Light-emitting Diode (LED) Cap Lamp Research

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Background
- 80% of perception is visual.
- Lighting is critical for safety.
- The cap lamp is a miner’s primary light source.
- Aging workforce: miner 43 yrs. old (average).
- Retinal illuminance: -40% than 20 yr old.

Objectives
Reduce Traumatic Injuries involving:
- Slips/trips/falls
- Moving machinery pining/striking
- Glare
- Age-related vision issues
Better lighting in smoke to help:
- Miners escape
- Rescue efforts

Accidents
- 158,861 slip/trip/fall non-fatal days lost injuries (2003-07)
- 31 pining/striking fatalities (1984-2007, continuous mining machine)

Results
- No glare issues
- 194% faster floor hazard detection
- 33% - 50% less power than other LED cap lamps
- 79% faster periphery detection to see moving machinery

Approach
1. Use the best light color for aging miner
   - Mining: a low light condition (mesopic)
   - Colors the eye is most sensitive to for mesopic

   - Results due to the color of light:
     - 53.8% reduced disability glare
     - 15% better peripheral detection
     - 23.7% better floor hazard detection

2. Illuminate the hazards in the field of view.
   - Model the field of view.
   - Illuminate the hazards.

Smoke Testing
- Traditional LED cap lamp (tunnel vision)
- NIOSH LED cap lamp (light the hazards)

The light beam distribution effect on viewing ceiling tags in smoke.