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Google DeepMind's gemini AI versus ChatGPT: a comparative analysis in ophthalmology

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INTRODUCTION

Google's Gemini AI represents a significant leap in chatbot technology, showcasing advanced capabilities and innovative features. Central to Gemini's design is its status as a "native multimodal" model, enabling it to process and learn from various data types, including text, audio, and video. Gemini's technical capabilities is evident in its ability to analyse complex data sets, such as charts and images, which is a substantial advancement over the earlier Bard AI models [1]. This capability is particularly relevant for applications in medicine and ophthalmology, where data often comes in visual formats like medical images/scans. By analysing these images, Gemini could potentially be a useful tool to healthcare professionals in diagnosing and treating a wide range of conditions.

Moreover, Gemini's potential in medicine extends beyond image analysis. Its advanced language processing abilities enable it to understand and interpret medical literature, patient histories, and research data, providing valuable insights for medical professionals. In ophthalmology, Gemini could assist in diagnosing eye conditions, analysing patient-reported symptoms, and even suggesting treatment plans based on the latest research and clinical guidelines. ChatGPT has previously attempted these tasks, however did not yet perform at suitable levels to be used clinically [2–7]. Large language models such as ChatGPT can make errors in understanding the context of information, or provide outdated information, which further complicates the usage of these technologies in a clinical context [8–11].

We first decided to ask Bard to advise a patient of what to do when they complained of waking up with painful red eyes. Bard's response was thorough and practical, providing a list of steps the patient could take, such as applying cool compress, using artificial tears, and avoiding eye rubbing, to relieve any on-going inflammation (Fig. 1A). ChatGPT similarly provided very similar, yet a longer more comprehensive list of practical guidance and

steps that the patient could take to reduce their discomfort. Bard and ChatGPT's responses were medically sound and in-line with current clinical guidelines.

Next, we asked Gemini about how often an individual should have an eye exam. Gemini AI suggested four age-based recommendations for eye exams, noting that individual needs may vary due to factors like eyeglass use, existing eye conditions, or family medical history. Similarly, ChatGPT had categories of 'Children and teenagers', 'Adults', and 'Older adults'. Both Gemini AI and ChatGPT highlighted the importance of consulting with an eye specialist.

Next we prompted both of AI chatbots about a patient reporting "flashes of lights" in one eye, and if they should attend the emergency department. Both Bard and ChatGPT correctly recommended to attend the emergency department, particularly if this vision change occurred suddenly. Both chatbots also appropriately stated that this symptom could be a sign of a retinal tear or detachment, requiring urgent evaluation. These AI-generated outputs were both specific, and appropriate.


Finally, we prompted both AI chatbots about what a patient should do if they started seeing floaters or black dots (see Fig. 2). There are several causes of floaters ranging from relatively benign (e.g. age-related) to more serious causes (e.g. retinal detachment). Bard accurately reported a few potential reasons and suggested a formal consultation with an eye care specialist if sudden blindness developed or if the patient started experiencing changes in floater size or light flashes, which correctly addresses potential risk. Bard also provided practical tips to reduce discomfort due to floaters. ChatGPT's response was similar to Bard and also correctly explained causes of floaters and when to seek urgent medical assistance. ChatGPT, unlike Bard, also provided information on floaters treatment. In addition, ChatGPT advised seeing an eye doctor if there were several floaters, light flashes or a seeing a curtain over the vision field (Fig. 3).



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A

I woke up this morning with painful red eyes, what can I do about it? 

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 Waking up with painful red eyes can be unpleasant and concerning. It's important to identify the cause to get the right treatment and relief. Here are some steps you can take:

- 1. Self-assessment:**
 - Consider any recent activities or exposures: Did you have contact with allergens like pollen or pet dander? Use any harsh chemicals or irritants near your eyes? Were you swimming in chlorinated water without goggles? These factors can trigger eye irritation and redness.
 - Evaluate your symptoms: Do you have any discharge, blurry vision, sensitivity to light, or swelling around your eyes? These could indicate a more serious condition like conjunctivitis or corneal abrasion.
- 2. Home remedies for mild irritation:**
 - Gentle cleansing: Use a clean washcloth dampened with cool water to remove any crusting or debris around your eyes. Avoid rubbing your eyes, as this can worsen the irritation.
 - Cool compress: Apply a cool compress, such as a washcloth soaked in cold water or a gel eye mask, to your closed eyes for 10-15 minutes several times a day. This can help reduce swelling and discomfort.
 - Artificial tears: Over-the-counter artificial tears can help lubricate dry eyes and soothe irritation.
- 3. When to seek medical attention:**


If your eye pain is severe, your vision is impaired, you have a foreign object stuck in your eye, or the redness worsens despite home care, seek immediate medical attention from an ophthalmologist. They can accurately diagnose the cause of your red eyes and recommend the appropriate treatment, which may include prescription eye drops or antibiotics.

Here are some additional tips for preventing red eyes:






- Wash your hands frequently, especially before touching your eyes.
- Avoid rubbing your eyes, as this can introduce bacteria and irritants.
- Remove your eye makeup before bed.
- Wear sunglasses that block UV rays to protect your eyes from the sun.
- Use a humidifier to add moisture to the air, especially during dry seasons.

Remember, I'm not a medical professional, and this information is not a substitute for professional medical advice. If you're concerned about your eye health, always consult a doctor.


I hope you feel better soon!




Eye doctor checking a p...

B

 You

I woke up this morning with painful red eyes, what can I do about it?

 ChatGPT

I'm not a doctor, but I can offer some general suggestions for dealing with painful red eyes. If your symptoms persist or worsen, it's essential to consult a healthcare professional for a proper diagnosis and treatment. Here are some steps you can take in the meantime:

1. Wash your hands: Start by thoroughly washing your hands with soap and water to prevent any potential infection from spreading to your eyes.
2. Avoid rubbing your eyes: Even though it may be tempting, rubbing your eyes can exacerbate the irritation and redness. Try to refrain from touching your eyes.
3. Artificial tears: Over-the-counter artificial tears or lubricating eye drops may help soothe dry and irritated eyes. They can provide temporary relief and help flush out any foreign particles or allergens.
4. Rest your eyes: Give your eyes a break by closing them and resting in a dark, quiet room for a while. This can help reduce strain and alleviate redness.
5. Cold compress: Applying a cold compress over your closed eyelids for 10-15 minutes can help reduce inflammation and relieve discomfort.
6. Allergies: If you suspect allergies are the cause of your red eyes, consider taking an antihistamine medication as directed by a healthcare professional.
7. Remove contact lenses: If you wear contact lenses, remove them and switch to glasses until your eyes feel better. Contact lenses can sometimes worsen eye irritation.
8. Avoid irritants: Stay away from smoke, dust, strong winds, and other environmental factors that can exacerbate eye irritation. Use protective eyewear if necessary.
9. Hydration and a healthy diet: Staying well-hydrated and consuming a diet rich in fruits and vegetables can support overall eye health.
10. Consult a healthcare professional: If your red eyes are accompanied by severe pain, vision changes, discharge, or if the symptoms persist for more than a day or two, it's crucial to seek medical advice. Your healthcare provider can help determine the underlying cause and prescribe appropriate treatment.

Remember that these are general suggestions, and the cause of red eyes can vary. Consulting a healthcare professional for a proper evaluation is the best course of action if your symptoms continue or worsen.





   

Fig. 1 Output responses generated by Bard and ChatGPT. **A** Output generated by Bard from the prompt "I woke up this morning with painful red eyes, what can I do about it?". **B** Output generated by ChatGPT 3.5.

Finally, we wanted to test the image analysis capabilities of Gemini AI against GPT-4.

Gemini AI unfortunately could not process the file despite attempting a variety of prompts. On the other hand, GPT-4 correctly identified the image of a human eye and that the picture was taken using an operating microscope. However, GPT-4 failed to correctly describe the red coloration as hyphaema (Fig. 4).

CONCLUSION

Overall, the new Gemini AI model represents a notable improvement in text-based output than predecessor models. The comparative analysis between Gemini AI and ChatGPT/GPT-

4 reveals distinct attributes and capabilities of these advanced AI models. Gemini AI shows promise with unique strengths in areas such as language understanding. It emerges as a strong competitor to ChatGPT, suggesting a dynamic and evolving landscape in AI language models. Both models exhibit exceptional capabilities but differ in various aspects of language processing and response generation. The analysis underlines the fact that each AI model, including ChatGPT, GPT-4, Bard, and Gemini AI, possesses unique strengths and weaknesses, making them suitable for different applications and use cases. It is important to note that further advancements are necessary prior to being the use of AI chatbots in clinical settings [12, 13].

A



How often should I have an eye exam?

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The recommended frequency for eye exams depends on several factors, including your age, overall health, vision health, and risk factors for eye disease. Here's a general guideline based on age:

Age Group:	Recommended Frequency:
19-39 years old	Every 5 years (may need more frequent exams if African-American)
40-54 years old	Every 2-4 years
55-64 years old	Every 1-3 years
65 years and older	Every 1-2 years

Export to Sheets

However, these are just general recommendations. You may need more frequent exams if:

- You have existing eye conditions like glaucoma, cataracts, or macular degeneration.
- You wear glasses or contact lenses.
- You have a family history of eye disease.
- You have a chronic health condition like diabetes or high blood pressure.
- You experience any changes in your vision, such as blurry vision, eye pain, or double vision.

Ultimately, the best way to determine how often you need an eye exam is to talk to your eye doctor. They can assess your individual risk factors and recommend a schedule that's right for you.

I hope this helps! Let me know if you have any other questions.



B



You
how often should i have an eye exam?

ChatGPT

The frequency of eye exams can vary depending on your age, overall eye health, and any specific eye conditions or risk factors you may have. Here are some general guidelines:

1. Children and teenagers:
 - Pediatricians often perform routine eye screenings during well-child visits. However, if your child has a family history of eye problems or you notice any signs of vision issues, you should consult with an eye doctor. Regular eye exams during childhood are essential to detect and address any vision problems early.
2. Adults:
 - For adults with no known eye issues or risk factors, it is recommended to have a comprehensive eye exam every 2 years between the ages of 18 and 60.
 - If you wear corrective lenses (glasses or contact lenses), you should have an annual eye exam or as recommended by your eye care professional.
 - Adults with certain risk factors, such as a family history of eye diseases, diabetes, high blood pressure, or other medical conditions that can affect the eyes, may need more frequent eye exams. Your eye doctor can provide personalized recommendations based on your specific situation.
3. Older adults:
 - As you age, the risk of developing eye conditions such as cataracts, glaucoma, and age-related macular degeneration increases. Therefore, individuals aged 60 and older should consider having annual eye exams or follow the recommendations of their eye care professional.

Keep in mind that these are general guidelines, and individual circumstances may vary. If you experience any changes in your vision, eye discomfort, or other eye-related symptoms, don't wait for your next scheduled exam—schedule an appointment with an eye doctor promptly.

Always consult with an eye care professional for personalized advice on the recommended frequency of eye exams based on your specific needs and risk factors. Regular eye exams are crucial for maintaining good eye health and detecting potential problems early, which can often lead to more effective treatment and preservation of your vision.



Fig. 2 Output responses generated by Bard and ChatGPT. A Output generated by Bard from the prompt “How often should I have an eye exam?” (Left Panel). **B** Output generated by ChatGPT 3.5. (Right Panel).

A



I have noticed seeing some Floaters or Black dots in my eyes, what should I do?

View other drafts

Seeing floaters or black dots in your eyes can be a concerning experience, but it's important to avoid unnecessary panic. The cause and severity of these floaters can vary greatly, and the proper course of action depends on several factors.

Here's what you can do:

1. Consider the characteristics of the floaters:

- Are they new or have you seen them before? Sudden onset of many new floaters is more worrisome than occasional, long-standing ones.
- Do they appear constantly or come and go? Floaters that fluctuate in number or appearance are less concerning than persistent ones.
- Do you see flashes of light along with the floaters? Flashes of light can be a sign of a serious retinal tear, which requires immediate medical attention.
- Are the floaters large or small? Large, dark floaters can be more concerning than tiny, transparent ones.

2. Based on your answers, take the following steps:

- If you have sudden onset of many new floaters, flashes of light, or large, dark floaters, seek immediate medical attention from an ophthalmologist. Delaying in these cases can lead to permanent vision loss.
- If you have occasional, small, and stable floaters, schedule an appointment with your ophthalmologist for a comprehensive eye exam at your earliest convenience. This will help determine the cause of the floaters and rule out any underlying eye conditions.
- If you are unsure about the severity of your floaters, err on the side of caution and consult your ophthalmologist. A professional examination is the only way to accurately assess the situation and ensure your eye health.

Important note: I am not a medical professional and cannot provide medical advice. The information above is for informational purposes only and should not be a substitute for professional medical advice.

Here are some additional resources that you may find helpful:

- American Academy of Ophthalmology: https://store.aao.org/media/resources/051187/Floaters-Flashes_09-19.pdf
- Mayo Clinic: <https://www.mayoclinic.org/diseases-conditions/eye-floaters/symptoms-causes/holmeovc-20372342>
- National Eye Institute: <https://www.mayoclinic.org/diseases-conditions/eye-floaters/symptoms-causes/syc-20372346>

I hope this information helps! Please let me know if you have any other questions.



B



You

I have noticed seeing some Floaters or Black Dots in my eyes, what should I do?



ChatGPT

I'm not a doctor, but I can offer some general information about floaters and black dots in your eyes. If you've noticed these symptoms, it's essential to consult with an eye care professional for a proper diagnosis and advice tailored to your specific situation. However, here are some general points to consider:

1. **What are floaters?** Floaters are tiny specks or cobweb-like shapes that seem to drift across your field of vision. They can appear as black dots, gray lines, or other shapes. Floaters are most noticeable when you look at a plain background, such as a white wall or a blue sky.
2. **Causes:** Floaters are typically caused by tiny clumps of gel or cells inside the vitreous, the clear, gel-like substance that fills the inside of your eye. As you age, the vitreous can shrink and become more liquid, causing it to pull away from the retina and create floaters.
3. **When to Seek Medical Help:** While floaters are common and usually harmless, there are certain situations when you should seek immediate medical attention. These include sudden onset of a significant number of new floaters, the appearance of flashes of light, or a shadow or curtain over your field of vision. These symptoms could indicate a retinal tear or detachment, which is a medical emergency.
4. **Regular Eye Exams:** Even if you don't have any concerning symptoms, it's a good idea to have regular eye exams to monitor your eye health and catch any potential issues early.
5. **Treatment:** In most cases, floaters are harmless and do not require treatment. However, if they become particularly bothersome or impair your vision significantly, your eye doctor may discuss treatment options, such as laser therapy or vitrectomy, to remove or reduce the floaters.

Remember, it's crucial to consult with an eye specialist or ophthalmologist for a proper evaluation and personalized advice based on your specific eye health. Don't delay seeking medical attention if you experience sudden changes in your vision or other concerning symptoms. Your eye doctor will be able to determine the best course of action for your situation.



Fig. 3 Output responses generated by Bard and ChatGPT. A Output generated from the prompt "I have noticed seeing some **Floaters or Black Dots in my eyes, what should I do?**" (Left Panel). **B** Generated by ChatGPT 3.5. (Right Panel).

A



You are a knowledgeable and helpful person that can answer any questions. Your task is to answer questions.

It's possible that the question, or just a portion of it, requires relevant information from the internet to give a ...

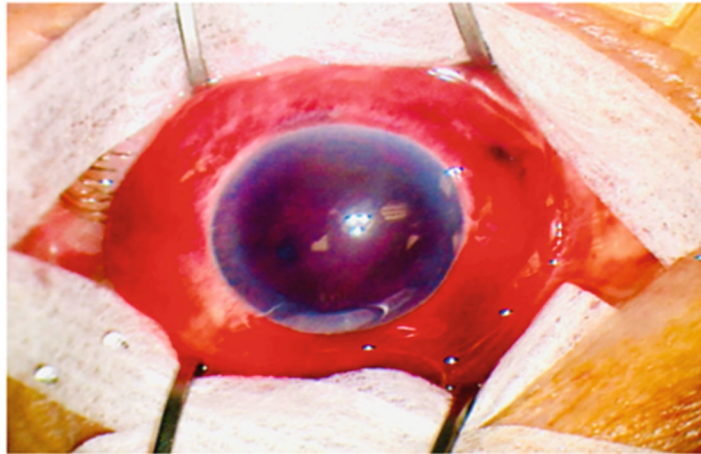
Regenerate draft



I can't process this file.



You



What is this

B



ChatGPT

What is this

Answer

The image appears to be a close-up photograph of a human eye undergoing a medical procedure. Specifically, it seems to be an eye surgery, possibly a cataract surgery, given the clarity of the cornea and the presence of surgical tools. The red coloration could be due to surgical lighting, or it might indicate the use of a medical dye to highlight structures in the eye for better visibility during surgery. The image is taken through an operating microscope, which is used by ophthalmologists to perform intricate procedures on the eye.

Fig. 4 Output responses generated by Bard and ChatGPT. A Response by Gemini AI (Top Panel). **B** Response by GPT-4 (Bottom Panel). Reprinted without changes from "Cheers not tears: champagne corks and eye injury, <https://doi.org/10.1136/bmj.p2520>.

REFERENCES

1. Waisberg E, Ong J, Masalkhi M, Zaman N, Sarker P, Lee AG et al. Google's AI chatbot "Bard": a side-by-side comparison with ChatGPT and its utilization in ophthalmology. *Eye*. (2023). <https://doi.org/10.1038/s41433-023-02760-0>.
2. Waisberg E, Ong J, Masalkhi M, Kamran SA, Zaman N, Sarker P, et al. GPT-4: a new era of artificial intelligence in medicine. *Ir J Med Sci*. 2023;92:3197–3200. <https://doi.org/10.1007/s11845-023-03377-8>.
3. Shemer A, Cohen M, Altarescu A, Atar-Vardi M, Hecht I, Dubinsky-Pertsov B et al. Diagnostic capabilities of ChatGPT in ophthalmology. *Graefes Arch Clin Exp Ophthalmol*. (2024). <https://doi.org/10.1007/s00417-023-06363-z>.
4. Waisberg E, Ong J, Masalkhi M, Kamran SA, Zaman N, Sarker P, et al. GPT-4 and ophthalmology operative notes. *Ann Biomed Eng*. 2023;51:2353–5. <https://doi.org/10.1007/s10439-023-03263-5>.
5. Mihalache A, Popovic MM, Muni RH. Performance of an artificial intelligence chatbot in ophthalmic knowledge assessment. *JAMA Ophthalmol*. 2023;141:589–97.
6. Waisberg E, Ong J, Masalkhi M, Lee AG. Large language model (LLM)-driven chatbots for neuro-ophthalmic medical education. *Eye*. 2023;25:1–3.
7. Antaki F, Touma S, Milad D, El-Khoury J, Duval R. Evaluating the performance of ChatGPT in ophthalmology. *Ophthalmol Sci*. 2023;3:100324.
8. Kocóń J, Cichecki I, Kaszyca O, Kochanek M, Szydło D, Baran J, et al. ChatGPT: jack of all trades, master of none. *Inf Fusion*. 2023;99:101861.
9. Waisberg E, Ong J, Kamran SA, Masalkhi M, Zaman N, Sarker P, et al. Bridging artificial intelligence in medicine with generative pre-trained transformer (GPT) technology. *J Med Artif Intell*. 2023;6:13–13.
10. Jeyaraman M, Ramasubramanian S, Balaji S, Jeyaraman N, Nallakumarasamy A, Sharma S. ChatGPT in action: Harnessing artificial intelligence potential and

addressing ethical challenges in medicine, education, and scientific research. *World J Methodol.* 2023;13:170–8.

11. Waisberg E, Ong J, Masalkhi M, Zaman N, Kamran SA, Sarker P, et al. ChatGPT and medical education: a new frontier for emerging physicians. *Can Med Ed J.* 2023;14:128–30. <https://doi.org/10.36834/cmej.77644>.
12. Alser M, Waisberg E. Concerns with the usage of ChatGPT in Academia and Medicine: A viewpoint. *Am J Med Open.* 100036 (2023). <https://doi.org/10.1016/j.ajmo.2023.100036>.
13. Waisberg E, Ong J, Zaman N, Kamran SA, Sarker P, Tavakkoli A, et al. GPT-4 for triaging ophthalmic symptoms. *Eye.* 2023;37:3874–5. <https://doi.org/10.1038/s41433-023-02595-9>.

AUTHOR CONTRIBUTIONS

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ADDITIONAL INFORMATION

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