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Photosensitivity and Epilepsy

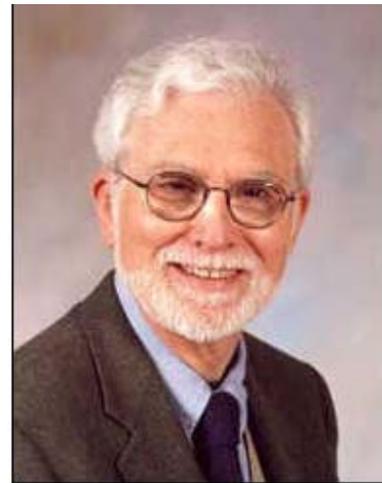
Shedding Light on Photosensitivity, One of Epilepsy's Most Complex Conditions

By Giuseppe Erba, M.D.

Certain individuals are born with special sensitivity to flashing lights or contrasting visual patterns, such as stripes, grids and checkerboards. Because of this condition, their brain will produce seizures when exposed to this type of visual stimulation.

Routine EEG testing, meant specifically to identify patients with this abnormal predisposition, includes exposure to strobe lights. At times during these tests, the EEG discharges can be accompanied by body jerks. If the individual is highly photosensitive, or if the visual stimulation is particularly strong and persistent, a seizure can occur. Affected people may not be aware of the risk until an EEG is performed or until they have a seizure when exposed to certain light stimulation.

Fortunately, this does not happen too often. Many additional factors are required to trigger a photically or pattern-induced seizure in photosensitive subjects.



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Who is Affected?

Photosensitivity, which is often associated with epilepsy, is a condition determined by gene transmission. Therefore, it may be present in several members of one family and is more active early in life. Children and adolescents are more prone than adults to have an abnormal response to light stimulation, and the first light-induced seizure almost always occurs before age 20.

Girls (60 percent) are more often affected than boys (40 percent), although seizures are more frequent in boys because they are more likely to be playing video games. Video games often contain potentially provocative light stimulation.

The condition, formally known as photosensitive epilepsy, is best treated with antiepileptic drugs. There are, however, noted cases of individuals with no previous evidence of epilepsy who only have seizures provoked by light stimulation. That being the case, these individuals must be followed carefully for the possible development of epilepsy, which technically means having unprovoked seizures. But until then, seizure prevention may be

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What Causes Light-Induced Seizures?

Photosensitivity is an intricate medical problem. Scientists have been able to identify many of the triggers, but the mechanism that makes the brain hyper-excitabile when the retina gets stimulated in a certain way remains poorly understood. The key features of a provocative stimulus, however, are outlined in a consensus reached by a group of international experts gathered by the Epilepsy Foundation... These are:

- The *flicker* of the light source, and the "frequency" at which the light changes. In other words, how many times the light flashes in a second. Generally, flashing lights between the frequencies of five to 30 flashes per second (Hertz) are most likely to trigger seizures. In order to be safe, the consensus recommends that photosensitive individuals should not be exposed to flashes greater than three per second.
- The *intensity* of the light source, meaning how bright it is, as well as the "contrast" between light and dark during the flicker. The consensus recommends the contrast between alternating dark and bright images be not greater than 20 candelas per square meter (a technical measure for brightness).
- The *area* the light stimulus occupies in the visual field. This is important because it actually determines how much of the brain gets stimulated. For instance, in the case of television viewing at a distance of about nine feet, the consensus recommends the area of the flashing stimulus on the screen be not greater than 25 percent of the total area. This also explains why most affected individuals can prevent the photosensitive reaction by simply covering one eye (monocular vision).
- The *pattern* of the image. Static or moving patterns of discernable light and dark stripes have the same effect as flashing lights because of the alternation of dark and bright areas. The danger depends on how many and how contrasted the stripes are in the visual field. The consensus recommends no more than five pairs of stripes if they are moving within the field of vision and no more than eight pairs if they are static. About 30 percent of individuals sensitive to lights are also sensitive to patterns.

There are other factors involved, as well. One is the viewer's *distance* from the light source because it directly affects the field of vision. For instance, going back to the example of television viewing, the closer the person gets to the screen, the greater the risk. More of the visual field is occupied; therefore, more of the brain gets stimulated.

The second factor is *color*. Certain colors are critical; in particular, the so-called saturated "deep" red. Within the visual spectrum, this color is the one with the longest wavelength and it can be easily eliminated by wearing appropriate optical filters (blue lenses). However, filtering may also drastically affect visual perception. For instance, it is important that drivers, if wearing special filtering glasses to gain protection against possible seizures, do not lose the ability to recognize the color of signals at intersections. On the other hand, these devices may be helpful for passengers riding in cars and during other everyday activities not requiring sharp color discrimination. Pairs of quickly-changing colors, particularly red and blue, are also known to be more provocative than others.

The most popular example of photosensitivity occurred in Japan on the night of Dec. 16, 1997. Close to 700 children were admitted to hospitals, mostly because of seizures that occurred while watching the popular cartoon *Pokémon*. The cause of this seizure epidemic was a very short (four seconds) rocket-launch sequence, with flashing red and blue fields occupying the whole screen, changing at a frequency of 12.5 per second. This experience taught us all these factors are

interdependent and can have powerful consequences when they occur in combination.

In addition to distance and color issues, associated factors include *sleep deprivation*, *fatigue* from playing video games too long, and *acute alcohol withdrawal*. All of these can facilitate the occurrence of catastrophic reactions, such as seizures.

Who's at Risk and How Often?

About 3 to 5 percent of the more than 3 million Americans with epilepsy are photosensitive, as indicated by an abnormal response to strobe lights during an EEG. The proportion of light sensitive patients is higher among those who have generalized epilepsy, as well as a genetically determined condition. And photosensitivity is even higher (close to 90 percent) in those with juvenile myoclonic epilepsy, a type of generalized epilepsy that mostly affects adolescents.

The amount of photosensitive individuals among the general population who had no prior seizures but have the potential for having seizures when exposed by chance to certain light stimuli is more difficult to ascertain. They usually have not had EEGs performed.

Earlier studies done in Europe sampling the EEGs of "normal" school children and adolescents found abnormal responses to strobe lights in 7.6 to 8 percent of those between ages 1 and 15, but in only 1 percent of those between ages 16 and 21.

Later studies, probably using stricter selection criteria, found the incidence of abnormal responses in comparable populations of normal school children to be 1.3 percent in England and 1.4 percent in Brazil. No such studies have ever been conducted in the United States.

Additionally, two important studies conducted by England's and Denmark's Air Forces looked at the EEGs of "healthy" young males between ages 17 and 25 applying to become pilots. The studies found abnormal responses to strobe lights in 0.35 percent of English men, and abnormal responses in 2.2 percent of Danish men. Assuming America's incidence of abnormal response to light stimulation among the general population (between ages 5 and 17) is also about 1.5 percent, it can be extrapolated that there are about 800,000 photosensitive people in this country who are not aware of the risk.

One notable population-based study was conducted in 1993 in Great Britain, specifically to estimate the number of seizures triggered by video games in individuals who'd never had a seizure before. The risk of "new onset" light induced seizures was 1.2 per 100,000 in the overall population, but 5.7 per 100,000 between ages 7 and 19.

This data is important because it indicates how infrequently actual seizures occur despite the high number of photosensitive individuals. The data only reflects Great Britain's risk level at the time of the study, however. Conditions may be different at other times, in other countries or when a highly provocative program is simultaneously broadcast to a large susceptible audience.

What Can be Done About the Problem?

There is no problem for individuals who are not photosensitive. But for those who are, especially for those who do not know it, there are potential environmental threats everywhere: theaters, dance clubs, rock concerts, the Internet, the street and at home.

The most common environmental hazards are natural sunlight, artificial lights (especially flickering, malfunctioning fluorescent lighting), cathode ray tube television screens and patterns from Venetian blinds, rolling escalators, striped walls and striped clothing. And although there is no

epidemiological data to support this statement, the most frequent triggers of photically-induced seizures nowadays are probably video games. This is not surprising because video games are in the hands of the most susceptible population, and also because video games contain strong visual stimuli to make them more attractive.

In the United Kingdom and Japan, the television industries have voluntarily adopted guidelines, similar to those contained in the consensus drafted by the Epilepsy Foundation, limiting the use of visual stimuli that could be potentially hazardous to susceptible viewers in broadcasted programs. Automatic analyzers review the programs "online" before airing them and point out segments transgressing the safety limits. The Epilepsy Foundation believes the same criteria should apply to video games, but this type of scrutiny has not yet been implemented for them. One of the reasons for this is because new video games allow players to set up the visual experience to their liking. Therefore, they can create unexpected risks for themselves.

Video games on DVD are currently rated for moral content (sex, language and violence), but not for safety. At present, no recommendations, guidelines, standards, regulations or rules address the issue of photosensitivity and the prevention of possible environmental hazards in the United States.

In fact, the 1990 Americans with Disability Act requires most workplaces and places serving the public, including theaters, restaurants and recreation areas, to have fire alarms that flash and ring at the same time for the hearing impaired. The Epilepsy Foundation strongly recommends the flashing rate be kept under 2 Hertz with breaks between flashes, a provision that is usually implemented but not enforced.

What Parents and Consumers Can Do?

The Epilepsy Foundation's professional advisory board has issued general recommendations for television viewing that include the following:

- Watch television in a well-lit room to reduce the contrast between the screen light and background light;
- Reduce the brightness of the screen;
- Keep as far back from the screen as possible (minimum five feet);
- Use remote controls to ensure proper distance from the television is maintained;
- Use small screens. When watching large screens, increase the distance from the screen.

For video game playing, in addition to the above precautions, the professional advisory board recommends the following:

- Players should not play if they are tired, especially if they are sleep deprived;
- Avoid excessive use of alcoholic beverages;
- Take frequent breaks from the game and look away from the screen every once in a while.
- If strange or unusual feelings develop, turn the game off. If players start feeling their bodies jerking, cover one eye with one hand and immediately look away.

Monocular vision (covering one eye) is a most useful practice because it works in most circumstances and still allows the subject to see. It is important to know that just closing the eyes does not prevent photosensitive reactions because the red-tinted light filtering through the eyelids will be just as provocative, if not more.

The greatest concern for parents of children who actively play video games is to know whether they are photosensitive or not. If there is a history of epilepsy in the family, especially a form of generalized epilepsy (which is more likely to be associated with photosensitivity), or if a close

relative, like a sibling, had or has light-induced seizures, it may be wise to consult a doctor. It only takes a simple EEG test to find out if the subject is at risk and if special precautions are warranted.

Nowadays, video games contain a generic warning alerting the player of the risk of seizures. Hopefully, in a not-too-distant future, games will carry a statement specifying whether their visual content is unrestricted or if they have been built in compliance with the specifications outlined in the Epilepsy Foundation's consensus statement. The Foundation and its professional advisory board believes there is a market for "safe" video games, and that parents and consumers will appreciate the opportunity to make informed choices.

All in all, photosensitivity is a relatively infrequent and benign condition, akin to but not synonymous with epilepsy. It raises intriguing medical and public health issues when it comes to identification of the condition and prevention of its consequences.

A large segment of affected individuals are unaware of the risks while environmental hazards that can cause seizures by chance stimulation are ubiquitous in modern society. Methods of prevention and remedies are available and should be tailored to the specific needs of the single individual, and this requires serious involvement by the treating physician. Prevention and remedy also require constant self-surveillance and advocacy.

The Epilepsy Foundation has taken a leading role in fostering knowledge about the condition and disseminating information to consumers and interested professionals. Consumers with questions or who have witnessed or experienced seizure events should contact the Epilepsy Foundation for guidance.