

## Research Assessment #4

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Subject: ISM (Independent Study and Mentorship)

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Lin, Haotian, et al. "Lens regeneration using endogenous stem cells with gain of visual function." *Nature* vol. 531,7594 (2016): 323-8. doi:10.1038/nature17181

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For my fourth research assessment, I found a study by Haotian Lin and their research team titled "Lens regeneration using endogenous stem cells with gain of visual function." This paper focuses on pediatric cataract treatment using stem cells to regenerate the lens. The current method for cataract surgery in infants is very invasive and has many complications. To combat this, these researchers researched many different models, including human and animal, to find a new approach that is minimally invasive and more effective. They specifically talk about using lens epithelial cells or LECs, a type of stem cell necessary for the natural homeostasis of the eye.

As I read the journal, I was interested and could use much of its information. Since this article is about lens regeneration, it is relevant to my project in ISM. I especially want to do a project based on stem cells and the eye, which immensely helped me. The methods and how they used the LECs helped me build my project. Moreover, it also helped me have an epiphany about my project; initially, I was focused on macular degeneration for my project; however, upon reading this, I also want to research cataracts and see if that may be a more viable option for me.

Moreover, when I analyze and examine the information in the study, I find that the survey of lens regeneration using endogenous stem cells is a novel approach that challenges the current treatments and surgery available. The study is trying to preserve the LECs and help promote natural lens regeneration

instead of the available traditional invasive therapies. Before I read this study, I was unaware that infants could experience cataracts and they would need surgery for this at such a young age. I also learned that sometimes the surgery is not successful, and the infants become aphakic, where they have no lens on their eye. The information benefits me as it can be classified into many different parts, and it touches on many topics such as regenerative medicine, Ophthalmology, stem cell application, and minimally invasive surgery techniques. The paper touches on all of these topics, and when we break down the information, I can split it into three main parts: the introduction, discussion, and methods. Throughout these parts, the topics I mentioned before are talked about. This study also adds a lot of new information to my current view of regenerative medicine. For example, this study proved that lens regeneration is possible and could be a viable option for my research project. Many studies have claimed that since the lens is so superficial, they can't regenerate it, but this study proved them wrong. Thus, the study is a turning point in ophthalmology since LECs before this were underappreciated in clinical settings. Using the body's cells to regenerate complex structures like the lens is innovative as it regenerates the lens to its total capacity, which differs from current treatments, which can only regain the partial function of the lens. Essentially, this study opened me up to many new possibilities.

Let's come to the question of how I can use this information. This study can blend perfectly well into my current idea for my project. At the moment, I want to conduct an experiment that uses stem cells to promote regeneration in the eye. More specifically, I want to monitor the ocular microenvironment and see precisely what is affecting regeneration in the eye. This study focuses on lens regeneration, so I want to research and focus on that for my study. A new question is whether mesenchymal stem cells can be differentiated into LECs and implanted into the eye, and how does that affect the microenvironment? The current study uses endogenous stem cells, similar to but not mesenchymal stem cells. Using the information from this study, I want to see if mesenchymal stem cells can do the same things. I can even use these techniques to see if the same method used with LECs can be used with cells in the retina. The LECs are in the front of the eye, but I initially planned to focus on the retina. However, this study could

also use the same methods in the retina. Finally, I could also use this information to experiment on myopia and hyperopia. Initially, when I came into the research field, I wanted to work on myopia and hyperopia, which are near and farsightedness, when the lens is not in the right shape and causes people to need glasses. So, using the methods and technology the researchers used to facilitate lens regeneration, I could also work on finding a way to reverse the effects of myopia and hyperopia. I also learned about a specific technique called Western blotting, which will be helpful for my project at ISM. Moreover, I was shocked to find that gene editing could also be used in the context of regenerative medicine, and I wanted to see if I could incorporate that into my project as well.

Finally, let us judge and reflect on this paper and the information that can be gained from it. Overall, the research paper was very well written and helpful as it helped me find new avenues of research. However, after reading and reflecting upon it, I felt some aspects of the paper were very disappointing. One of the main things I was very confused about was the paper's organization. The paper had its discussion before the methods and the data at the end, which made it difficult to understand and decipher. I felt that the researchers knew what they were talking about and did a lot of good research; however, at some points, they didn't explain precisely what they did, making it hard to understand. When I read the introduction and the discussion, it sparsely mentioned gene editing; however, once I got to the methods and data sections, it randomly mentioned gene editing as if I was supposed to know that. Essentially, the poor organization and explanation were significant drawbacks of the paper. This was disappointing since this experiment was much more complicated than the research I read about last week for my research assessment. But the parts I could understand and read were really helpful in achieving my goals. After I reflected, I felt that before I read this paper, I really pigeonholed myself into one specific niche research topic, only focusing on macular degeneration and mesenchymal stem cells. But now, with the perspective I gained from this new paper, I feel I have many more possibilities to explore before choosing such a niche topic. However, I still feel that I have an idea for my project I really want

to focus on stem cells and the ocular environment, but I want to do more research before I try to pick a specific portion of the eye to experiemnt on.