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Vision Glossary

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VISION GLOSSARY

1. The function of uniform terminology is to promote understandable and exact communication in the area of vision. A great deal of effort has been expended to make these definitions suit this purpose. It is recognized that this terminology, like other dictionaries, must be revised periodically to reflect current usage and changing needs. The Driver Vision Subcommittee of the Human Factors Engineering Committee, therefore, solicits suggestions for improvements and additions to be considered in future revisions.

Accommodation: The process by which the eye changes focus from an object at one distance to an object at another distance.

Achromatic: Lacking in hue and saturation. Achromatic visual experience vary only in luminance (from black to white).

Adaptation: The process by which the retina becomes accustomed to more or less light than it was exposed to during an immediately preceding period. It is a change in the sensitivity of the photoreceptors as a function of preexposure to light.

After-Image (Visual): A sense impression which continues or recurs periodically for a short time after stimulation of the sensory mechanism has ceased; after-sensations may be positive or negative, either reproducing or being complementary to the preceding experience. Generally, they occur only under certain circumstances.

After-Sensations: Same definition as after-image, except omit (visual).

Ambinocular Field: The total area that can be seen by either eye. It is not limited to the binocular field but includes, in addition, monocular regions visible to the right eye but not to the left, and vice versa.

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Ametropia: The refractive condition in which, with accommodation relaxed, parallel rays do not focus on the retina; a condition representing the manifestation of a refractive error, specifically myopia, hypermetropia, or astigmatism, hence, a deviation from emmetropia.

Angle of Incidence: The angle formed between the incident light ray and the normal at the point of incidence.

Angle of Refraction: The angle, formed at the point of emergence, between the emergent ray and the normal.

Angstrom, A: Unit of wave length equal to 10^{-10} m (one ten-billionth metre).

Apparent Movement: An illusion of motion brought about by certain patterns of nonmoving stimuli; motion pictures are a familiar example.

Astigmatism: Unsymmetrical curvature of refractive surfaces of the eye which result in inaccurate focusing of parallel rays of light on the retina.

Bezold-Brucke Effect: When luminance is increased, all chromatic colors, except a certain invariable blue, yellow, green, and red, appear increasingly like blue or yellow and decreasingly like green or red.

Blind Spot: The area of the retina at which the fibers of the optic nerve leave the eye. It contains no light receptors and therefore does not mediate visual experiences. The nerve fibers themselves are insensitive to light.

Blindness: Generally legally defined in the United States as visual acuity for distant vision of 20/200 or less in the better eye, with best correction or visual acuity of better than 20/200 if the widest diameter of field of vision subtends an angle no greater than 20 deg. (Some states include up to 30 deg.) (A measure of 20/200 visual acuity means that a person can see a distance no greater than 20 ft (6.5 m) what one with normal sight can see at 200 ft (65 mm).)

Blink Rate: Frequency with which eyelids covers eye under specified conditions.

Brightness: The attribute of visual sensation determined by intensity of light radiations reaching the eye, producing variations along the achromatic scale from black to white. The most common unit of measurement is the millilambert.

Brewster's Law: If the electric vibration of the incident waves are parallel to the plane of incidence, and if the angle of incidence is such that the angle between the reflected and refracted beams equals 90 deg, the entire beam is transmitted, and one is reflected.

Brilliance (Subjective Brightness): The subjective attribute of any light sensation giving rise to the percept of the luminous intensity, including the whole scale of qualities of being bright, light, dim, or dark.

Candela: The unit of luminous intensity. One candela is defined as the luminous intensity of $1/60$ th of 1 cm^2 of projected area of a blackbody radiator operating at the temperature of solidification of platinum (2046 K).

Candlepower: It is defined as $1/60$ th of the intensity of 1 cm^2 of a blackbody radiator at the temperature of solidification of platinum (2046 K). Luminous intensity expressed in candelas.

Central Vision: The seeing of objects in the central part of the visual field, approximately 3 deg in diameter. (Also called foveal vision.)

Chroma: Short form for Munsell chroma, an index of saturation of the perceived color.

Chromatic Aberration: Imperfection of an image produced by variations of index of refraction of elements of an optical system.

Contrast: The subjective assessment of the difference in two parts of a field of view seen simultaneously or successively. (Hence, luminosity contrast, lightness contrast, color contrast, simultaneous contrast, successive contrast.)

Convergence: Process of varying the rotation of the eyes, as the object observed approaches the viewer, to allow image to be formed at corresponding regions of the two retinas; that is, the turning of the two eyes toward each other so that their respective lines of sight meet at a common point in space, the point of the object being focused on.

Critical Fusion Frequency: Frequency of intermittent light stimulation at which flicker is no longer perceived.

Dark Adaptation: The general increase in visual sensitivity resulting from stimulation at an intensity level lower than that to which the eye has been just previously adapted when reference is made to very low levels at which only rod vision is operative. Dark adaptation is often referred to as scotopic adaptation.

Deuteranopia: The more common form of red-green blindness, in which the visible spectrum is not shortened at the red end.

Ø Diffuse Reflection: Reflection where the incident ray is redirected over a range of angles.

Diopter: The amount of accommodation exerted by the eye is expressed in diopters, the unit used for designating the refractive power of a lens. The power of a lens in diopters is the reciprocal of its focal length in metres ($D = 1/F$). A one-diopter lens focuses parallel rays at a point 1 m away from it.

Directional Luminous Reflectance: Ratio of luminance of an imperfectly diffusing surface to the luminance of a perfectly reflecting, perfectly diffusing surface.

Disability Glare: Brightness in the visual field that is some percentage greater than the luminance to which the eyes are adapted so as to cause interference with visual performance.

Discomfort Glare: Brightness in the visual field that is some percentage greater than the luminance to which the eyes are adapted so as to cause annoyance or discomfort.

Emmetropia: The refractive state of the eye when, with the lens of the eye at rest (least convex), parallel rays are brought to focus on the retina (no refractive error).

Glare: A brightness within the visual field that is greater than the luminance to which the eyes are adapted.

Heterophoria: A term used to denote a tendency to imperfect coordination of the various muscles which move the two eyes so as to maintain binocular single vision.

Homochromatic After-Image: Brief after-image with approximately the same hues as the original. (Also called positive after-image.)

Hyperopia: A refractive error in which, with the lens inside the eye in the resting state (least convex), parallel rays of light are focused behind the retina.

Hue: Is the aspect of color commonly denoted by such names as red, yellow, green, blue, orange, and many others. The most closely related physical property of light is wavelength - though the hue purple does not correspond to any wavelength in the spectrum.

Illuminance: The flux striking a surface, measured in lumens per unit area.

Index of Refraction: Ratio of sines of angles of incidence and refraction in transparent material.

Internal Absorption Factor: The ratio of the directed luminous flux absorbed by a transparent body during a single passage from the first surface to the second surface (difference between the flux leaving the first surface and that reaching the second surface) to the flux leaving the first surface.

Inverse Square Law: The illumination (E), at a point in a plane perpendicular to the line joining the point and the source, is directly proportional to the luminous intensity (I) of the source in the direction of the point, and inversely proportional to the square of the distance (D) from the point to the source. For a point source: $E = I/D^2$.

Iris: The colored, contractile, and centrally perforated disc in front of the eye lens. It controls the aperture of the eye's optical system. (Normally, it is inactive to the amount of light striking the retina.)

Lambert: Unit of luminance. It is the luminance of a perfectly diffusing surface emitting or reflecting 1 lm/cm^2 of surface area.

Light Adaptation: The general reduction in retinal sensitivity resulting from stimulation at an intensity level higher than that to which the eye has been adapted when reference is made to the levels at which cone vision is fully operative. Light adaptation is often referred to as photopic adaptation.

Lumen: The luminous flux through a unit solid angle of 1 sr from a uniform point source of 1 cd.

Luminance: The luminous intensity of any surface in a given direction per unit of projected area of the surface as viewed from that direction.

Luminescence: The process whereby light (or visual radiation) is emitted at certain wavebands in excess of that which would be expected from a full radiator at the temperature of the emitter. Particular aspects of luminescence are referred to as fluorescence and phosphorescence.

Luminous Flux: That quantity which is characteristic of a flow of luminous (not radiant) energy.

Luminous Transmittance: Ratio of the luminous flux transmitted by the object to the luminous flux incident.

Munsell System: A system of classifying and designating color attributes of object in terms of perceptually uniform color scales for the three variables: hue, value, and chroma.

Myopia: Refractive defect of certain eyes so that, with accommodation of the lens for infinity, parallel rays of light are brought to a focus before they reach the retina.

Neutral Filter: Optical filter that does not alter the chromaticity of the light it transmits.

Neutral Wedge: Neutral optical filter with continuous gradation from low to high density.

Ocular Dominance: Visual perceptions of most people tend to be more or less dominated by the vision of one of the eyes.

Ophthalmology: The branch of medicine dealing with the structure, function, and diseases of the eye.

Optic Nerve: The nerve bundle which transmits retinal sensations from the reference of the eye to the brain, and which is known as the second cranial pair.

Parallax: The apparent relative movement of objects in the field of vision as the point of view is shifted laterally. Objects nearer to the observer than the point fixated seem to move against the direction of the shift; objects beyond the point fixated move with the shift. Also refers to the apparent difference in rate of movement of two objects actually moving at the same velocity but at different distances from the observer.

Parallax (Binocular): The apparent displacement or difference in apparent location of an object as seen from two different points not on a straight line with the object, for example, a pointer apparently displaced on a scale when the head is moved in relation to it. (Also operates monocularly.)

Phosphorescence: One form of luminescence. The ability of certain substances to continue to emit light long after the source of excitation energy has been removed.

Photoelectroluminescence: The use of light or other electromagnetic energy to create an electric current which, in turn, induces electroluminescence.

Plane of Polarization: Plane of incidence of a beam polarized by reflection at the polarizing angle.

Plane of Vibration: Plane parallel to the electric field of a polarized beam of radiant energy and perpendicular to the plane of polarization.

Presbyopia: The diminishing ability to increase the convexity of the crystalline lens which results in the failure to bring the diverging rays from near objects to a focus on the retina.

Primary Line of Sight: The line connecting the point of observation and the fixation point. (Point of observation is the midpoint of the baseline connecting the centers of rotation of the two eyes.)

Protanopia: Form of dichromatism (color blindness) in which red and bluish-green are confused, and relative luminosity of red is much lower than for normal observer.

Pupillary Distance (PD): The distance between the centers of the pupils at the described point of fixation.

Purkinje Phenomenon: Brightness produced by long-wave stimuli decrease distinctly more rapidly than the brightness produced by short-wave stimuli when the luminances of chromatic stimuli are reduced sufficiently to involve twilight vision and gradually enough to permit the corresponding adaptation.

Rayleigh Equation: Ratio of red to green required by each observer to match spectral yellow.

Rayleigh's Law of Scattering: When heterogeneities of a transmitting medium have average dimensions somewhat smaller than the wavelength of the incident energy. The fraction of the incident flux scattered is inversely proportional to the fourth power of the wavelength.

Retina: An outgrowth of the brain forming a thin lining at the back of the eyeball and containing the light-sensitive rods and cones which are the peripheral end organs of the optic nerve.

Reflection Factor: The ratio of the reflected luminous flux to the incident luminous flux. It is usually expressed as a percentage.

Refraction: Deflection of radiant energy from a straight path in passing from one medium to another.

Resolving Power: The capability of an optical system to separate the images of two closely situated points in the object space.

Saccadic Movements: The sudden movement of the eyes from one fixation point to another.

Saturation: Quality of sensation by which an observer is aware of the relative concentration (percentage) of any one dominant wavelength in a source containing a mixture of wavelengths.

Scotopic Vision: Vision when the eyes are adapted to very dim light, nocturnal vision. Its sensory organs are the rods. It is achromatic and of low-contrast sensitivity. Capacity for focus is very limited.

Snellen Index: A measure of visual acuity. Ratio of distances at which a particular observer and an observer with "normal" vision can resolve a test object. Ordinarily, the numerator of the ratio is 20. The denominator is the distance at which observer with normal vision must stand in order to barely resolve a test object barely resolved by the particular observer at 20 ft (6.5 m).

Snell's Law: Ratio of sines of angles of incidence and refraction is reciprocal of ratio of refractive indices of initial and final media.

Solid Angle: The solid angle, in steradians, of a surface seen from a point is numerically equal to its projected area on a sphere, centered at that point, divided by the square of the radius of the sphere. A sphere subtends 4π steradians at its center.

Spectral Distribution: Relative distribution of radiant energy or flux in the spectrum.

Spectrophotometer: Device for the measurement of spectral transmittance, spectral reflectance, or relative spectral emittance.

Spectrum: Spatial arrangement of components of radiant energy in order of their wavelengths.

Specular: The reflectance or transmittance when light is not diffused by an object.

Specular Reflection: Reflection in accordance with the laws of optical reflection, as in a mirror.

Steradian: Unit of solid angle, subtended at the center of a sphere of 1 m radius by 1 m² area on that sphere.

Stereo Acuity: The ability to perceive binocularly the solidity and relative distances of objects. Stereo acuity is defined arbitrarily as the degree of binocular perception of apparent depth induced by stereoscopic means. This is differentiated from the discrimination of real depth or the relative distances of objects viewed as they are actually oriented in space relative to each other.

Stereopsis: Stereoscopic vision - the capacity for three-dimensional seeing. It is a function of the two eyes acting in unison, but each receiving slightly different views of solid objects. However, other cues besides binocular vision may contribute to stereopsis, permitting some degree of depth to be perceived monocularly.

Stroboscope: Device for presenting a rapid series of exposures of a related sequence of visual stimuli. An illusion of continuous motion may be produced. Also used to stop apparent motion of a moving object.

Transmission Factor: The ratio of the transmitted luminous flux to the incident luminous flux. Where mixed transmission occurs, the total transmission factor can be divided into two parts - direct transmission factor and diffuse transmission factor. In general, the values of the various transmission factors depend upon the angle of incidence, the modes of illumination, and the spectral composition of the incident light.

Tristimulus Values (of a light): The amounts of the three reference stimuli required to match the light considered in a given trichromatic system. In the standard C.I.E. (1931) colorimetric system, the symbols X, Y, and Z are specified for the tristimulus values.

Tritanopia: Rare form of dichromatism (color blindness) in which certain blues and yellows appear gray and relative luminosity of blue is much lower than for normal vision.

Troland: A unit of retinal illumination equal to that produced by viewing a surface having a luminance of 1 cd/m^2 through a pupil having an area of 1 mm^2 . Originally called photon by Troland and later renamed in his honor to differentiate it from a photon of light energy.

Ultraviolet: Radiant energy having wavelengths of $0.4 - 0.04 \mu\text{m}$.

Ultraviolet Radiation: The radiation beyond the violet end of the visible spectrum with wavelengths less than 400 nm . It is divided, for convenience, into: UVA - transmitted by glass, $400 - 320 \text{ nm}$; UVB - sunburning region of sunlight, $320 - 280 \text{ nm}$; UVC - transmitted by quartz, 280 nm .

Viewing Angle: The angle between a line perpendicular to the emitting surface and the observer's line of sight.

Visibility: The clarity with which an object can be seen. It is increased both by luminance difference and by intensity of illumination. The characteristic of an object and its surroundings, including background and media through which light must be transmitted, indicating its probability of being seen. (The problem is that visibility is not always increased by brightness contrast and intensity of illumination, though it is a function of brightness, contrast, intensity, attenuation in transmission, and psychological factors, such as visual constancies and mental set/or expectation.)

Visual Acuity: Capacity for discerning detail. Resolution capacity of the viewer. Acuteness of vision is much greater at the fovea than on other parts of the retina. Visual acuity is also a function of the brightness, contrast, and other characteristics of the objects viewed and of the state of adaptation, location of the retinal image, and other characteristics of the observer.

Visual Angle: The angle subtended by an object of vision at the nodal point of the eye. The magnitude of this angle determines the size of the corresponding retinal image, irrespective of the size or distance of the object.

Visual Field: The totality of visual stimuli which act upon the unmoving eye at a given moment.

Visual Perception: The integrated conscious response and interpretation of the total visual stimulus situation. This response may be modified or interpreted in terms of stored physiological and psychological remnants of past experience which are brought to bear in that situation.

Visual Surround: All portions of the visual field except the visual task on the specified visual target.

The phi (ϕ) symbol is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. If the symbol is next to the report title, it indicates a complete revision of the report.