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Letter to the Editor: New Observation

Visual Snow Syndrome: Use of Text-To-Image Artificial Intelligence Models to Improve the Patient Perspective

Michael Balas[1] and Jonathan A. Micieli[2,3,4]

[1]Temerty Faculty of Medicine, University of Toronto, Toronto, Ontario, Canada, [2]Department of Ophthalmology and Vision Sciences, University of Toronto, Toronto, Ontario, Canada, [3]Division of Neurology, Department of Medicine, St. Michael's Hospital, University of Toronto, Toronto, Ontario, Canada and [4]Kensington Vision and Research Centre, Toronto, Ontario, Canada

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Visual snow syndrome (VSS) is a positive visual disturbance that has been described as the constant flickering of innumerable tiny dots throughout the entire visual field. In other words, it is like seeing the world through the static noise of an untuned television.[1] VSS has only been identified in the literature recently, with the first case report written by Liu et al. in 1995.[2] The current criteria to make a diagnosis of VSS include the presence of tiny dots in the entire visual field lasting more than 3 months, in addition to the presence of at least two of the following visual symptoms: palinopsia, entoptic phenomena, photophobia, and nyctalopia.[1] Moreover, the symptoms should not be consistent with typical migraine visual aura or better explained by another disorder, such as hallucinogen persisting perception disorder. This syndrome typically presents in young adulthood, with the most common comorbid conditions being migraine and tinnitus. Although VSS is an increasingly recognized condition, it may be hard for the clinician to truly appreciate the patient perspective and to have a pictorial representation of the symptoms. Artificial intelligence (AI) allows for a novel approach to create illustrations based on a combination of words. We made use of various text-to-image algorithms and applied them to a patient with VSS.

A 17-year-old man was referred from his optometrist due to complaints of "seeing everything through grainy static interference in both eyes", which he first noticed two years prior to presentation. This static vision was constant and more obvious in light-coloured environments, such as looking at a white wall. He also endorsed photosensitivity in addition to a floater noticed in the left eye that was particularly visible in bright environments. He described certain instances where he had poor vision at night, and he reported no palinopsia. His past medical history includes a myringotomy at age 4 for inner ear blockages that have resolved since age 9, as well as sinus headaches that occur with environmental pressure changes. Both of his parents experienced migraines. He has no allergies and reports no alcohol use, smoking, or recreational drug use including hallucinogens.

The examination revealed normal afferent visual function including normal visual acuity (20/20 OU) and full confrontation visual fields. Pupillary examination revealed normal sized pupils without a relative afferent pupillary defect, and dilated examination of the fundus demonstrated normal appearing optic nerves and maculae. Optical coherence tomography of the retinal nerve fiber layer and macula in both eyes were also normal. Humphrey 24-2 SITA-Fast visual fields were normal.

We performed an additional phone interview with the patient to obtain more information and descriptive terms of the visual phenomena he was experiencing, in his own words. We then took his self-reported descriptions and translated them into images using various publicly available text-to-image AI models, including "DALL · E 2" (www.openai.com/dall-e-2), "Stable Diffusion" (www.stability.ai), and "Midjourney" (www.midjourney.com/home). These models are all freely accessible (up to a certain number of generated images) via their own respective websites and easy to use, with no prior computer science experience required. After examining all of the generated images from each model, we selected the top two that we believed were most appropriate and consistent with the patient's story as well as previous artistic renditions of VSS. These images are shown in Figures 1 and 2. They were generated within seconds using the "Midjourney" model from a short description of a complex visual syndrome in a realistic environment. While this technology continues to improve and evolve, our results already highlight the promise for AI to help us better understand our patients and see the world through their eyes.

VSS is a relatively new condition that does not have any objective examination findings.[3] A diagnosis is made based on the patient's description of their experience. This may be difficult for family members, friends, and medical staff to understand, since patients may use variable language and a pictorial representation of their experience is difficult to obtain. In this paper, we made use of various text-to-image AI models and applied them to VSS to produce images that can be used in educational settings.

"DALL · E 2," "Stable Diffusion," and "Midjourney," among other text-to-image models, all comprise different variations of generative models and function in similar ways, seamlessly converting user-specified text into evocative images. Some of the current state-of-the-art model architectures include Transformer

Corresponding author: Jonathan A. Micieli, Kensington Vision and Research Centre, 340 College Street, Suite 501, Toronto, Ontario M5T 3A9, Canada. Email: jmicieli@kensingtonhealth.org

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Figure 1: Generated using Midjourney with the caption: "POV lying in bed at night seeing through grainy static interference." This image portrays the patient's first time experiencing these symptoms.

Figure 2: Generated using Midjourney with the caption "Seeing a snowy landscape through static grainy interference." This image portrays the circumstances which elicit the patient's visual symptoms the most: snow, clouds, and other environments with bright white backgrounds.

Language Models which derive meaning from the textual input, typically used in conjunction with generative adversarial networks (GANs), variational autoencoders (VAEs), or diffusion probabilistic models (DMs), which synthesize the image based on the transformer's text embeddings.[4–6] These text-to-image training methods are also often described as Zero-Shot Learning, which refers to the process by which these AI models are able to understand and generate data they have never seen before.

Given their novelty, text-to-image models and similar technologies have yet to be used in the medical literature or integrated into clinical practice. In this report, we describe one possible application of this technology, which is to empower patients with the ability to translate their concerns into rendered visual images. This can help patients clarify their ailments as well as foster empathy by helping them feel understood. Another possible use case of this technology involves the opposite, whereby providers can better communicate visual disease or treatment outcomes to the patient, such as in plastic reconstructive surgery to set expectations or in conditions with physical manifestations to promote medication adherence and lifestyle modifications. These text-to-image models may also be used to generate scientific or educational materials that can be incorporated into textbooks and presentations without requiring licensing agreements and illustrators.

Ultimately, these AI models introduce a new dimension of communication into patient care and medicine, one that will continue to grow and evolve in tandem with the sophistication of these algorithms. We encourage the early adoption and use of these technologies to ensure that medicine keeps pace and helps inform their development.

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