

THE NEED TO NOTICE

USC Aviation Safety and
Security Program

Thomas Anthony, Director





USC

The Need to Notice



How we see

How we know



- The Need to Notice



- Central to Threat and Error Management (TEM)
- Central to Safety Management Systems (SMS)
- Central to Accident and Incident Investigation
- Important Hazard Identification Process on a personal, professional, and organizational level.

First, some definitions



- Threat
- *An event that occurs outside the influence of the flight crew, but which requires crew attention and management if safety margins are to be maintained*
- *Increases the complexity of the operation.*

Threat and Error Management



- **ERROR**
- *Actions or inactions that lead to deviations from intention or expectation*
- *Important to recognize that errors are often consequences and causes*

- 
- *4.2.3 A hazard is defined as a condition or an object with the potential of causing injuries to personnel, damage to equipment or structures, loss of material, or reduction of ability to perform a prescribed function.*

» *ICAO Safety Management Manual*

How does the definition of THREAT differ from the definition of HAZARD?

- **THREAT** *An event that occurs outside the influence of the flight crew, but which requires crew attention and management if safety margins are to be maintained*
- **HAZARD** *A hazard is defined as a condition or an object with the potential of causing injuries to personnel, damage to equipment or structures, loss of material, or reduction of ability to perform a prescribed function.*



- How do we identify safety hazards?
- Catch errors?
- Identify threat conditions?
- ***NOTICING***

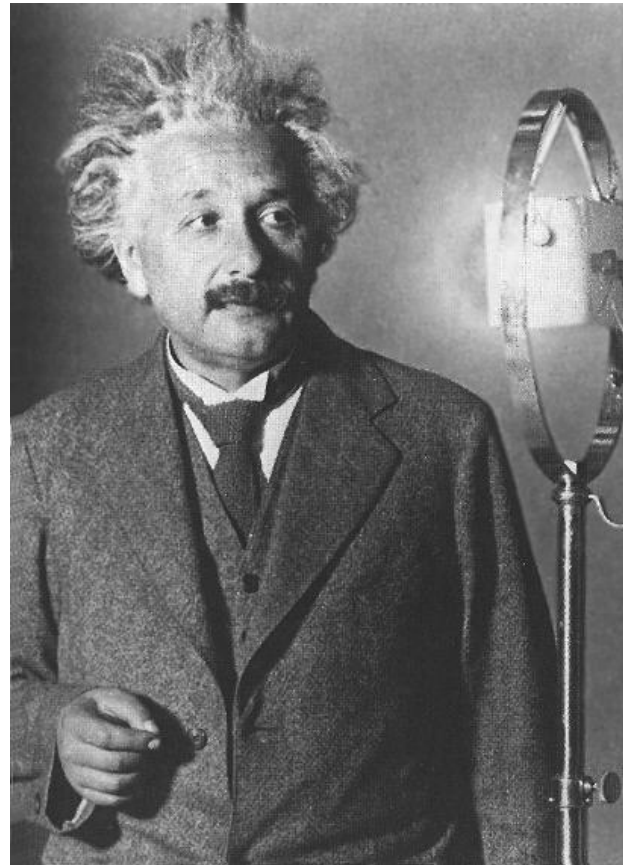
But what is NOTICING ?



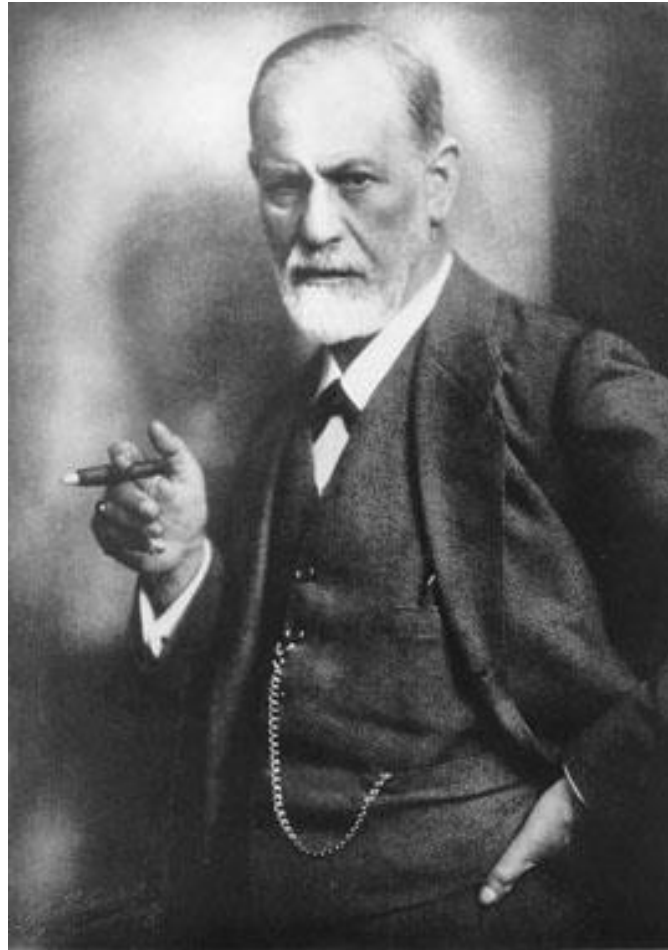
The Story of the Mini



The Professor



The Father of Psychology



The Father of Psychology



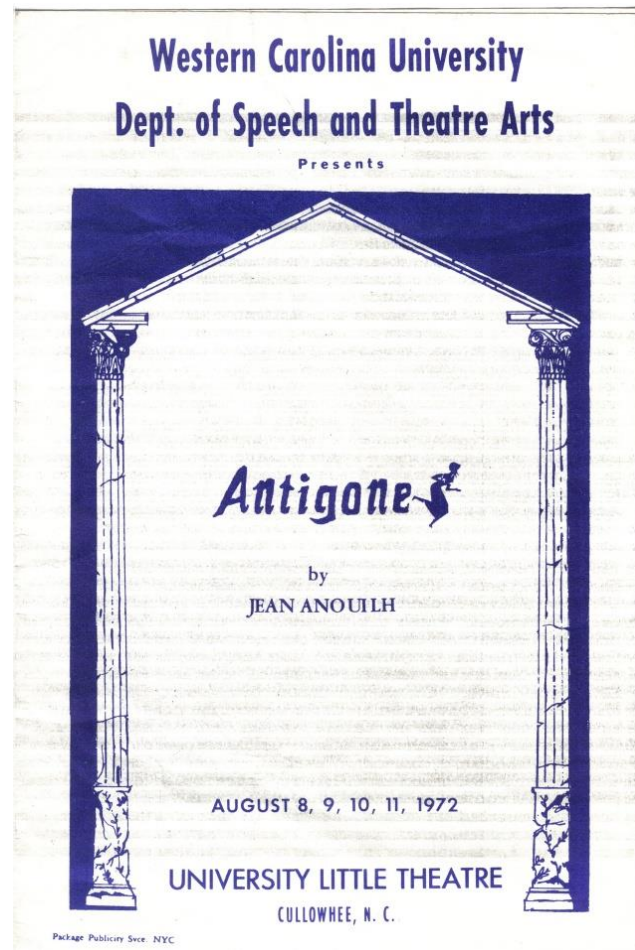
- NOTICING is not perfect

*“Both irritating and laughable is a lapse in reading to which I am frequently subject when I walk through the streets of a strange city during my vacation. I then **read antiquities on every shop sign that shows the slightest resemblance to the word**, this demonstrates the questing spirit of the collector.”*

– Freud, The Psychopathology of Everyday Life, pg. 88, Modern Library 1938



.. Antiquities, (antiques)



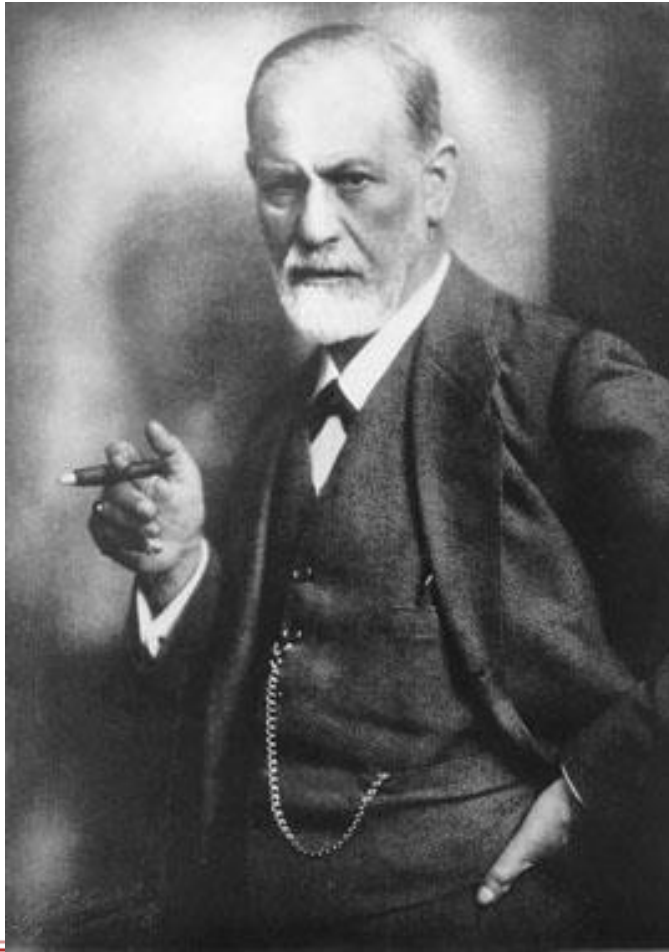
The Father of Psychology



- NOTICING is not perfect

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- But perfect is not the function of NOTICING
- “Caught my eye”,
- “Saw out of the corner of my eye”
- Noticing is generalized

Another manifestation of Noticing The Little Voice

CALLBACK

From NASA's Aviation Safety Reporting System



Number 373

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Sound Advice — Listen to the Little Voice



ASRS report narratives frequently contain references to a "little voice" that offers timely advice. The voice, of course, resides within the mind of the reporter and is usually the voice of experience or sometimes just the "vocalization" of a gut feeling. While it is possible to get through some situations despite what a little voice is telling us, the following reports show that the voice usually has something important to say.

"I Heard the Voice of *Little Voice* One of My Instructors"

Good lessons from flight instructors have a way of staying in the minds of good aviators. In the case of this Piper Cherokee pilot, a little voice from the past got him refocused on the task at hand and prevented a marginal situation from getting much worse.

■ ...I departed...eastbound for [my] destination in clear weather. Approaching the airport, a cloudbank was visible moving in from the southwest at about 2,000 feet. I flew over the clouds looking for a hole, but none was found. ... Ducking under the clouds proved futile since the ceiling continued to drop as I got closer to [the airport]. At half the normal pattern altitude and without a Special VFR clearance, I decided to head back west to [the departure airport]. I made a right turn for the shortest route, but unfortunately that took me into the cloudbank. Continuing the turn would have kept me in the clouds too long and a belated left turn now would have us headed out over the Atlantic in IMC, so the only option was to climb to the cloud tops, which I knew were at about 2,000 feet. I became concerned that someone might have gotten an IFR release and that I might be on his heading and altitude, so I decided to clear the area as quickly as possible, which meant to climb.

After what seemed like an eternity, I heard the voice of one of my instructors telling me to stop looking at

the white bluff outside the windshield and to scan my instruments. I saw the airspeed indicator sliding through 60 knots and quickly began recovering from my unusual attitude. After returning the aircraft to a normal climb, we cleared the clouds and landed without incident.

Making that right turn to save a few minutes of flight time could have been disastrous, but having paid attention to good flight instructors in the past gave the little voice in my head a chance to bring me back to the job at hand.

"The Little Voice in the Back of My Head Started Getting Louder"

An Air Traffic Controller missed a potentially critical altitude error, but was set straight by a little voice that grew loud enough to get some attention.

■ The pilot of aircraft X had requested direct to the ABCDE fix for the RNAV (GPS) RWY 31 approach with the intent of [making] two turns in the holding pattern, then a touch-and-go and on to ZZZ. When I assumed the sector, the aircraft was already proceeding direct and descending to 3,000 feet. In the chart book for the low sector, the ILS 31 and the GPS 31 plates face each other and both use [a common fix] as part of the approach. On the ILS it is the IAP (Initial Approach Fix); on the GPS it is the point after the LAE. The MVA (Minimum Vectoring Altitude) in the sector as a whole is 3,000 feet, with some areas higher due to antennas. One such higher area is located southeast of the airport just beyond ABCDE, with an MVA of 3,600 feet. After a quick glance at the chart (where I might have viewed the ILS plan view by mistake), I cleared the flight to maintain 3,000 feet until ABCDE.

As the flight progressed toward the fix, the little voice in the back of my head started getting louder. Just how can the holding pattern at ABCDE (which is to the southeast) be at 3,000 feet when there is an antenna there? I picked up the approach plates and immediately identified my error. The aircraft was climbed to 3,600 feet with an apology and an explanation. The pilot admitted to missing the altitude error as well. The aircraft climbed in time to fly the pattern at the published altitude, but it was much closer than I would have liked.

The reporter went on to explain how fatigue and scheduling factors may have influenced this incident. These are two concerns that have been the subject of continuing study by industry and the FAA. Staying



- Noticing is a form of recognition that involves **subconscious** processing
- **Subconscious** processing based upon priorities, values and learning
- “*..the questing spirit of the collector.*”



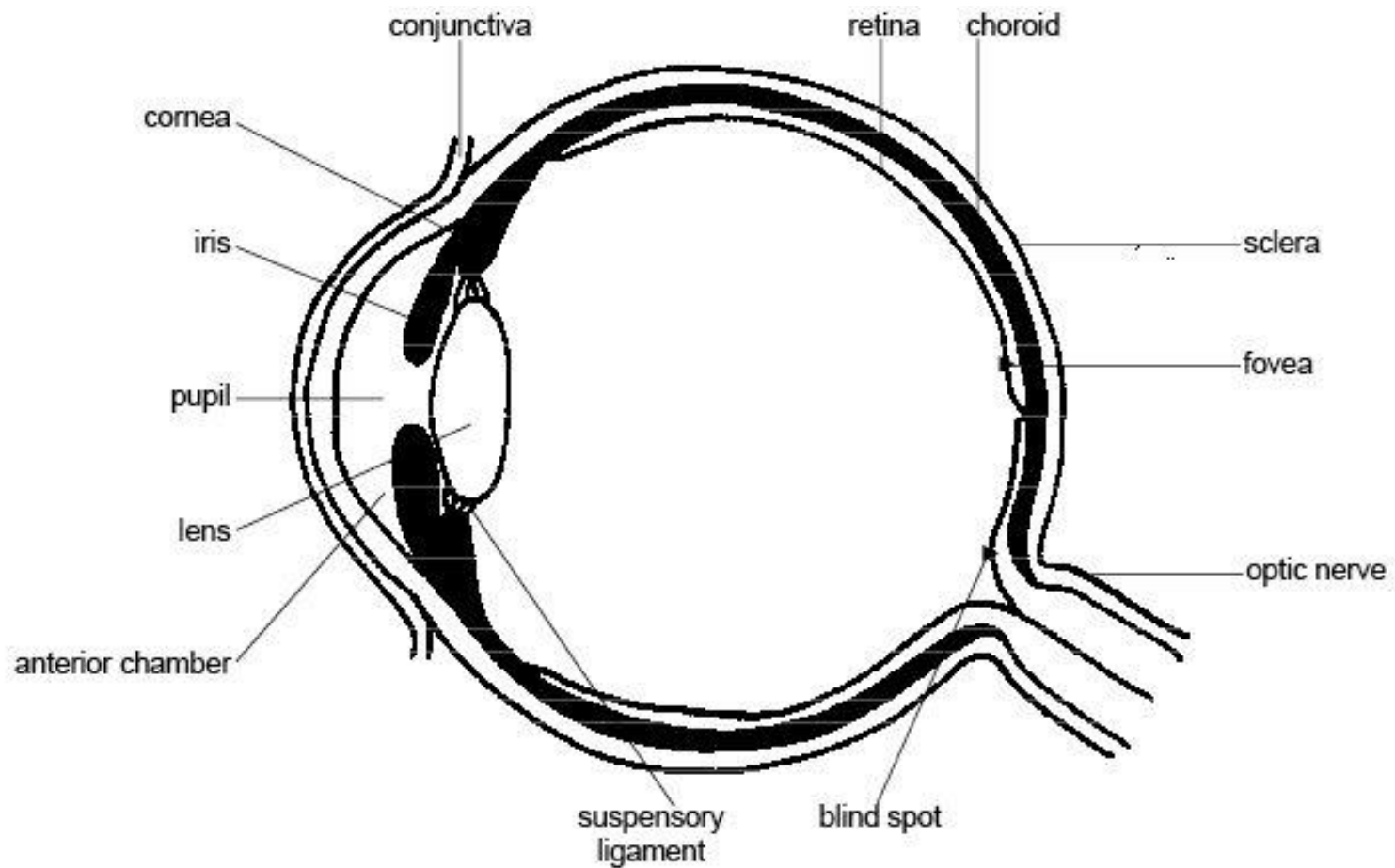
- NOTICING is peripheral
- NOTICING serves to direct our attention to further clarification
- Direct our attention to possible **hazards**

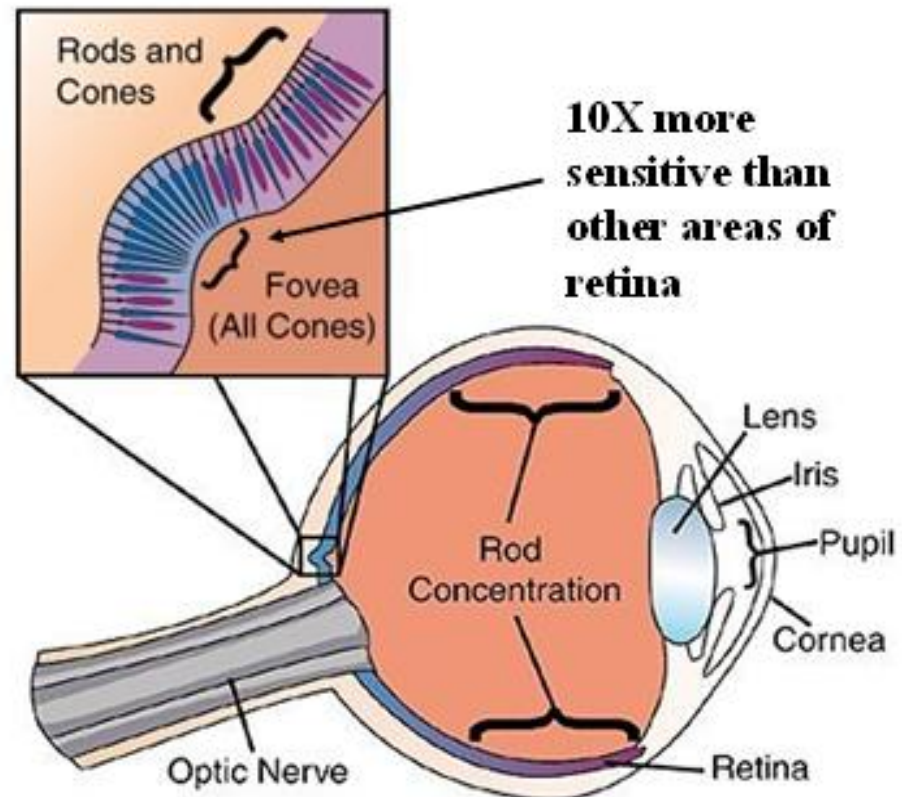
NOTICING



- What is our dominant human mechanism for becoming aware of hazards?
- Look out! Watch out!
- **Vision**

VISION - The Structure of the Eye





The RETINA of the Eye

Specialized Functions



- **Rods**
 - Single color (blue-green)
 - Low acuity – no better than 20/60
 - High sensitivity to low light
 - Approximately 91 million
 - Distributed throughout retina
- **Cones**
 - Senses all colors
 - High acuity – 20/20 or better
 - Less sensitive to low light
 - Approximately 5 million
 - Small area - Concentrated in fovea (center of retina 1/16")



- The RODS serve to direct the attention of the eye
- To direct the attention of central vision, the CONES
- The RODS, therefore, are our built-in physiological threat/hazard identification mechanism
- “Made you look” mechanism



- Attracted to differences in light and dark
- Movement
- Rotating Beacons, strobes, flashing lights
- Ernest K. Gann *Fate is the Hunter*
- Noticing and Safety



- *..the pilots at last won a minor battle which had lasted too long. We persuaded the lines to install wing tip and tail lights on our planes which would flash instead of remaining fixed. The steady type had too often been mistaken for a star or a distant light on the earth below.*
- Fate is the Hunter, Ernest K. Gann, Simon and Schuster 1961

Noticing



- Hunters – only notice game when it moves
- Without movement, it was not seen
- Same photons striking retina
- Without the noticing function provided by the rods we are not ***conscious*** of the presence of the deer
 - “I didn’t ***know*** it was there until it moved.”

Subconscious Processing



- Noticing involves subconscious processing
- Pre- established values or priorities – the Mini
- Noticing is not just visual – The Cocktail Party Phenomenon
- Where else is subconscious processing demonstrated?



- **Remembering**
- “That reminds me..”
- One observation triggers a remembering
- Retracing steps
- Or.. “pops to the surface like a cork”
- Subconscious processing with or without a cue as in Noticing

Other manifestations of subconscious processing



- John Lennon “Nowhere Man”
 - After working for five hours trying to write a song – nothing
 - “Then, ‘Nowhere Man’ came, words and music, the whole damn thing as I lay down.”
-
- Interview, John Lennon, 1980 related by Timothy Egan, New York Times,
 - March 22 ,2014

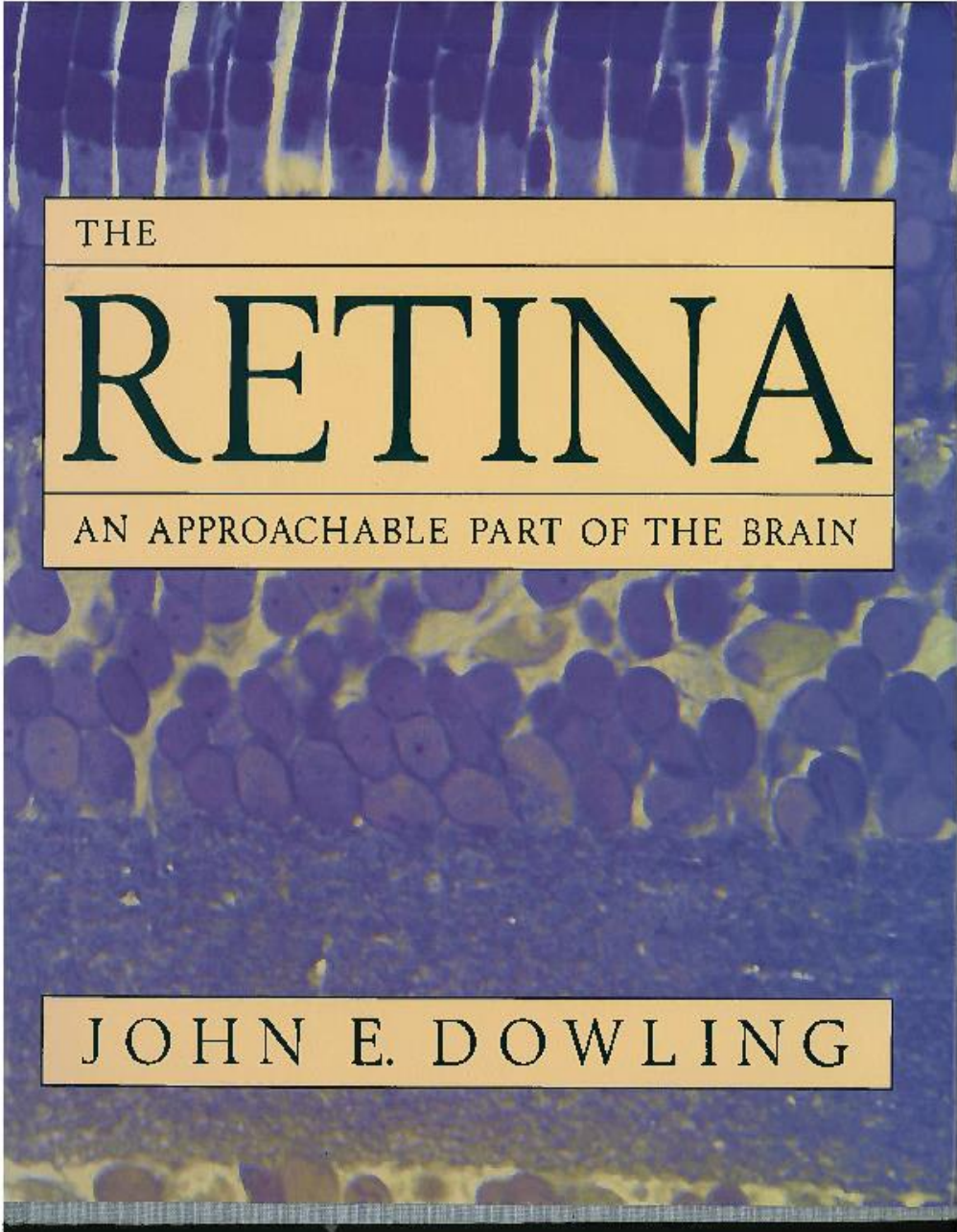
Affect of Fatigue on Noticing



- Interest level - Newspaper
- Freud – notes affect of fatigue and exhaustion on remembering
 - *“In fact, depending upon our own general state and the degree of fatigue, the first manifestation of functional disturbance (forgetting) evinces itself in the irregularity of our control over foreign vocabulary.” ibid. pg. 41*
 - *“..the state of affairs in forgetting names need not be different. Favored by exhaustion, circulatory disturbances and intoxication, I am robbed by an unknown psychic force of the control over proper names.” ibid, pg. 50*



- NTSB study of Accidents Trucking Industry
- 278 Fatal to Driver Accidents , majority cited sleep deprivation and fatigue as causal factor
- Falling asleep or reduction of ability to Notice?
- Retinal rods perform an attention directing function –
- A hazard identification function
- What makes them so important?

A microscopic image of retinal tissue, showing a cross-section of the retina with various layers of cells. The image is in color, with a blue and yellow tint. The top part shows a layer of cells with a distinct pattern, while the bottom part shows a more granular layer.

THE

RETINA

AN APPROACHABLE PART OF THE BRAIN

JOHN E. DOWLING

How Can the Retina be So Important?



- ***The retina is part of the brain***, having been sequestered from it early in development but having kept its connections with the brain proper through a bundle of fibers—the optic nerve.

» Eye, Brain, and Vision, David Hubel, Harvard, Publisher:
W. H. Freeman 1995

The Retina, An Accessible Part of the Brain



- *That **the retina** originates from the neural tube and **is a true part of the brain** is reflected in a number of its functional characteristics.*
 - The Retina, An Approachable Part of the Brain, The Belknap Press of Harvard University Press 1987
 - *Physically, the retina is a thin layer of nerve tissue with the consistency and thickness of a wet cigarette paper.*
 - » The Brain from Top to Bottom, Mc Gill University, Canada

Subconscious Processing – What is happening?



- Rods and Cones
- Conscious of central vision signals via cones
- Processing of rod info, direct attention
- Also balance
- Walk and read the paper or Ipod (complimentary to inner ear)
- Maintain stability while processing something else
- Complimentary to inner ear
- *Maintain **situational awareness** while focusing on another task*

Newness – another aspect of Noticing



- **“What did you do last Sunday?”**
- Memory is not a photo album, but a survival tool.
- Use our experiences, as captured in memory, to anticipate and prepare for upcoming events and encounters.
- Ability to predict is inherent in the ways our brains work
- NOVELTY the most attractive type of input
- NOVELTY is the primary, if not primal, trigger of learning

- *What Did You Do Last Sunday? Moshe Barr, Director of Cognitive Neuroscience Laboratory, Harvard Medical School and Massachusetts General Hospital, Los Angeles Times May 29, 2011*

Pattern Recognition



- “When facing problems in real life situations, the first question is always, “What am I looking at?” Phillip J. Kellman, UCLA.
- The brain is a pattern-recognition machine.. when focused properly, it can quickly deepen a person’s grasp of a principle..”
- Scientists have long know that the brain registers subtle patterns subconsciously, well before a person knows he or she is learning.

» *Brain Calisthenics for Abstract Ideas*, Benedict Carey, New York Times, June 7, 2011



- Intra-retinal pattern processing
- Enhance of edges and differences in contrast
- Patterns
- Prior to transmission via the optic nerve
- *Neuronal circuits for conscious vision and subconscious vision functions (eg. regulation of sleep timing) interact in the retina.*
 - Abstract: *Cross-talk between ganglion-cell photoreceptors and other neurons in the retina.*
Kwoon Yu Wong 1 June 2008 – 31 May 2010 National Eye Institute.
- *Thus, the cell's response reflected an elementary spatial analysis carried out within the eye...*
 - *The Retina, An Approachable Part of the Brain*, Dowling, Chapter 1

Intra-retinal processing



- Connects retina to cranial portions of brain
- 1.2 million nerve fibers (axons)
- Approximately 91 million rod cells
- 4.5 million cone cells
- Reduction of approximately 100 photo receivers to 1 transmitter
- In the fovea the nerve cells connect to as few as five (5) cones
- In other areas of the retina they may connect to as many as 1,000
- Specific (cones-central vision) vs. Generalized (rods-generalized)

The third photo-sensitive mechanism of the retina



- Rods and Cones are not the only photo-sensitive cells in the retina
- **ipRGC's**

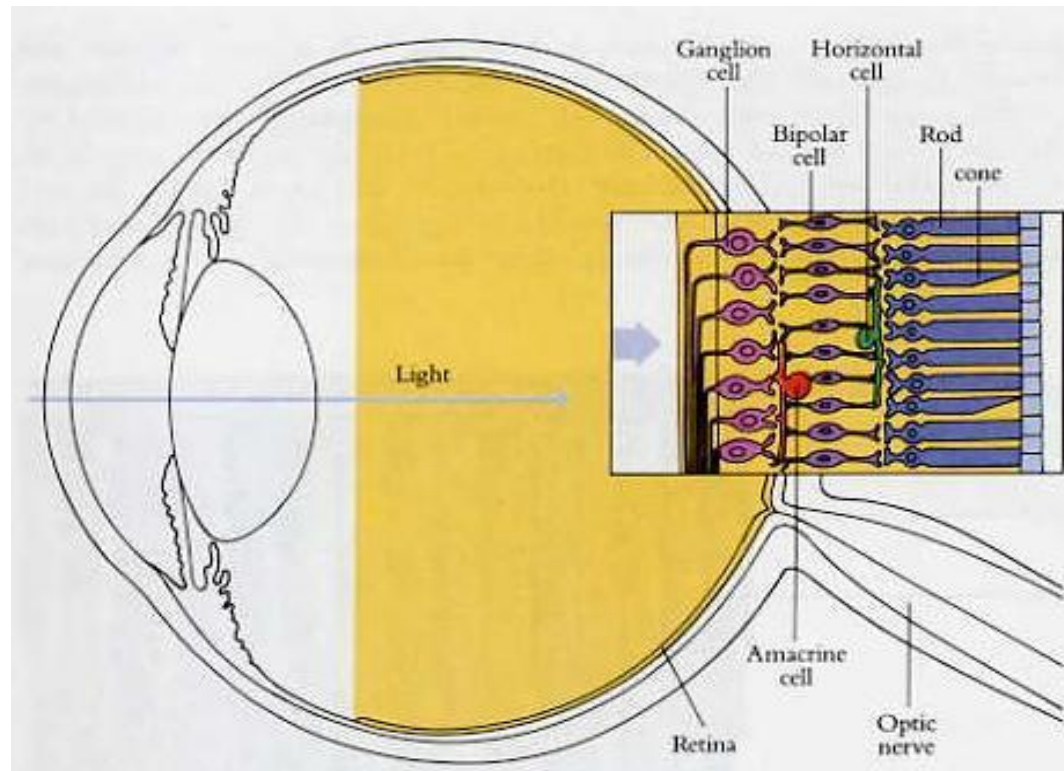


Intrinsically Photo-sensitive Retinal Ganglion Cells

- Ganglion cells, nerve cells found in the brain
- Third type of photo-receptor in retina
- Newly discovered
- Basically **non-image forming**
- “Neuronal circuits for .. Subconscious vision functions (e.g. the regulation of sleep)”
- “ipRGC’s react bidirectionally with rod and cone driven cells in the retina”

- *Cross-talk Between Ganglion-Cell Photoreceptors and Other Neurons in the Retina* Kwoon Yiu Wong, National Eye Institute, June 1, 2008-May 2010

ipRGC's –Where are they?





- IpRGC's – how they work
- Connect via the optic nerve to the pineal gland
- Pineal gland secretes melatonin
- Melatonin causes sleepiness
- Melatonin is also generated in the retina
- Intra-retinal inhibition of cone function



Fatigue

ipRGC's and circadian clock in tandem

NTSB Study of 278 Fatal to Driver Truck Accidents, the major cause was sleep deprivation and fatigue.



- Since messages from the ipRGC's result in the secretion of melatonin by the pineal gland (pineal organ) it is clear that they have direct relevance to the issue of fatigue.
- More than physical tiredness.
- Light – Dark cycle triggers the secretion of chemical within the body that leads to sleep.
- Appears to be a redundant mechanism to the Circadian clock.
- *The question is: what is the interaction between iprGC's and rod/cones within the retina itself? Yes, there is a secretion of a melatonin-like chemical in the retina that reduces the functioning of the retinal cones.*

Summary



- Noticing is an essential hazard identification function
- It involves conscious and subconscious processing
- Primary mechanism is the retina
- The retina is part of the brain
- Rods and Cones have different and complementary functions
- Rods are attention directors, hazard identifiers
- Cones engage the conscious mind to clarify and assess
- Rods – subconscious processing/ situational awareness
- Subconscious processing based upon learning and priorities
- Important to recognize the role of Noticing/ subconscious processing in Hazard Identification

Thank you

