Optogenetics have delivered unprecedented results. The field has a long history going back to Francis Crick 1979, recently people like Georg Nagel, Karl Deisseroth, Ed Boyden and others, have made breakthrough innovations, starting with publications from Karl Deisseroth in 2004 showing light activation of neurons expressing a channelrhodopsin.

In 2011, Ed Boyden used optogenetics to cure mice of certain form of blindness, <https://www.youtube.com/watch?v=jY5Aynh1-cU>

Longer talk, about 18 mn video, <https://www.ted.com/talks/ed_boyden_a_light_switch_for_neurons?language=en#t-927907>

And in May 2021, a blind man’s sight is partially restored using optogenetic therapy:

<https://www.youtube.com/watch?v=iHP2s1WSNSs>

<https://www.nytimes.com/2021/05/24/science/blindness-therapy-optogenetics.html>

In the case above, it took about 10 years to use optogenetics to prove itself in the clinics, discuss some potential applications of optogenetics, the limitations of the genetic therapy you will describe to make it as human therapy, and/or ways to address them.

Describe some concrete applications of optogenetics, and discuss its current limitations and potential venus to address them.

Optogenetics seem to be such a paradigm shift in biomedical engineering. Your comment about being invasive is probably a major roadblock to transition easily the therapies to humans.

Still when you mention restoring motor functions from paralysis, it seems that the stakes are so important that there will be a strong motivation to make it successful.

Reading your post about using optogentic therapies to reduce pain made me think that it could be useful for some surgeries where you want the patient to be conscious without using anesthesia or other surgeries where even administering the anesthesia like with an epidural, could be painful. The ethical considerations about editing genes though, I do not think it is specific to optogenetics. However, I could imagine cases for which decreasing levels of pain could be used outside of medical contexts. Societies will have to address the legal implications but it might be one of these situations where the pace of progress is too fast for them to handle quickly enough their implications (See AI fake news, or responsible AI and other related topics).

Thank you for sharing this information about abilify. What you are proposing could be a game-changer in antipsychotic to carefully stabilize dopamine levels and be able to design a very precise light triggering system will open the field to powerful and efficient drugs as you are describing.

Among the posts here, it seems a recurrent acknowledgment that optogenetic therapies will be a tremendous differential factor in mental disorders. As you are indicating addressing efficiently depression will be a huge win for optogenetic therapies. Going through the article you listed, I realized one technical aspect to handle could be in some cases the deactivation of the optogenetic apparatus when the neuronal function has been fully restored and the therapy has to be designed from the ground-up as temporary (I don’t have in mind a specific situation where this will be required but for example the patient maybe due to the burden of the limited comfort provided by the therapy might decide to be pulled off from it).

Thank you for sharing all this information and an interesting and critical application of optogenetics. However even with their current limitations, there is probably a lot domain expert accumulated all these years in designing pacemakers to different biological settings, and I was wondering how much, will be needed to be replicated or re-engineered, before the optogenetic pacemakers provides superior results. For example, you mention injecting rhodopsin into the SA node, how much dose is needed and at which data point, it could have side-effect.

Maybe the optogenetic way is so different that the obstacle the mechanical pacemakers are facing become irrelevant or significantly diminished.