaling, to keep them from entering the air? In other words, if cloth masks can’t filter the air I am breathing in, how can it filter the air someone else is breathing out? This is a sensible question, but it also has a very sensible answer.

As I explained above, viruses are transmitted via water droplets that people expel. So whether or not a mask can filter out an infected droplet has everything to do with the droplet’s size. If it’s big enough, yes even cloth masks can catch it; but if it’s too small, it will pass right through.

This is why a cloth mask doesn’t offer its wearer as much protection as, say, an N95 mask. The longer a water droplet hangs in the air, the more chance it has to evaporate; and the more it evaporates, the smaller it gets; and the smaller it gets, the more likely it is to be able to pass through your cloth mask. So if you are wearing a mask in a room with an infected person who is not wearing a mask, there are likely lots of smaller mostly evaporated infected droplets in the air that are too small to be captured by your mask--and so your mask is not going to offer all that much protection.

However, the particles coming out of an infected person's mouth will not have had a chance to evaporate yet; they will still be large. As a result, if the infected person is wearing a mask, the infected droplets existing in their mouth will likely be captured and not expelled into the air. This doesn't protect them; they are already infected. But it does protect you. So if you are maskless, in a room with a masked infected person, you actually have some amount of protection. (This is also why not wearing a mask is so selfish; others are protecting you by wearing one, but you are not bothering to protect them.) ,

So clearly, all of Rancourt's talk about whether your mask can filter infected droplets from the air you breathe in, and humidity being the cause of seasonal spikes, is completely irrelevant to the issue at hand. Regardless of how humid it is, or whether masks can protect their wearer, cloth masks will stop the large infected droplets coming out of an infected person's mouth from entering the air; they thus lower the probability that the infected person will infect others. Consequently, making sure all infected persons (even those who don't know they are infected) are wearing masks, by making everyone wear a mask, will work to reduce the infection rate in the general population.

Of course, a mask won't do this if the infected person only wears it over their mouth, and not their mouth and nose. Since they are both connected, what comes out of your mouth comes out of your nose too--and that includes infected droplets. But the notion of imperfect mask use brings us to Rancourt's fourth and final argument:

**Failed Argument 4: Masks Can't Guarantee 0% Exposure, Thus They are Useless**

In his final argument, Rancourt suggests that masks can't work because they are not 100% effective at stopping infected droplets. Why must they do so? Because, he says, the minimal infective dose (MID) for COVID is really low; exposure to just one infected droplet will make a person sick. And so, he says, "the studies that show partial stopping power of masks, or that show that masks can capture many large droplets produced by a sneezing or coughing mask-wearer...are irrelevant." But, again, his argument is fundamentally flawed. There are essentially two problems with his argument.

*Problem 1: No evidence for COVID's Minimal Infective Dose (MID)*

First of all, he provides no direct evidence for COVID's MID. He, instead, cites a study from 2011 (by Yezli and Otter) about influenza. But COVID is a different disease that affects those it infects in much different ways (for example, it seems to affect blood vessels and cause blood clots). So influenza's MID can only point in the direction of COVID's MID, at best.

Second, he merely states that "It is believed that a single virion can be enough to induce illness in the host." But of course a belief is not evidence. He quotes Zwart et al. (2009), saying his study on a virus-insect system showed that "the action of a single virion can be sufficient to cause disease."

But the fact that something *can be sufficient to cause something*, doesn't mean that it is or will in all or even most cases.

Third, even the evidence he provides for influenza doesn't show that one infected droplet will make a person sick. According to Rancourt himself, Yezli and Otter's study only suggests that the "50-percent probability MID easily fits into a single (one) aerolized [sic] droplet." That only means that one droplet making its way into your system means that you are about 50% likely to get sick. So, it's "enough" in the sense that it *could make you ill*, but it's not "enough" in the sense that it is *guaranteed to make you ill*. Again, he seems to be equivocating--this time on the word "enough."

And the other evidence he provides, like from Baccam et al. (2006) and Brooke et al. (2013), only talk about how quickly or efficiently viruses reproduce in cells once they are infected--not the probability of cells becoming infected once exposed.

Still, according to Rancourt's summary of Yezli and Otter, you are 50% likely to get influenza if you are exposed to between 100-1000 virions, and droplets between 1μm and 10 μm can contain between 1000 and 10,000,000. As stated before, the average droplet is about 2.5 μm and so probably contains 2500 viruses. If COVID is anything like influenza, just a few such droplets making it through a person's mask would make one's probability of getting sick pretty high. And according to Neupane (2009), a cloth mask's efficiency of blocking such particles is only between 63% to 84%. This is enough to make one wonder whether Rancourt might actually be right. How can masks do any good? But this brings us to the second problem with this argument.

*Problem 2: The All or Nothing Fallacy*

The all or nothing fallacy is a variety of the false dilemma fallacy. One commits the false dilemma fallacy when one suggests that there are fewer options than there actually are. "You are either for us, or against us." No, actually, I could just be neutral, or not care. The all or nothing fallacy presents a false dilemma by suggesting that there are only two options—either *all* or *nothing*—when in fact there are many more options in the middle ground between those two extremes.

The fallacy is very common when talking about the effectiveness of laws. Take gun laws for example. No amount of background checks or licencing requirements will stop all gun crimes. This fact causes many to suggest that we should have no gun laws at all. But, of course, this is fallacious. The point of laws is not to eliminate all criminal or harmful activities; it is to reduce them. And gun regulations, while they cannot eliminate all gun crime, can and do reduce it. Notice that speed limits cannot prevent everyone from speeding, and cannot eliminate all car crashes. But not one would argue that speed limits are useless and that we should not even bother with them. They reduce *the amount* of speeding and thus make the roads safer.

In the same way, masks cannot eliminate COVID infections; even if everyone is wearing a mask, some people will still get infected, because masks are not perfect. They cannot guarantee no

transmission. But if everyone is wearing them, they can make the number of infected droplets in the air far fewer. And if you still happen to be exposed to one in the air, they can reduce the chance of exposure (by up to 84%!). Thus, even though they cannot eliminate it, mask mandates will *reduce* the probability of infection, and thus the number of people infected.

This also applies to the fact that some people will use their masks improperly--by, say, hanging their nose out of the top. Yes, their mask is not effective. But by mandating mask use, the number of infected people wearing them properly raises, and thus the probability of healthy people becoming infected drops.

**Rancourt's Concluding Arguments**

Rancourt finishes his article by claiming that no "bias free" study could ever show that mask mandates are effective. But that "bias free" phrase is doing a lot of work. Notice that, if any such study ever came out, he would just claim that it was biased and dismiss it. He has just built into his argument what logicians call an "ad hoc" excuse--an unfalsifiable way to excuse away any contrary evidence. It is a telltale sign of pseudoscience and irrationality.

He also suggests that no such study could be done because "Mask-wearing is associated (correlated) with several other health behaviors" and "The results would not be transferable, because of differing cultural habits." But, of course, these are simply things that such studies would have to take into account and control for. It does not mean they cannot be done.

He also lists a number of "unknown risks" to mask wearing, suggesting that the risks of a mask mandate would outweigh its benefits. But not only are the supposed risks he lists miniscule compared to the tens of thousands of lives that mask mandates could save, and the enormous economic benefit that masks could generate by allowing businesses to open up without major risk, but they are completely unfounded.

Notice what he is doing: He is asking us to take all the scientifically proven evidence for the benefits of masks and completely ignore it, but take seriously, as if they are proven, all these "risks" that he is just essentially creating out of whole cloth. This would be like, I don't know, not putting a cast on your broken leg because your friend says "Hey, there could be asbestos in those casts; you don't know." Yeah, maybe--I guess? But until I have good reason to think such a thing is an actual risk, and that the risk outweighs the benefit, I'm going to do what has been proven to work.

**Conclusion**

I have presented this argument with no illusion about convincing Rancourt that he is wrong. Doubting the scientific consensus is clearly part of his identity, and when a belief is tied to someone's identity, presenting evidence against is likely just going to backfire. Indeed, Rancourt

seems to be the poster child for the Dunning Kruger effect, and the fact that intelligence alone doesn't make one adept at avoiding bad arguments--but, instead, makes one better at creating fallacious (but seemingly convincing) arguments for false conclusions. Upon reading this, I'm sure Rancourt would produce a whole list of ad hoc excuses to explain away his errors.

If he does, don't be fooled. As an old philosophy professor once said of a fellow student of mine, "He's just smart enough to be dangerous." Any arguments Rancourt gives will be steeped in fallacies and pseudoscience. And that's not me constructing an ad hoc excuse. That's me extrapolating from the available data.

If he does offer such arguments, I'd love to explain why they are wrong. Unfortunately however, as I believe this article proves, it always takes longer to explain what is wrong with bad arguments than it does to make them.