Human Factors

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Outline

Essential Human Factors

- Physical
- Sensory
- Cognitive -Information Processing

Context: Pedestrians in the built environment

Other road users

Who are we talking about

- Pedestrians (ADA)
- Bicyclists
- Transit Operators and Passengers
- Drivers
- _____
- _____

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Facts and Figures

Population demographics

US population is ageing and becoming more obese

- Adults with physical difficulties: 35.6 million
- Adults unable to walk a quarter mile: 15.9 million
- Adults with hearing trouble: 34.5 million
- Adults with vision trouble: 19.4 million
- People who are obese in 2030: 42% of population

Strength

Age related changes in muscle mass and elasticity

Result in:

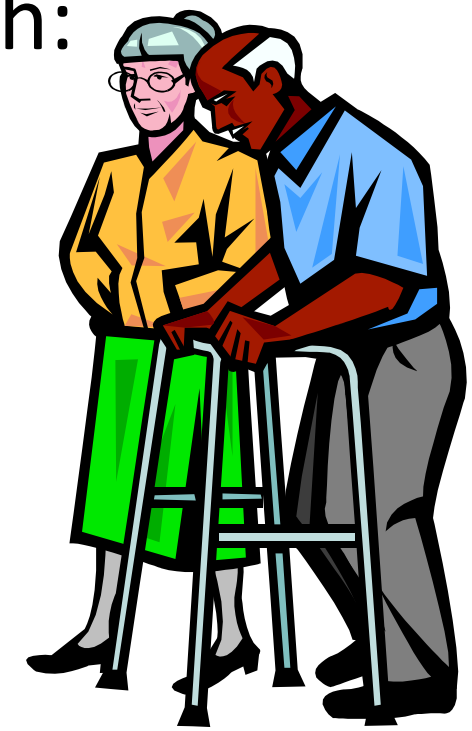
- Decrease in muscle tone
- Joint strength- arthritis
- Decrease in bone mass

Older people often suffer from muscle and joint stiffness

- difficulty preventing falls

Fragility

- Fragility increases beginning at 60-64 yrs.
- By age 80, elderly more likely than 20 year old to die from injuries sustained in a crash:
  - 4 times – male
  - 3.1 times - female



Learning about aging and disabilities…

- There are many types
- They often are combined
- They are rarely “black and white”
- “Not all elderly are disabled and not all people with disabilities are elderly”
- “If we design for people with disabilities it is easier for everyone to use!”

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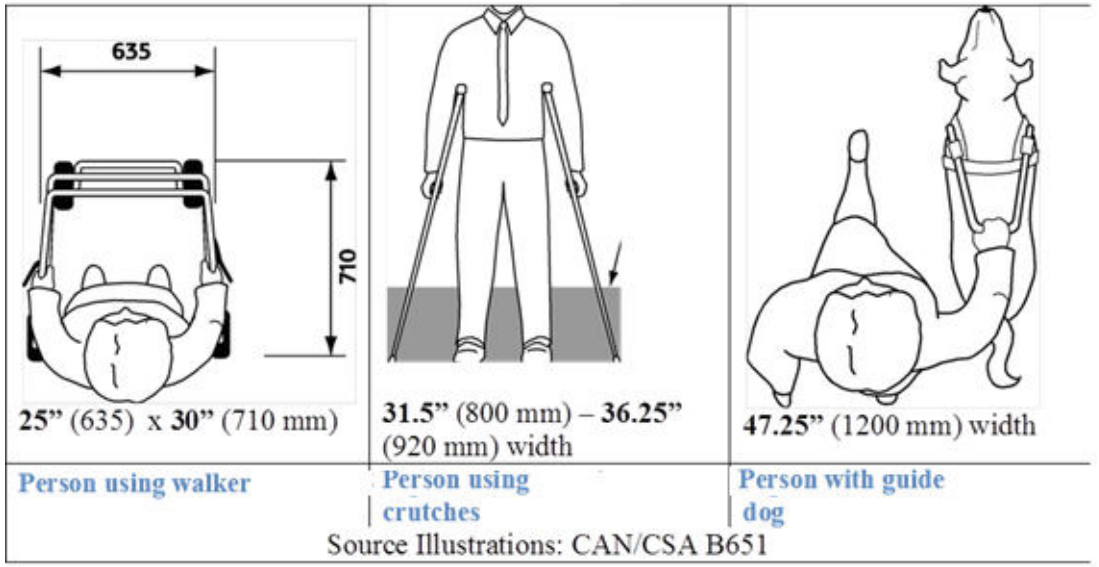
Pedestrians with Mobility Impairments



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Wheeled Mobility Devices

Walker

Manual wheelchair

Power chair

Bariatric chair

Large 3 – wheel scooter

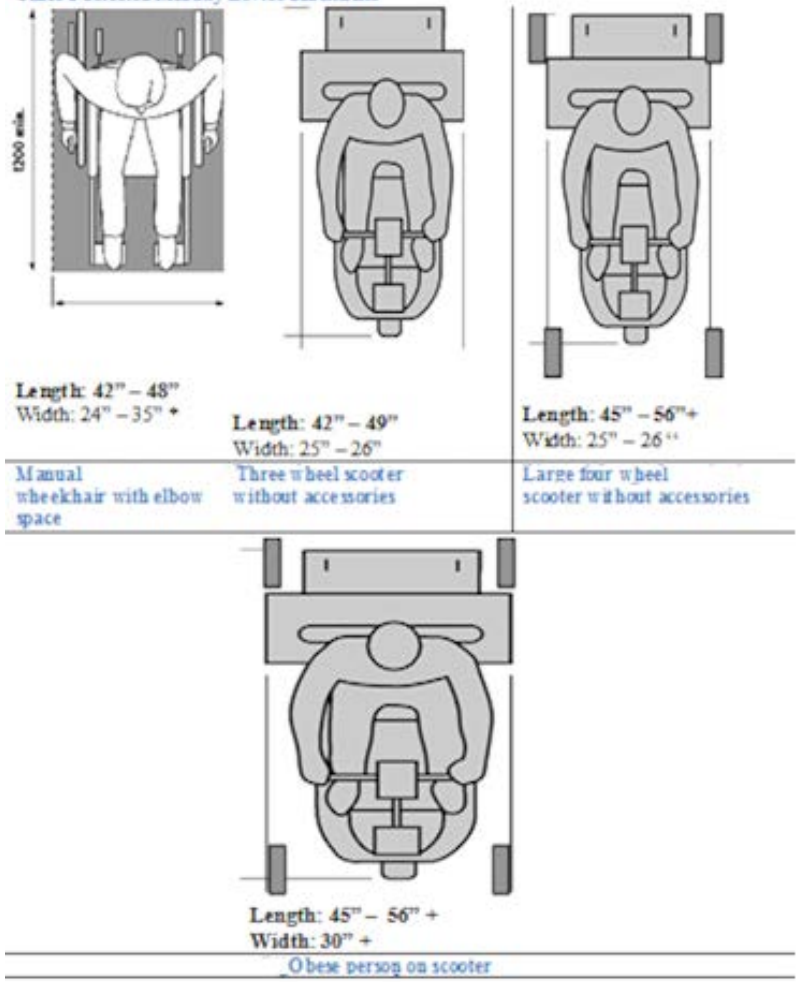
Large 4 -wheel scooter

Segway

T3 Mobile

Mobility Device Characteristics - Sizes

Table 1 Selected Mobility Device dimensions



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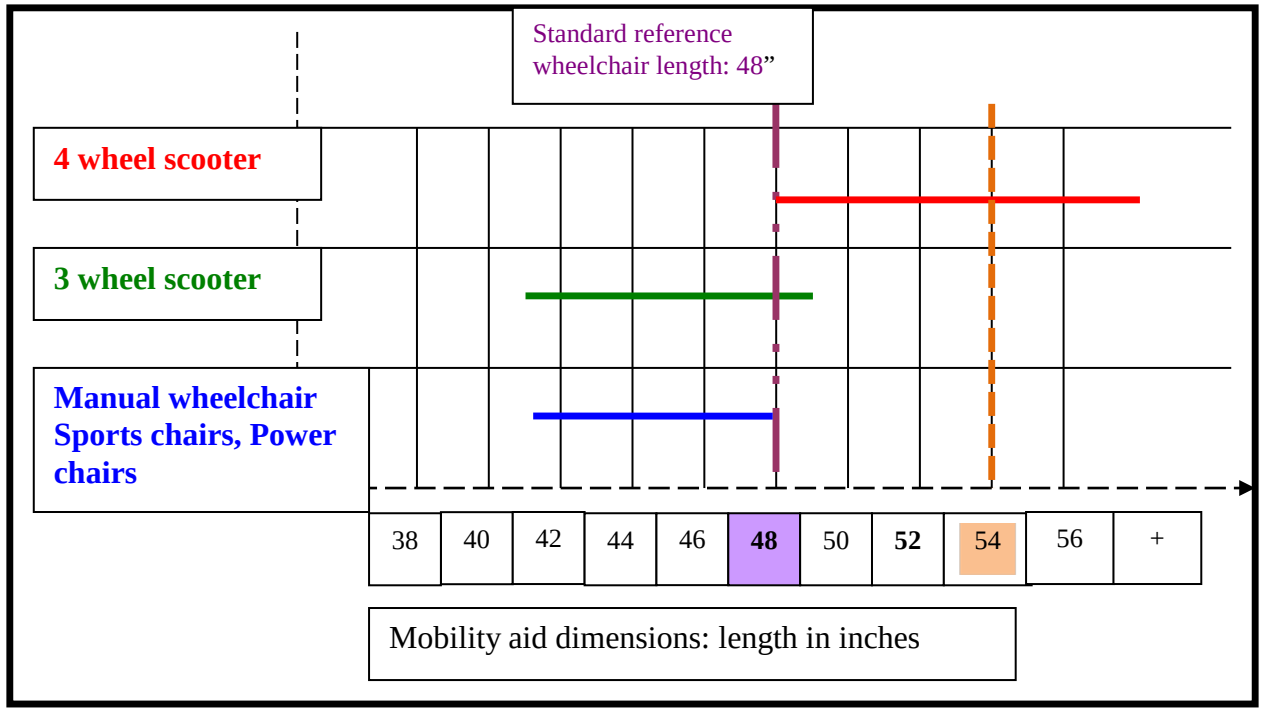
Mobility Device Characteristics – Length



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Mobility Device Characteristics - Weight

[Source: UK Survey of Occupied Wheelchairs, 2005]

Device Type	Survey Year	Mean kg/**lbs.**	Min kg/**lbs.**	Max kg/**lbs.**	5%ile kg/**lbs.**	50%ile kg/**lbs.**	95%ile kg/**lbs.**
Self-Propelled	1999	96.0 **211.2**	46.6 **102.52**	184.4 **405.68**	67.2 **147.84**	93.0 **204.6**	131.4 **289.08**
	2005	99.7 **219.34**	50.0 **110.00**	197.2 **433.84**	65.6 **144.32**	97.0 **213.4**	145.2 **319.44**
Attendant-Propelled	1999	89.0 **195.8**	58.0 **127.6**	181.0 **398.2**	68.0 **149.6**	83.0 **182.6**	127.0 **279.4**
	2005	91.9 **202.18**	36.8 **80.96**	185.6 **408.32**	58.2 **128.04**	88.4 **194.48**	136.7 **300.74**
Electric Wheelchair	1999	168.0 **369.6**	94.0 **206.8**	384.0 **844.80**	116.0 **255.2**	158.8 **349.36**	258.0 **567.6**
	2005	180.1 **396.22**	90.6 **199.32**	326.2 **717.64**	114.8 **252.56**	171.6 **377.52**	273.4 **601.48**
Electric Scooter	1999	166.0 **365.2**	79.0 **173.8**	314.0 **690.8**	109.0 **239.8**	159.2 **350.24**	222.0 **488.4**
	2005	162.5 **357.5**	86.6 **190.52**	338.6 **744.92**	108.0 **237.6**	149.8 **329.56**	258.4 **568.48**
All Chairs	1999	120.5 **265.1**	47.0 **103.4**	384.0 **844.8**	70.0 **154.0**	108.0 **237.6**	206.0 **453.2**
	2005	130.7 **287.54**	36.8 **80.96**	338.6 **744.92**	67.0 **147.4**	118.4 **260.48**	230.2 **506.44**

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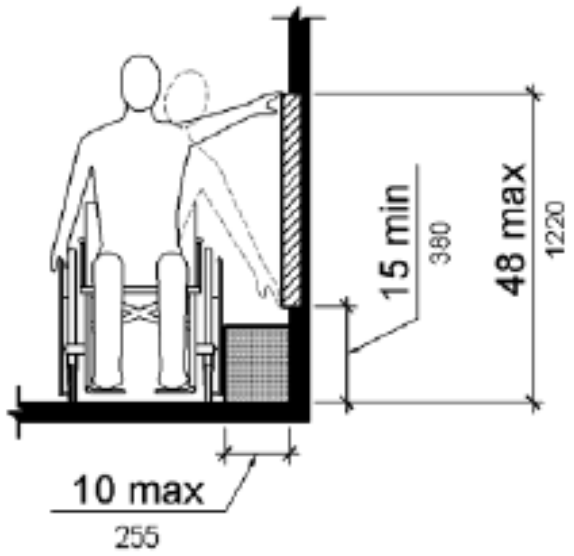
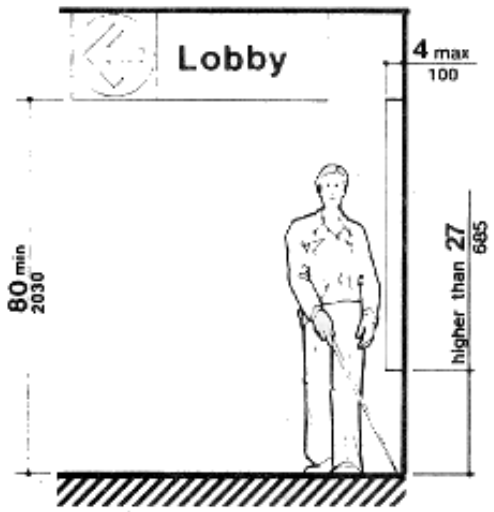
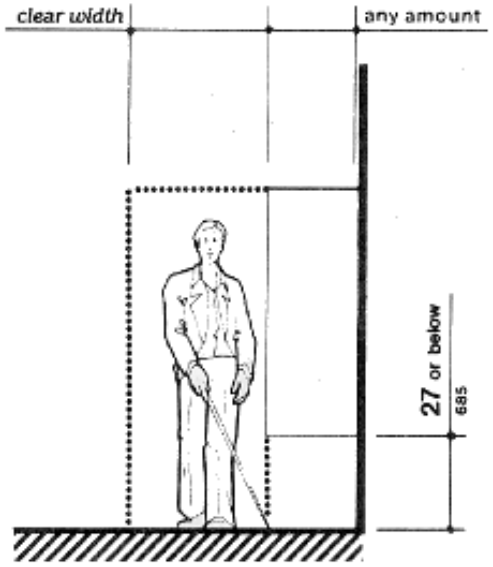
Important Dimensions







ADAAG

Mobility Device Impact on built environment

- Sidewalks
- Curb Cuts

Large Mobility Devices/Light Electric Vehicles

- Where should they operate?

Sensory -Perception

VISION most important in driving, riding a bike, operating a WhMD

- **Provides 90-95% of driver-related information**

Eye Physiology – how aging impacts eyes

- Requirements for increased lighting
  - Due to decrease in pupillary diameter
- Optic media – more scattering of light- floaters
- Changes in lenses

Impacts: Signage and Lighting- tripping hazards

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Visual Acuity

- Fewer receptor cells on retina with age results in:
  - Resolution of fine details is coarser
  - Solved by greater size and contrast of important details, and increased illumination

Use of large print media

Impacts: Signage and Lighting

Many “blind” people are not completely blind.

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Cataracts

Glaucoma

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Age-related Macular Degeneration

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Diabetic Retinopathy

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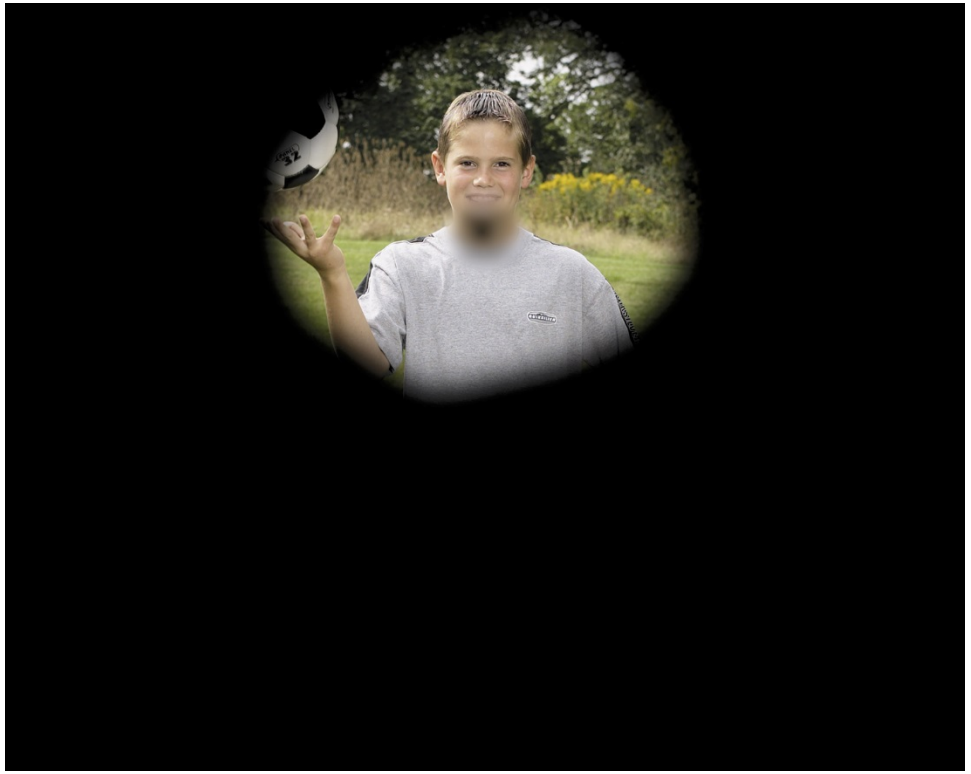
Retinitis Pigmentosa



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Glare and Light Sensitivity

- Contrast Sensitivity Function (CSF)
  - Problems with small objects –un even sidewalks
  - Need high levels of contrast lighting
- Increased time to adjust to the dark –Shadows on sidewalks
- Glare recovery time increases with age
- Problem for people with cataracts
- Problems with on coming headlights

Depth Perception

- Requires **two** eyes [binocular vision]
- Primarily provided by environmental cues
- Impact of dark environments
  - Sidewalk bumps

What about hearing and smell

Hearing

- Important for environmental cues and clues
- Detecting sirens
- Ear buds
- [Distracted Pedestrians]

Smell?

- [Situational awareness]

Cognitive Function

Important factors in Aging Cognition:

- Variability of performance increases with age
- Speed of processing information decreases with age
- Therefore, amount of processing is reduced, and time required increases

Functional cognitive processing

- Impact on Changeable Message Signs (CMS)
  - Bits and bytes
    - Control the amount of information presented
    - Use few key words {How many lines of text?}
  - Scroll rates
    - Speed of presenting information
  - Spreading
    - Placement and frequency of signs

Attention

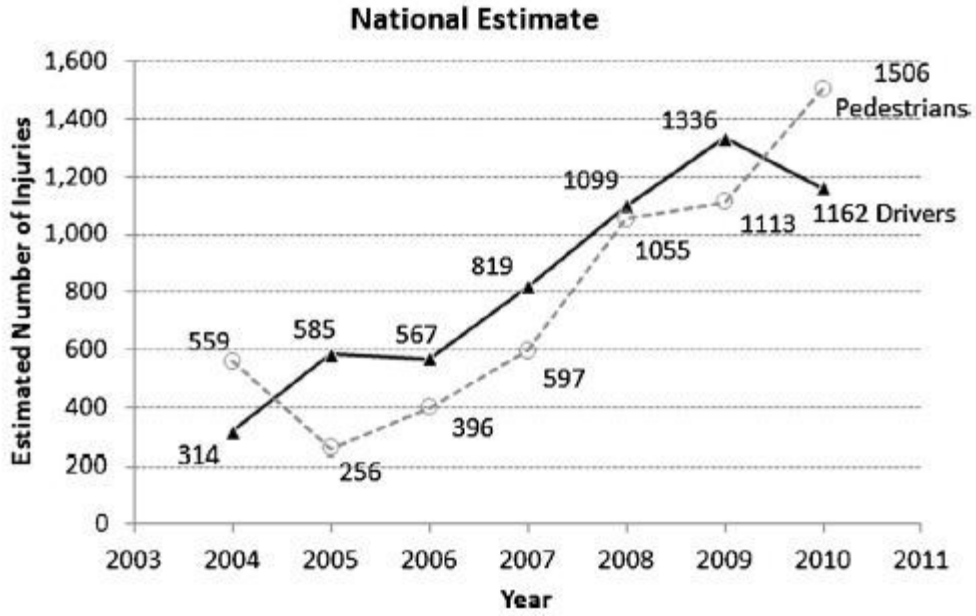
- Problems with attention switching abilities problems
- Dementia
  - Problems getting lost
  - Following directions
  - Stopping for directions
    - `Not just a gender issue!’
  - Failure to yield

Distraction

Definition: a thing that prevents someone from **giving full attention** to something else

Distracted walking

"Pedestrian injuries due to mobile phone use in public places



[Nasar et al , Accident Analysis and Prevention Vol., 57, August 2013 pgs. 91-95]

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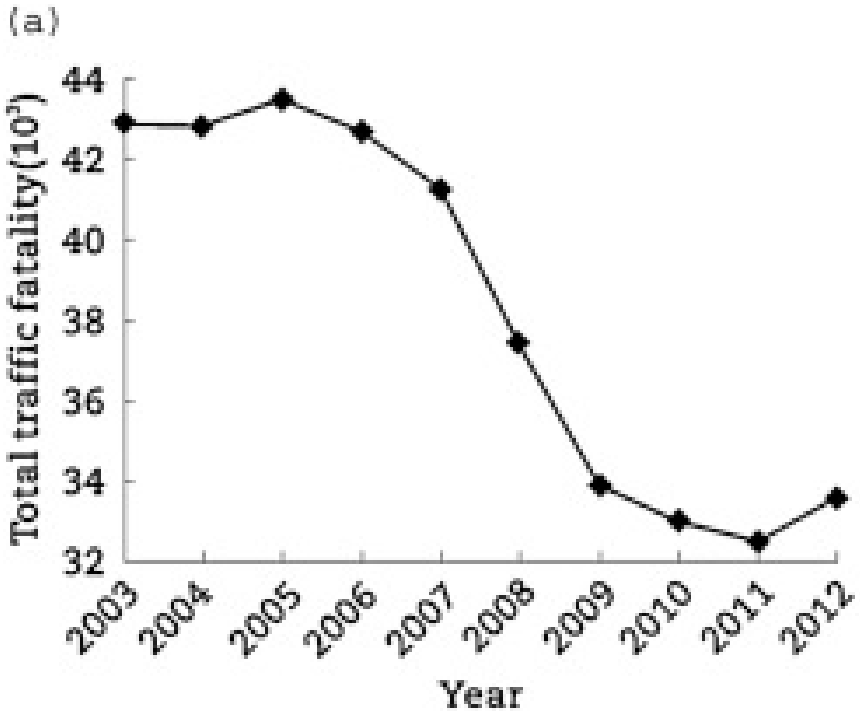
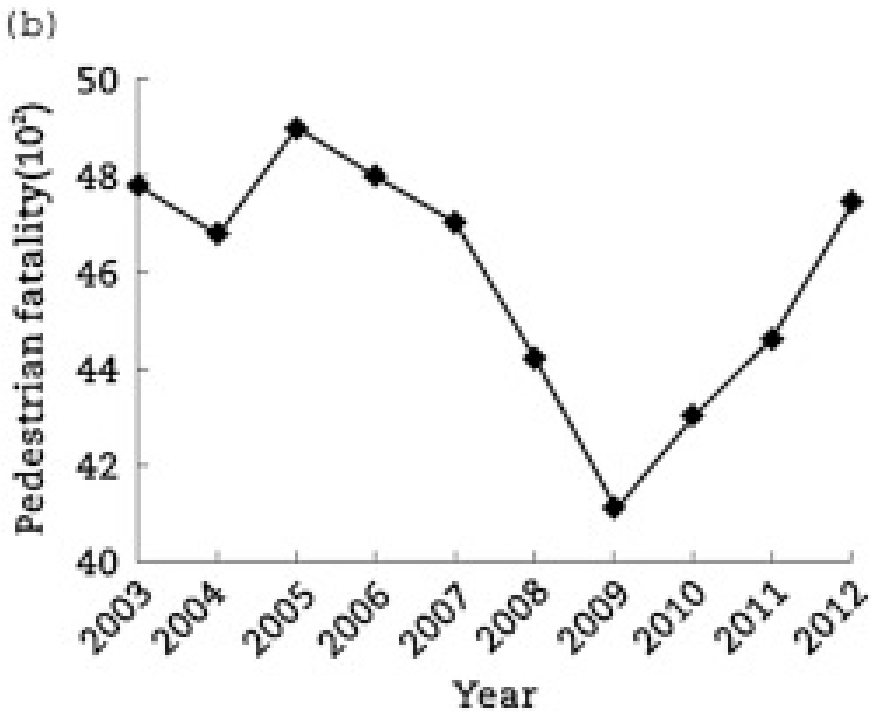
NHTSA, 2014 Data





What is happening?

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Alcohol

Alcohol is a depressant drug. It slows down the activity of the central nervous system, including the brain.

Alcohol could affect your driving by causing:

- Impaired vision
- Reduced reaction times
- Reduced concentration and vigilance
- Feeling more relaxed and drowsy, which may cause a driver to fall asleep at the wheel
- Difficulty in understanding sensory information
- Difficulty doing several tasks at once (e.g. keep in the lane and in the right direction, while concentrating on other traffic)
- Failure to obey road rules
- Over confidence, which may lead to risk taking

{http://www.druginfo.adf.org.au/topics/how-does-alcohol-affect-driving}

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Drugs

- After alcohol, **marijuana** is the drug most often found in the blood of drivers involved in crashes
- Stimulant drugs, such as caffeine, amphetamines and cocaine, may increase alertness, but this does not mean they improve driving skills.
- Amphetamines do not seem to affect driving skills when taken at medical doses, but make some people overconfident, and can lead to risky driving.
- Higher doses of amphetamines often make people hostile and aggressive.

Stimulants -Cocaine

Cocaine

- Feel confident about their ability
- Affects vision, **causing blurring, glare and hallucinations**.
- “Snow lights”—weak flashes or movements of light in the peripheral field of
- May also hear sounds that aren’t there, such as bells ringing, or smell scents that aren’t there, such as smoke or gas, which **distract** them

Cannabis and other hallucinogens

Cannabis

- Impairs depth perception, attention span and concentration, slows reaction time, and decreases muscle strength and hand steadiness

Hallucinogenic drugs, such as LSD, ecstasy, mescaline and psilocybin, distort perception and mood

Prescribed Drug Effect

- Reliable evidence that prescribed drugs increase risk of crashes, especially for elderly drivers
- For seniors, (slower metabolism) many drugs have higher active levels and last longer
- Central nervous system effects increase with age
- Increased potency of over the counter (OTC) drugs