

Careers in Human Factors and Ergonomics

Brian Peacock
September 2009

Most of
the World

Ergonomics = Human Factors

HFE

USA

Definition

*The **scientific study of**
human characteristics,
capabilities and limitations
applied to the design of
equipment, workplaces,
environments, jobs,
instructions, interfaces,
systems, processes etc*

.....

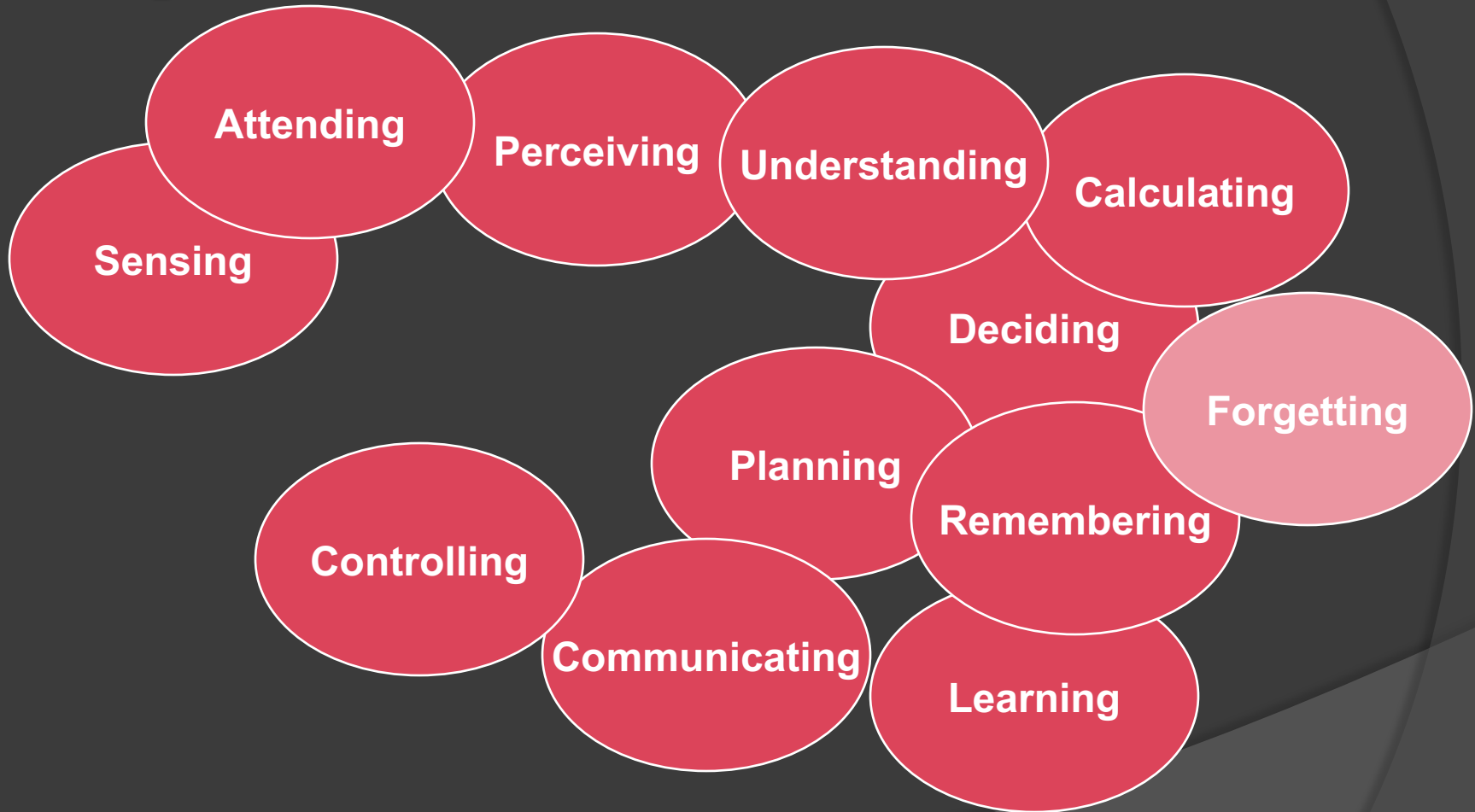
Physical Characteristics, Capabilities and Limitations



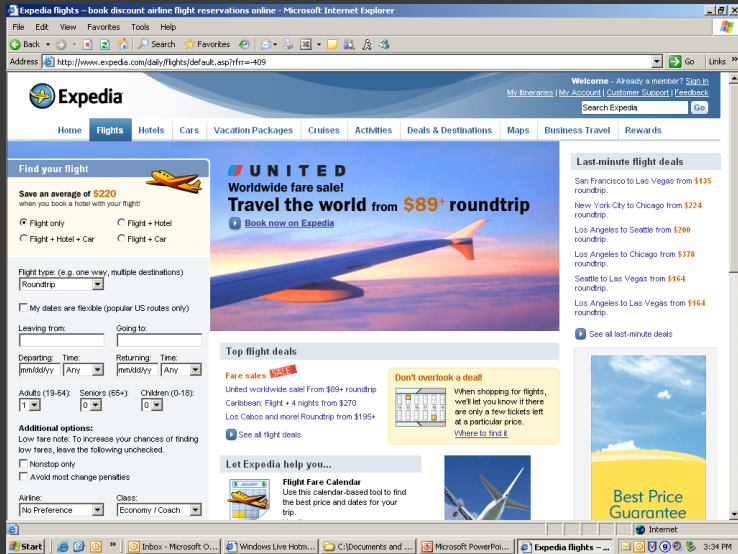
Variable Physical Capabilities



Mental Characteristics, Capabilities and Limitations



Mental Demands



Environmental Factors

Thermal

Heat
Humidity
Cold
Air movement

Acoustic

Communication
Hearing loss

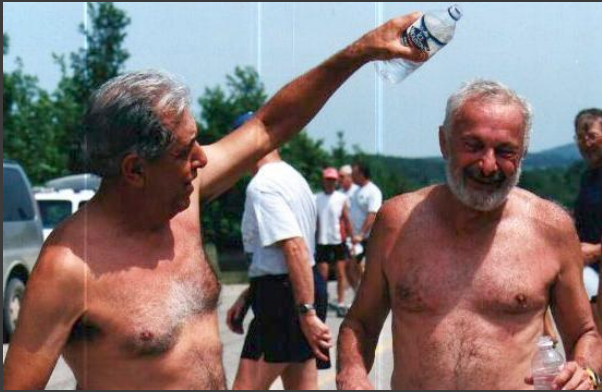
Vibration

Hand / Arm
Whole body

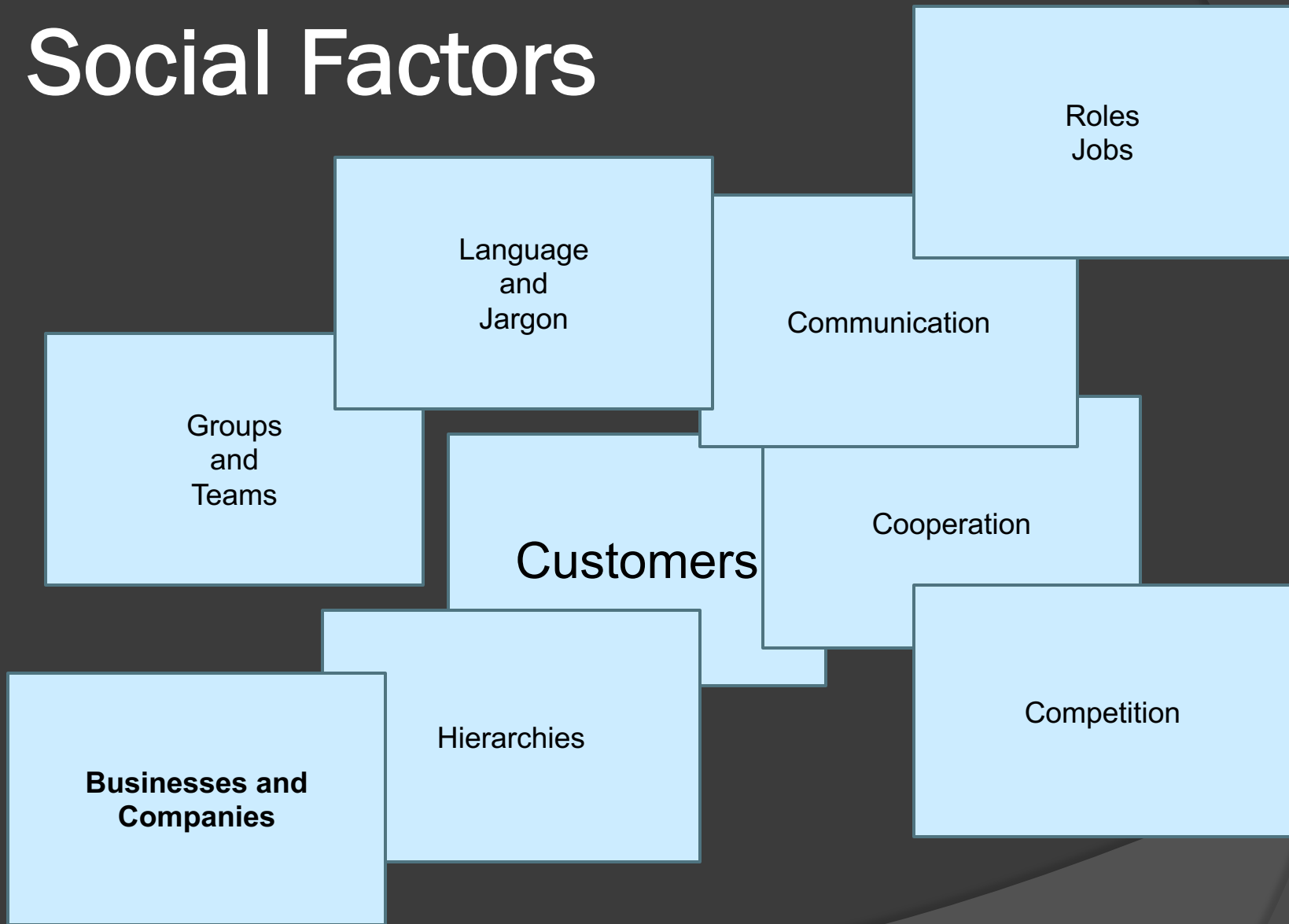
Light and Dark

Vision
Contrast
Color

Environmental Factors



Social Factors



Temporal Factors



Social Factors

People vary



Good Human Factors

- ① **Knowledge of human characteristics, capabilities and limitations**
 - plus
- ② **A bag of tools and techniques**
 - plus
- ③ **Domain knowledge**

Purposes of Ergonomics

- ① **Effectiveness** – fulfilling customer requirements
- ② **Efficiency** – optimal use of resources
- ③ **Safety and Health** – don't hurt people or the system or the environment
- ④ **Satisfaction** – motivating all concerned

People Vary:

Everybody write the following:

- Age
- Height
- Weight
- Time to run a mile
- Pushups in a minute
- Time taken to multiply 365 by 1472
- Time taken to decide whether to stop or go when the light turns to amber
- Number of mistakes you made already today
- Time taken and errors made while sending a text message to your friend

***If it isn't applied to the
design of something it
isn't Ergonomics***

(but it might be one of the
related basic sciences –
psychology, physiology,
biomechanics etc)

Design

With People in Mind

BUSES AND
2 PERSON
CAR POOLS ONLY

EXIT 90

EXIT 351B

REST ROOMS
7:00 AM - 11:00 AM ET

TO  WEST
1 3/4 MILES
↓

HH EXIT 84
Ivanhoe Blvd
1 MILE

RIGHT LANE
ENDS
1/4 MILE

EXIT 3/4 OLD 49
 EAST

EXITS 64AB
EXIT 62
EXIT 62 OLD 24CDE

EXIT 62

EXIT 74A
↑  ↑
Kissimmee
2 MILES

EXIT 62

EXIT 62

TOLL 536  441  TOLL 95  NORTH EAST 
Sand Lake Rd. Wood ↓ ↑ Hell's Celebration ↗
Dora John Fairbanks
EXIT ONLY HOV EXIT ONLY

OLD 24CDE

Eatonville
Historic Dist.



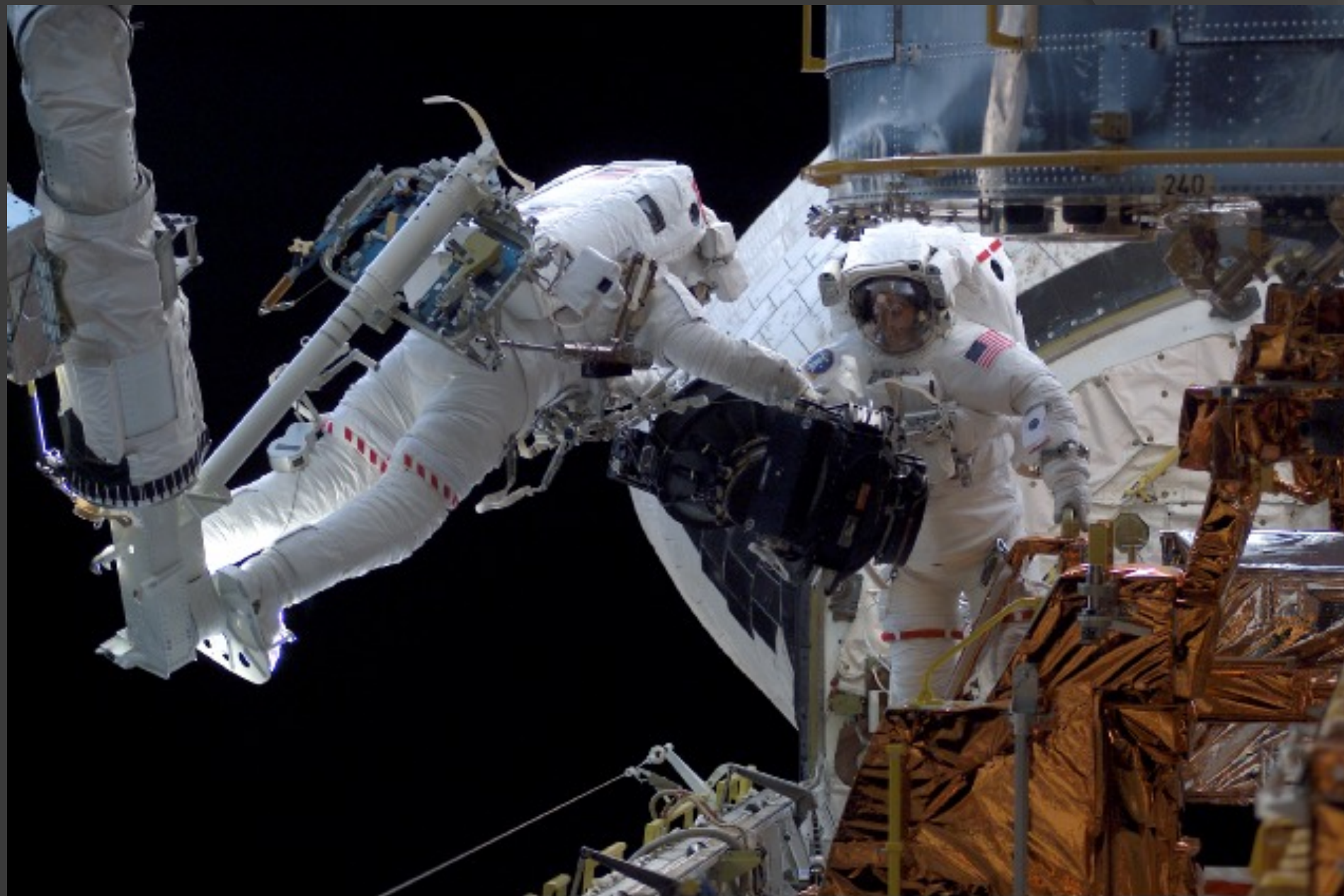
20
MPH

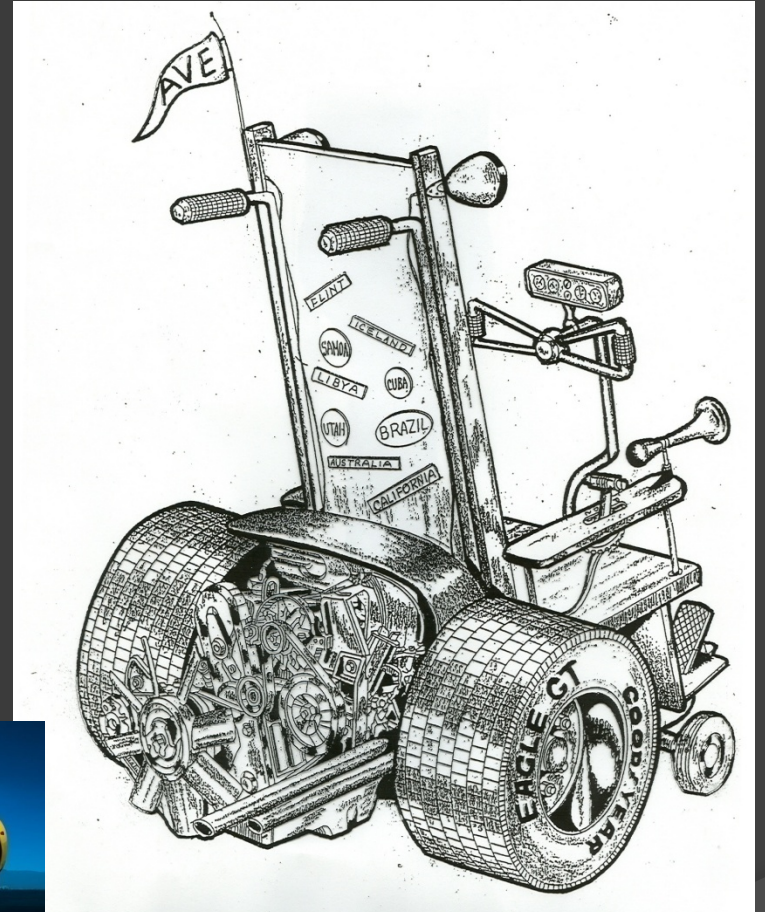
REST
AREA
↙ ↘

TO
S. International Dr.
Orlando World Center
EXIT 103 1/4









**Which will you drive
when you are 80?**





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Check out your phone and your computer



Beautiful Design



Games and Applications

Who fits in a Cessna? Who can reach the controls?



How do you make a space suit?



Hong Kong Mass Transit Railway

- Seats
- Grab rails
- Entry / Egress
- Emergency Buttons
- Instructions, Charts and Warnings



Size Games

- How tall are you?
- How long is your arm?
- How wide are your shoulders?
- How long are your legs?
- How big are your feet?
- How should you design the interior of a car?



Movement

- Joint differences
 - Range of motion
- Gait
 - Walking, running
- Pulling and pushing
- Throwing
- Catching
- Writing
- Typing
- Driving



Movement Applications

- Climbing stairs and ramps
- Eating
- Assembly
 - How long does it take to assemble a car?



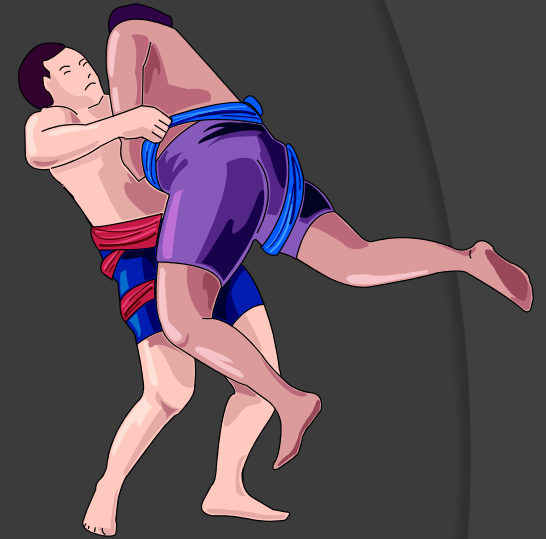
Strength

- ⦿ Moments – Force x Distance
- ⦿ Archimedes – give me a lever long enough and I will move the earth
- ⦿ Lift
- ⦿ Hold
- ⦿ Push
- ⦿ Carry

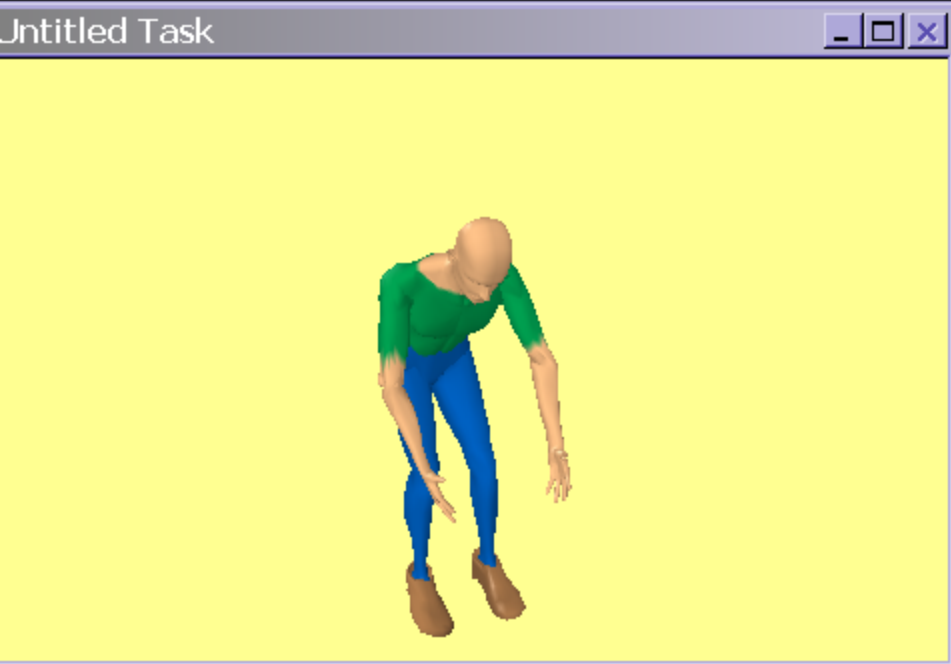
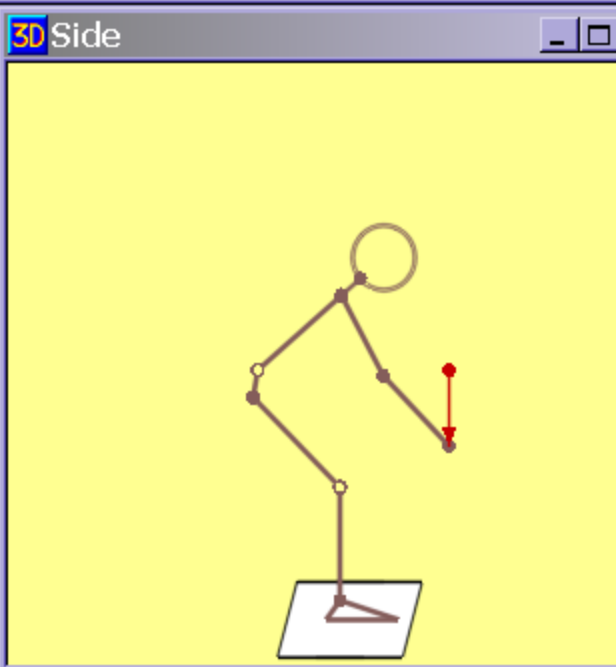
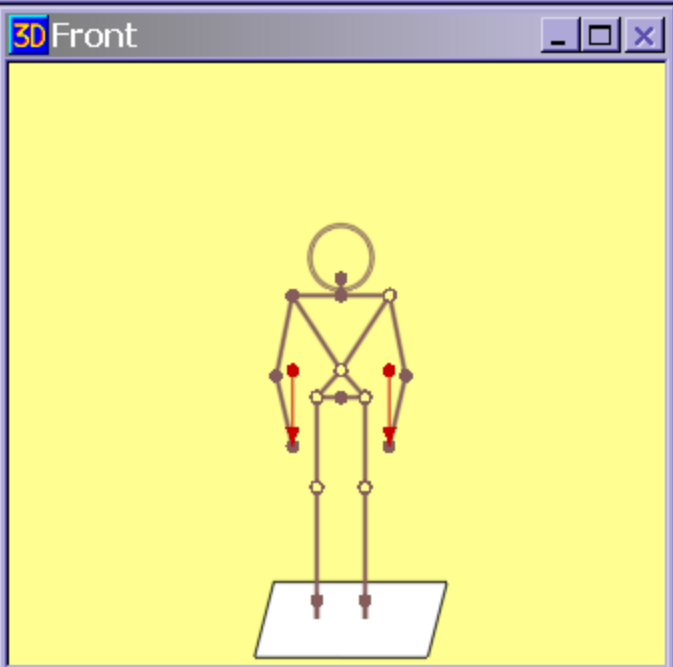
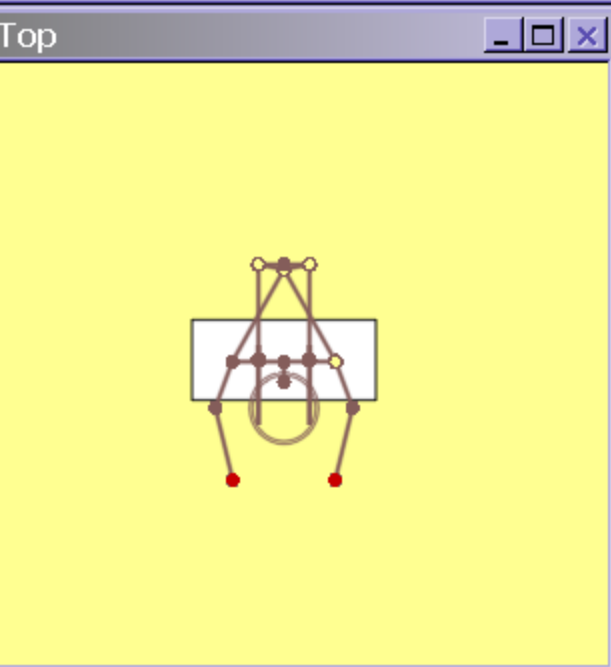


Strength Games

- ◎ Arm wrestle
 - Moments
- ◎ Stand with arms out to the side
 - Turn your partner
- ◎ Pick up book bag
 - With arms straight
 - With center of gravity of weight close to your CG







3D Status - Untitled Task

Anthropometry	Hand Forces (lb)		Hand Locations (in)	
Gender: Male, Percentile: 5th	Left: 10	Right: 10	Horizontal:	Left: 14.7
Ht (in): 64.4, Wt (lb): 131.6			Vertical:	Right: 14.7
			Lateral:	Left: 22.6
				Right: 22.6
				Lateral: -6.5
				Right: 6.5

3D Low back Compression (lb):

L4/L5: 551

Strength Percent Capable (%)

Elbow:		100
Shoulder:		99
Torso:		98
Hip:		94
Knee:		99
Ankle:		99

Balance: Acceptable
Coef. of Friction: ---

3DSSPP 5.0.7, Copyright 2006, The Regents of the University of Michigan - ALL RIGHTS RESERVED

Stamina

- ⦿ Getting glucose and oxygen to your muscles and carbon dioxide and other waste products away
 - Krebs cycle
- ⦿ Getting rid of heat energy
- ⦿ Heart, lungs and circulation
- ⦿ Fatigue
 - Local
 - General

Stamina Applications

- Agriculture
- Manual materials handling
- Soccer



Stamina Games

- ⦿ Hold heavy object out at arms length
 - For as long as you can
 - Draw graph of individual differences in holding time
- ⦿ Do 100 deep knee bends
- ⦿ Go climb a mountain
- ⦿ Run a marathon

Skill

- ⦿ Control of movement
 - Motor skill, motor control
- ⦿ Afferent and efferent nerves
- ⦿ Coordination
- ⦿ Feedback
 - Visual, tactile, kinesthetic
- ⦿ Learning

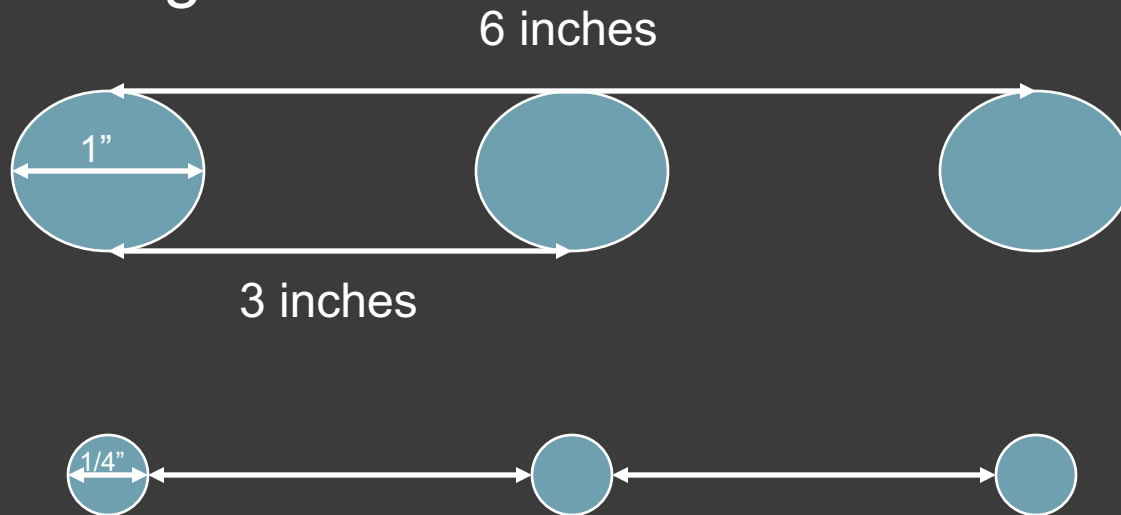


Skill Examples



Skill Games

- Tight Targets Take Time
- Fitts' Law
- De Jong's Law



Draw the circles, With a pencil place dots alternately in pairs of circles, Record the times for ten dots, Compare the effects of target size and target spacing. Read about Fitts' Law

Memory

- Iconic
- Short term
- Long term
 - Many variations



Memory Games

- Numbers and set length 9284783283
- Primacy and recency tac ipg ocw
- Von Restorff
- Interference 1GTDT13Y65K205418
- Miller

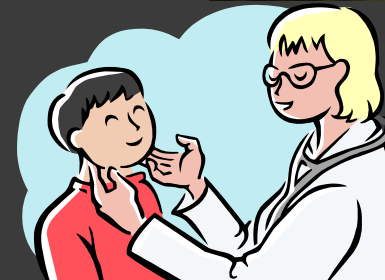
Alpha4 Bravo Bravo4 Foxtrot Hold Short of Charlie

Memory Games

- ◎ Write down
 - The number
 - The 3 letter codes
 - The car VIN number
 - The instructions for taxiing back to the ramp

Decisions

- ◉ Who to vote for
 - Pepsi or Coke
 - Democrat or Republican
 - American Idol
- ◉ Decision difficulty and information
 - Common cold or pneumonia?
 - Stop or go when the light turns amber?
 - Which is the correct test answer?

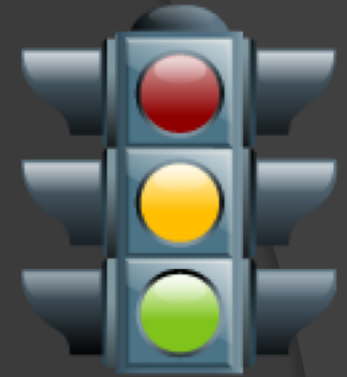


Decision Games

- Thinking time
 - Sort cards in to two piles – face up
 - Sort into red and black piles – face up
 - Sort into Hearts, Clubs, Diamonds, Spades – face up
- Hick – Hyman Law



Reaction Time Games



- ◎ Dollar bill
- ◎ Stopping at a red light
 - You are driving at 40 mph (44 ft/sec) and the light changes from green to amber when you are 50, 100, 150, 200 feet away.
 - At 44 ft / sec it takes 10 seconds to stop safely
 - Should you stop or go?
 - What other information do you need?
 - What assumptions do you make

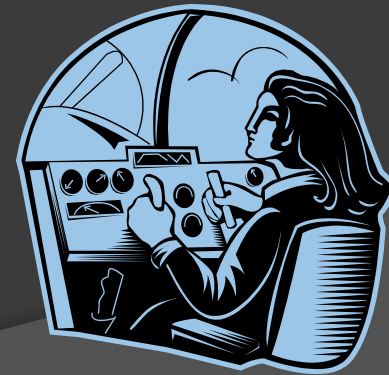
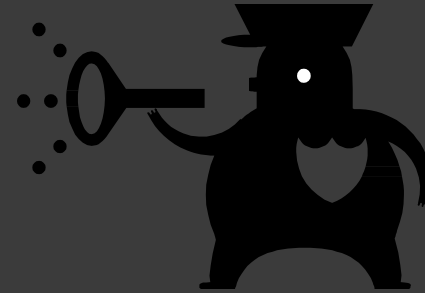
Circadian Rhythms and Shift Work

- Night and day
- Meal times
- Social activities
- Body temperature
- Alertness
- Accidents
- Shift schedules



Shift Work Applications

- Police, fire, ambulance
- Radio
- Shops
- Manufacturing
- Transportation
 - Truck driving
 - Pilots - Jet lag

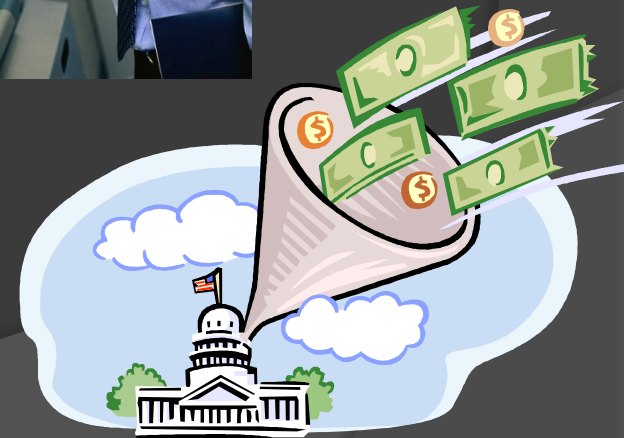


Shift Work Games

- ⦿ Create a diary of your daily activities
 - Sleep, eat, work, play, watch TV, talk etc
 - Record the times started and ended
- ⦿ Take your body temperature every 4 – 6 hours
 - Repeat for a week
- ⦿ Draw a graph of the changes in temperature over time
- ⦿ Ask your parents and friends about shift work

Understanding

- Using the VCR / DVD / TV remote control
- Navigating a web page
- Using the fax machine
- Filling out your tax returns



Understanding Games

- ⦿ Log on to the Internet
- ⦿ Find web pages for
 - Travel
 - Electronic device purchases
 - Medicine effects and contra indications
 - Weather
 - College admissions
- ⦿ Record the time taken to find out what you wanted to know
- ⦿ Record the number of navigation errors you made

Aviation Digital Data Service (ADDS)

Output produced by METARs form (1706 UTC 06 March 2008)
found at <http://adds.aviationweather.gov/metars/index.php>

```
KPRC 061653Z 36008KT 10SM CLR 04/M14 A3023 RMK AO2 SLP227 T00391144
```

```
KPRC 061132Z 061212 34010KT P6SM SKC  
TEMPO 1216 34013G23KT  
FM1600 36012G22KT P6SM SKC  
FM0100 30008KT P6SM SKC  
FM0400 VRB05KT P6SM FEW250  
FM1000 21004KT P6SM FEW250
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Flight type: (e.g. one way, multiple destinations)
Roundtrip

My dates are flexible (popular US routes only)

Leaving from: Going to:

Departing: Time: Returning: Time:
mm/dd/yy Any mm/dd/yy Any

Adults (19-64): Seniors (65+): Children (0-18):

Additional options:
Low fare note: To increase your chances of finding low fares, leave the following unchecked.

- Nonstop only
- Avoid most change penalties

Line: Class:
Preference: Economy / Coach

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- New York City to Chicago from **\$224** roundtrip.
- Los Angeles to Seattle from **\$200** roundtrip.
- Los Angeles to Chicago from **\$378** roundtrip.
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- Los Angeles to Las Vegas from **\$164** roundtrip.

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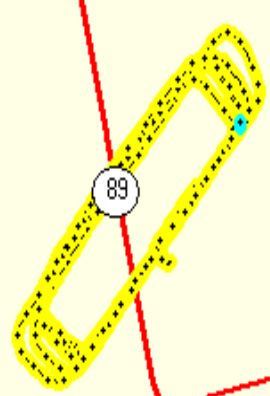
Best Price Guarantee

Mental Workload

⦿ Information / Time

- ⦿ Improves with practice
- ⦿ Affected by stress
- ⦿ Multi-tasking
- ⦿ Causes many errors
 - Driving, Flying
 - Air traffic control
 - Production management
 - Project supervision

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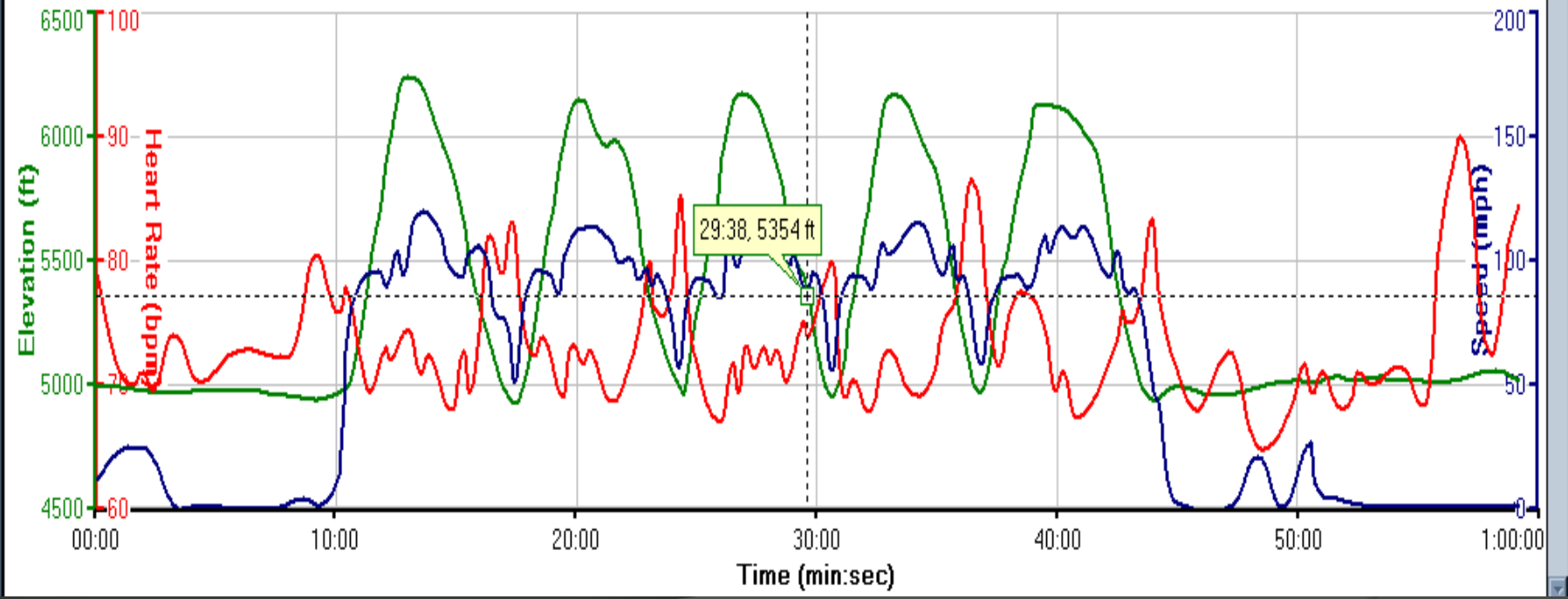
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Time



7/21/2006 6:35:17 AM



ATC Communications

- **FAA probes FedEx near-miss**

- Planes were much too close; may be worst local error in 10 years
- Federal investigators are studying a near-miss between two FedEx planes over Memphis last Thursday that likely is the most serious air traffic control error here in 10 years.
- Officials say both the pilot and controller believed the other had transposed numerals in the flight number. Because the crew did not read the number back as it was heard -- which is standard procedure -- the tower issued directions meant for another plane, putting flights 527 and 257 within 100 feet of each other vertically and less than a mile apart laterally.
- **The latest incident in Memphis happened shortly before 4p.m. Feb. 21 as FedEx flights 527 and 257 were preparing for simultaneous takeoff on parallel runways.**
- Controllers say the margin for error was increased because the pilot called in on the wrong radio frequency.
- "Westbound FedEx 257 crew checked in on the frequency for the east departure controller," Sufka said.
- The east departure controller, who had just seen data on eastbound 527 on his screen, thought the pilot had transposed the numbers and told FedEx 527 to turn left and climb.
- "FedEx 257 hears this and answers to it," said Sufka, who listened to a replay of the conversation and said the crew read-back on the flight number was unintelligible.
- **"This is where our controller makes the mistake," Sufka said. "He didn't catch the erroneous read-back."**

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Acronym	Meaning
AAR	Airport Acceptance Rate or Airport Arrival Rate. The number of arrivals an airport is capable of accepting each hour.
AC, A/C or ACFT	Aircraft
ADZY or ADVZY	Advisory
ARPT	Airport
ARSR	Air Route Surveillance Radar. Air Route Traffic Control Center (ARTCC) radar used primarily to detect and display an aircraft's position while en route between terminal areas. The ARSR enables controllers to provide radar air traffic control service when aircraft are within the ARSR coverage. In some instances, ARSR may enable an ARTCC to provide terminal radar services similar to but usually more limited than those provided by a radar approach control.
ARTCC	Air Route Traffic Control Center. A facility established to provide air traffic control service to aircraft operating on IFR flight plans within controlled airspace and principally during the en route phase of flight. When equipment capabilities and controller workload permit, certain advisory/assistance services may be provided to VFR aircraft. There are 20 ARTCCs in the continental U.S.
ASR	Airport Surveillance Radar. Approach control radar used to detect and display an aircraft's position in the terminal area. ASR provides range and azimuth information but does not provide elevation data. Coverage of the ASR can extend up to 60 miles.
ATC	Air Traffic Control. A service operated by appropriate authority to promote the safe, orderly and expeditious flow of air traffic.
ATCSCC	Air Traffic Control System Command Center
ATCT	Airport Traffic Control Tower. A terminal facility that uses air/ground communications, visual signaling, and other devices to provide ATC services to aircraft operating in the vicinity of an airport or on the movement area. Authorizes aircraft to land or takeoff at the airport controlled by the tower or to transit the Class D airspace area regardless of flight plan or weather conditions (IFR or VFR). A tower may also provide approach control services (radar or nonradar).
CDM	Collaborative Decision Making. Cooperative effort between the various components of aviation transportation, both government and industry, to exchange information for better decision making.
CDR	Coded Departure Routes. Predefined routes used to route air traffic around areas of severe weather.
CIGS	Ceilings. The height above the ground of the base of the lowest layer of clouds when over half of the sky is

Acronyms, abbreviations and codes

Ergonomics and Human Factors Organizations

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User-friendly voting systems for the elderly assist voters of all ages.



Human factors researchers at Florida State University have identified ways to improve electronic voting accuracy among older voters while also shortening waiting time at the polls. [Read More...](#)

What's New

- [Call for Participation: Human Factors and NextGen](#)
- [Candidates for Human Factors Editor Sought](#)
- [American National Standards Institute Approves ANSI/HFES 100-2007 Computer Workstation Standard](#)
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Welcome

Welcome to the web site of the Board of Certification in Professional Ergonomics (BCPE). This site was created as a resource for obtaining information about BCPE and its certification programs. We hope you find it useful and informative and continue to visit www.bcpe.org for the latest news and information on BCPE and ergonomics certification.

Who We Are

Established in 1990 as an independent nonprofit organization, the BCPE is the certifying body for individuals whose education and experience indicate broad expertise in the practice of human factors/ergonomics. To date, nearly 1,000 professionals have successfully met BCPE's certification criteria and been awarded one of the following distinguished credentials: Certified Professional Ergonomist (CPE), Certified Human Factors Professional (CHFP), Associate Ergonomics Professional (AEP), Associate Human Factors Professional (AHFP), or Certified Ergonomics Associate (CEA).

The BCPE is governed by an elected board of leading professionals and is managed by an Executive Administrator and a Financial/Information Systems Manager. The BCPE also adheres to the criteria and policies for competency assessment set by [NOCA](#), the National Organization for Competency Assurance, and has been endorsed by the [IEA](#), the International Ergonomics Association, as an accredited ergonomics certifying body.

To learn more about BCPE and becoming certified, visit our [About BCPE](#) and [Certification Information](#) pages today.

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Calendar Of Events
 March 2008

Examination Offerings
[March 10, 2008](#)
[April 7, 2008](#)
[June 1, 2008](#)
[September 21, 2008](#)
[December 1, 2008](#)

Business Meetings
[May 2-4, 2008](#)
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Latest jobs

m Looking for a new job? Or wanting to find out what kind of


Articles

Who's looking at you?



How do we identify when someone's behaviour is suspicious? There can be times when a person is totally innocent but appears to be suspicious, or when someone who is suspicious tries to behave normally. [more »](#)

Ergonomics - helping keep traffic on the move



When you are sitting in a hold-up on a motorway or on a major road, spare a thought for the Highways Agency staff whose job it is to get the traffic flowing freely again. However frustrating it might seem at the time, the stress you will be under will be temporary, but Regional Control Centre (RCC) operators can face considerable pressures throughout their working day. [more »](#)

In the spotlight

m Renew your membership
 All Society memberships become due for renewal in January of each year. Your invoice will be issued soon. At this time, you may want to change your journal choice or upgrade your membership. If so, we have all the information you need here.

m Renew your membership
m Members web portal
 Keep the Society up to date with your contact details and professional interests. Please check and make any amendments using this new secure facility.

Council nominations sought
 The Society is run by a group of volunteers that make up the Society Council, and conduct business on behalf of the membership. Nominations are now sought for positions on Council and PAB. [more »](#)

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<http://www.ergonomics.org.uk/>

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International Ergonomics Association

This website has been developed by the International Ergonomics Association (IEA) to provide information and opportunities to interaction on international issues relating to the science of ergonomics.

The IEA has developed this website to facilitate open access to information on ergonomics to researchers, practitioners, students, and members of the public interested in exploring the history and development of ergonomics.

Also known as Human Factors, ergonomics is a multi disciplinary science that focuses on the needs of the human in the design of products, work processes and technology systems.

Upcoming Events

- [ODAM' 2008](#)
19 - 21 March 2008, Sao Paulo, Brazil
- [Annual Conference 2008](#)
1 - 3 April 2008, University of Nottingham, UK
- [IranErgo 2008](#)
7 - 8 May 2008, Teheran, Iran
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