

## CMPE 233: Human Factors



### Individual Differences



## Individual Differences

- ▶ **Personality**
  - Develops over a person's lifetime
  - Manifested into thoughts, feelings, attitudes and behavior
  - Affected by nature (biological heritage) and nurture (life experiences, friends)
  - Situational factors might cause personality to affect behavior
- ▶ **Ability: what a person is capable of doing**
  - Cognitive ability
  - Physical ability
  - Emotional intelligence (the ability to understand and manage one's own feelings and emotions and the feelings and emotions of others)
  - Affected by nature and nurture (education, practice, exercises)



## Attitudes and Behavior

- ▶ **Attitudes:** relatively lasting feelings, beliefs, and behavior tendencies directed toward specific people, groups, ideas, issues, or objects.
- ▶ **Attitudes consist of three components:**
  - **AFFECTIVE** = feelings
  - **COGNITIVE** = beliefs
  - **BEHAVIORAL** = predispositions to act
- ▶ **Three principles relate attitudes to behavior:**
  - General attitudes best predict general behaviors
  - Specific attitudes best predict specific behaviors
  - The less time that elapses between attitude measurement and behavior, the more consistent will be the relationship between them

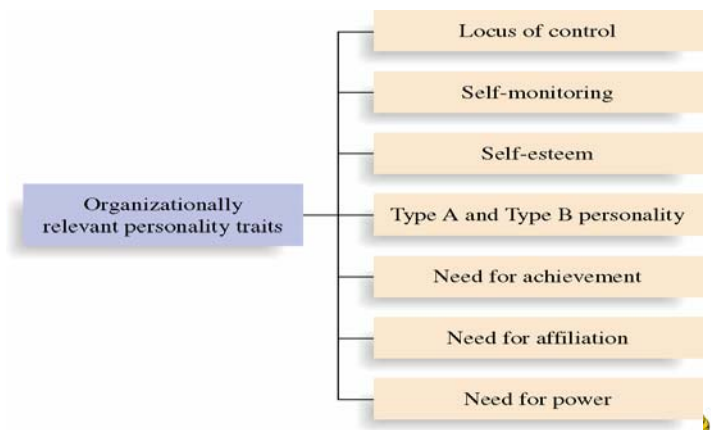


## Personality Traits

- ▶ **Extraversion**
  - Predisposition to experience positive emotional states and feel good about themselves and the world around them
- ▶ **Neuroticism**
  - Tendency to experience negative emotional states, feel distressed, and generally view themselves and the world around them negatively
- ▶ **Agreeableness**
  - How well a person gets along with other people
- ▶ **Conscientiousness**
  - The extent to which an individual is careful, scrupulous, and persevering
- ▶ **Openness to experiences**
  - the extent to which an individual is original, has broad interests, and is willing to take risks



## Personality Traits Relevant to Organizations



## Personality Traits

- ▶ **Locus of control**
  - A belief of where the outcomes of our actions come from
  - Internals tend to attribute outcomes their own control
  - Externals attribute outcomes to external circumstances
- ▶ **Self monitoring**
  - The extent to which people try to control the way they present themselves to others
- ▶ **Self esteem**
  - the extent to which people have pride in themselves and their capabilities
- ▶ **Type A vs. type B**
  - Type A individuals have an intense desire to achieve, are extremely competitive, have a sense of urgency, are impatient, and can be hostile
  - Type B individuals are more relaxed and easy going



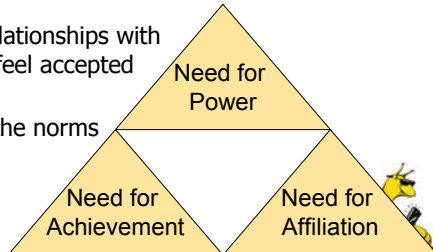
## McClelland's Learned Needs

### ► Achievement (nAch)

- Achievers seek to excel and thus tend to avoid both low-risk and high-risk situations
- Prefer to work alone or with other high achievers
- Need regular feedback in order to monitor the progress of their achievements

### ► Affiliation (nAff)

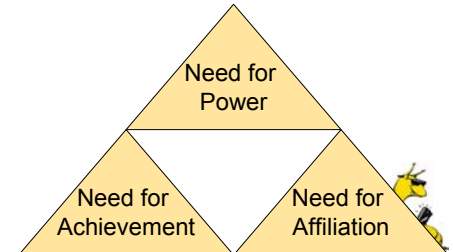
- need harmonious relationships with others and need to feel accepted by others
- tend to conform to the norms of their group



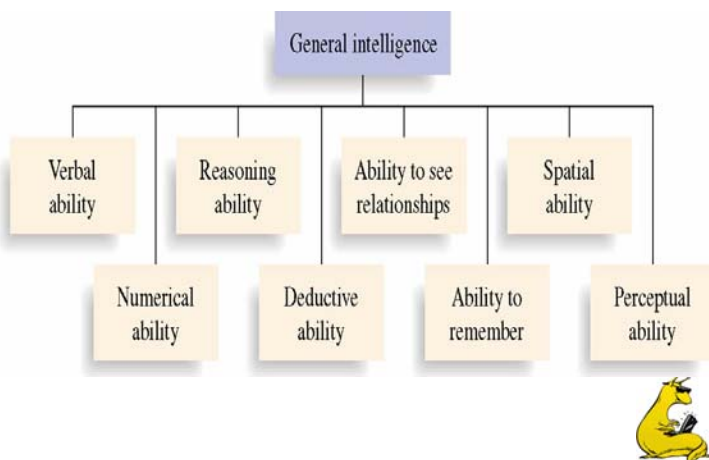
## McClelland's Learned Needs

### ► Power (nPow): personal and institutional

- Those who need personal power want to direct others, and this need often is perceived as undesirable.
- Persons who need institutional power (also known as social power) want to organize the efforts of others to further the goals of the organization



## Cognitive Ability



## Expertise Differences

### ► Dreyfus' model of skill acquisition

- Studied airplane pilots, chess players, car drivers, adult learners of a second language

### ► The road to mastery of an activity is essentially

- a lifelong learning process.
- can take place at times when one is not consciously aware that one is learning, but
- generally requires a focused effort at understanding new concepts and practicing new skills

### ► Five stages: novice, advanced beginner, competence, proficiency, expertise

### ► Best way to observe stages:

- Unstructured problems
- Number of potentially relevant facts enormous
- Variety of solutions extensive



## Stages

### ► Novices

- Follow specific rules for specific circumstances
- No modifiers, "context free"
- Don't feel responsible for other than following the rules

### ► Advanced beginners

- New "situational" elements are identified
- Rules begin to be applied to related conditions
- Decisions still are mostly made by rule application
- Does not experience personal responsibility

### ► Competence

- Recognize the complexity of task and a larger set of cues
- Select and concentrate on the most important cues
- No longer aware of absolute rules; they are assumed
- Experimentation with new behaviors



## Stages

### ► Proficiency

- Unconscious, fluid, and effortless performance begins to emerge
- Approach to problem molded by perspective arising from multiple real world experiences
- "Holistic similarity recognition"
- Learner uses intuition to realize "what" is happening
- Conscious decision-making and rules used to formulate plan

### ► Expertise

- No decomposition of situation into discrete elements
- Pattern recognition extends to plan as well as diagnosis
- Don't make decisions
- Don't solve problems
- Do what works



## Application of Dreyfus' model

- ▶ Expert vs. novice programmers
- ▶ Novice programmers
  - lack an adequate mental model of the area [Kessler and Anderson, 1989]
  - are limited to a surface knowledge of subject, have fragile knowledge (knows but fails to use when necessary) and neglect strategies [Perkins and Martin, 1986]
  - use general problem solving strategies (i.e., copy a similar solution or work backwards from the goal to determine the solution) rather than strategies dependent on the particular problem
  - tend to approach programming through control structures
  - use a line-by-line, bottom up approach to problem solution [Anderson, 1985]



## Application of Dreyfus' model

- ▶ Expert programmers
  - have many mental models and choose and mix them in an opportunistic way [Visser and Hoc, 1990]
  - have a deep knowledge of their subject which is hierarchical and many layered with explicit maps between layers
  - when given a task in a familiar area, work forward from the givens and develop sub-goals in a hierarchical manner, but given an unfamiliar problem, fall back on general problem solving techniques
  - have a better way of recognizing problems that require a similar solution [Davies, 1990]
  - tend to approach a program through its data structures or objects [Petre and Winder, 1988]
  - use algorithms rather than a specific syntax
  - have better syntactical and semantical knowledge and better tactical and strategic skills [Bateson, Alexander & Murphy, 1987]



## Regardless of expertise

- ▶ Given a new, unfamiliar language, the syntax is not the problem, learning how to use and combine the statements to achieve the desired effect is difficult.
- ▶ Learning the concepts and techniques of a new language requires writing programs in that language. Studying the syntax and semantics is not sufficient to understand and properly apply the new language.
- ▶ Problem solution by analogy is common at all levels; choosing the proper analogy may be difficult.
- ▶ At all levels, people progress to the next level by solving problems. The old saying that practice makes perfect has solid psychological basis.
- ▶ Discussion: should tools for novices:
  - Have less or more functionality than those for experts?
  - Have different functionality than those for experts?



## Helping novices

- ▶ What happens when things go wrong?
  - Solve it yourself
  - Get help
- ▶ How do one gets help?
  - Look up (inquire) things in problem-solution database
  - Peer support (discussion boards, blogs)
  - Manual, documentation, helpdesk (human or automated)
- ▶ Good help
  - *Elicitation*: Helper asks user what is wrong. Get enough information from user to determine problem and choose solution.
  - *Explanation*: Helper tells user how to fix the problem. Explain why the solution worked, and how to avoid such problems in the future



## Mismatch between expert and novice models

- ▶ The helper is an expert; the user is a novice
- ▶ Novice may lack technical vocabulary to understand the elicitation questions
- ▶ Novice may lack background knowledge to understand explanation of solution
- ▶ Expert may be unable to empathize with novice
- ▶ Discussion:
  - How do we understand (read: model) the knowledge of someone who is not supposed to know very much?
  - Traditionally, novice is modeled as subset of expert knowledge
  - But how do you model novice knowledge "in general"?



## Possible solutions?

- ▶ Helpers best help novices by *making analogies to everyday life situations*
- ▶ Problem: "My browser runs slowly"
- ▶ Solution: "Check if it's network congestion or virus"
- ▶ Elicitations:
  - When did it happen?
  - Did you download any new applications lately?
- ▶ Solutions:
  - Try at different times of the day
  - Run an antivirus program. Install virus watch program.
- ▶ Explanations:
  - If you have the flu, you can't do things as fast as you normally would. Computer virus is like a flu virus.
  - An antivirus program is like tamiflu. But just like tamiflu, sometimes it cures the problem, sometimes it can't because the virus has mutated into something new.

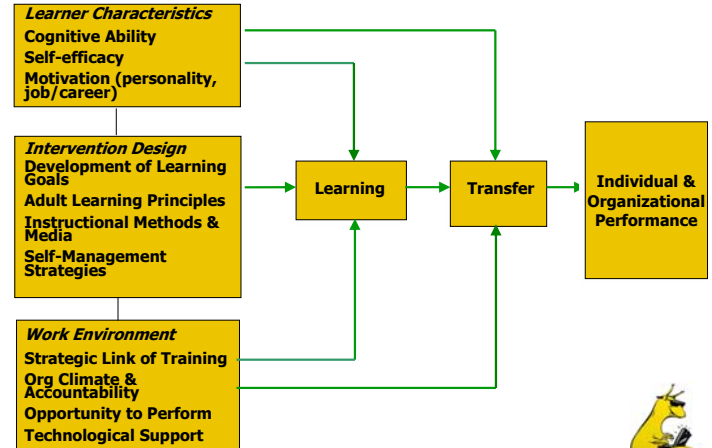


## Transfer-of-Training Theories

Theory	Emphasis	Appropriate Conditions	Type of Transfer
<b>Identical Elements</b>	Training environment is identical to work environment.	Work environment features are predictable and stable.	Near
<b>Stimulus Generalization</b>	General principles are applicable to many different work situations.	Work environment is unpredictable and highly variable.	Far
<b>Cognitive Theory</b>	Meaningful material and coding schemes enhance storage and recall of training.	All types of training and environments.	Near and far

Noe (2008)

## Training Transfer Model



Baldwin & Ford, 1988

## Training Evaluation Process: Kirkpatrick's Framework



## Transfer of Training

- ▶ **Retention**
  - 40% of skills learned in training are transferred immediately
  - 25% remain after 6 months
  - 15% remain after 1 year
  - Material learned under "spaced practice" is usually retained longer
- ▶ **Obstacles:**
  - Environment: time pressures, inadequate equipment, few opportunities to use skills, inadequate budget/resources
  - Lack of peer support: peers discourage use of new knowledge and skills or unwilling to provide feedback
  - Lack of supervisory support: doesn't accept ideas or suggestions learned in training, doesn't discuss training opportunities, opposes the use of skills learned in training, communicates that training is a waste of time

## Training in Virtual Reality

- ▶ **Why?**
  - Cheap, secure, repeatable, realizable, etc.
  - Free setting of the **environment parameters**, control over the **development of the training**, easy monitoring of the **trainee response**
  - VE as a game format: increased motivation (e.g. young population) → better learning
- ▶ **Why not?**
  - Technology limits: real environments hard to reproduce (computing power, mechanical feedbacks, etc).
  - Transfer of training: Does transfer of training always exist from a VE to the real world?

## Other differences

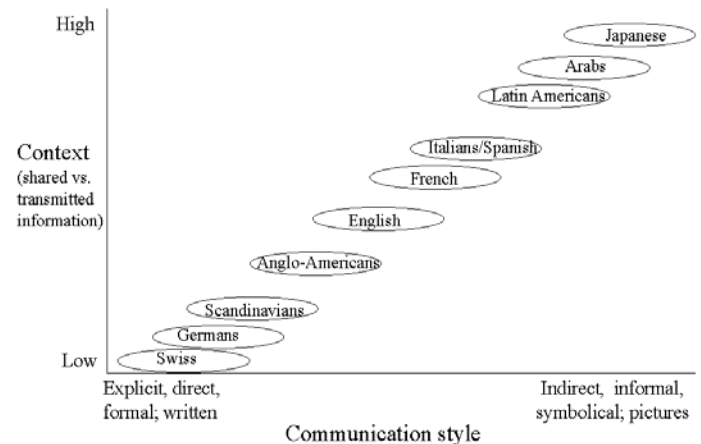
- ▶ **Between-subject differences: systematic, reliable**
  - Architectural (processing) differences, e.g., processing speed, working memory capacity, decay
  - Knowledge-based differences
    - ▶ Knowledge contents (e.g., facts, strategies, etc.)
    - ▶ Same content, but differences in experience/practice, e.g., different trial sequences, different real-world experiences
  - Representational differences
    - ▶ Features represented, knowledge structures
- ▶ **Within-subject differences: temporal, subtle**
  - Knowledge/experience grows (learning)
  - Processing parameters change (e.g., fatigue)
  - Representation changes (insight)

## Hofstede's 5 Dimensions of Culture

- ▶ **Power-distance**: the extent to which the less powerful members of organizations and institutions accept and expect that power is distributed unequally
- ▶ **Individualism**: the degree to which individuals are integrated into groups
- ▶ **Masculinity**: the distribution of roles between the genders
- ▶ **Uncertainty avoidance**: a society's tolerance for uncertainty and ambiguity
- ▶ **Long-term orientation**: how a society deals with virtue regardless of truth



## Hofstede's model



## Culture vs. UI : Power Distance

- ▶ **Metaphors**
  - **High**: Institutions, buildings with clear hierarchy: schools, government, monuments, *etc.*
  - **Low**: Institutions, buildings with equality options: play/games, public spaces, *etc.*
- ▶ **Mental Models**
  - **High**: Reference data with no relevancy ranking
  - **Low**: Less structured data with relevancy
- ▶ **Navigation**
  - **High**: Restricted access, choices; authentication; passwords
  - **Low**: Open access, multiple options, sharable paths



## Culture vs. UI: Power Distance

- ▶ **Interaction**
  - **High**: Severe error messages: "Entry Forbidden," "You are wrong;" wizards or guides lead usage
  - **Low**: Supportive error messages, cue cards
- ▶ **Appearance**
  - **High**: Images of leaders, nations; official music, anthems; formal speech
  - **Low**: Images of people, daily activities; popular music; informal speech



## Culture vs. UI: Individualism vs. Collectivism

- ▶ **Metaphors**
  - **Individualist**: Action-oriented, tools
  - **Collectivist**: Relationship-oriented
- ▶ **Mental Models**
  - **Individualist**: Product- or task-oriented
  - **Collectivist**: Role-oriented
- ▶ **Navigation**
  - **Individualist**: Individual paths; popular choices, celebrity choices; stable across roles; customizable
  - **Collectivist**: Group-oriented, official choices; changes per role



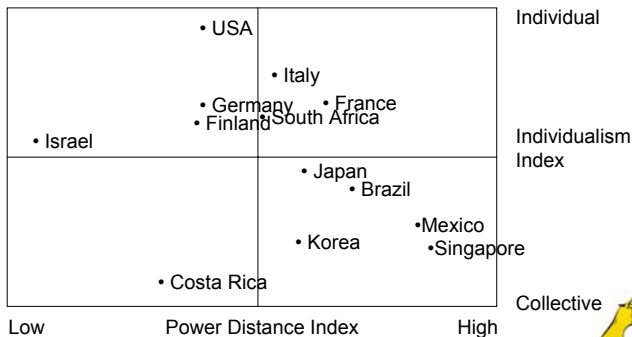
## Culture vs. UI: Individualism vs. Collectivism

- ▶ **Interaction**
  - **Individualist**: Keyword searches; active-oriented; multiple devices; customizable;
  - **Collectivist**: Limited, official devices; role driven
- ▶ **Appearance**
  - **Individualist**: Images of products, people; low context; hyperbolic, dynamic speech; market-driven topics, imagery, language; customizable; direct, active verbs
  - **Collectivist**: Images of groups, organizations; images of roles; high context; official, static terminology; institution-driven topics, imagery, language; passive verbs

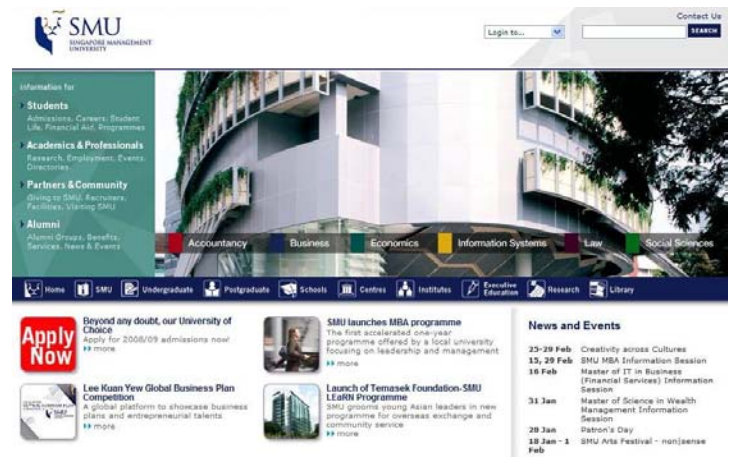




## Power Distance vs. Individualism-Collectivism



## Singapore Management University



## Tel Aviv University



## Culture vs. UI: Masculinity vs. Femininity

- Metaphors
  - **Masculine:** Sports-oriented; competition-oriented; work-oriented
  - **Feminine:** Shopping carts; family-oriented
- Mental Models
  - **Masculine:** Work/business structures; high-level, "executive views;" goal-oriented
  - **Feminine:** Social structures; detailed views; relationship-oriented
- Navigation
  - **Masculine:** Limited choices, synchronic
  - **Feminine:** Multiple choices; multi-tasking, polychronic

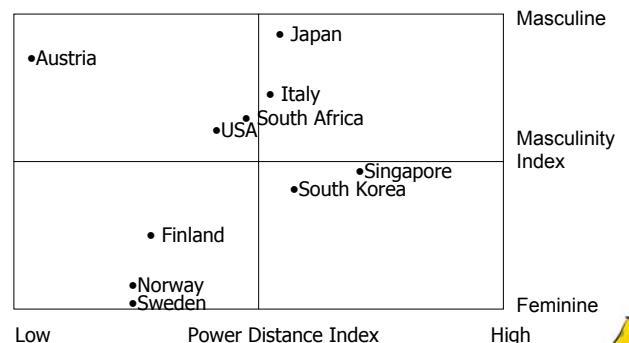


## Culture vs. UI: Masculinity vs. Femininity

- Interaction
  - **Masculine:** Game-oriented; mastery-oriented; individual-oriented
  - **Feminine:** Practical, function-oriented; co-operation-oriented; team oriented
- Appearance
  - **Masculine:** "Masculine" colors, shapes, sounds
  - **Feminine:** "Feminine" colors, shapes, sounds; acceptance of cuteness



## Power Distance vs. Masculinity



## NHK – Japanese TV



## Norwegian TV



## Culture vs. UI: Uncertainty Avoidance

- ▶ Metaphors
  - **High:** Familiar, clear references to daily life; representation
  - **Low:** Novel, unusual references; abstraction
- ▶ Mental Models
  - **High:** Simple, clear articulation; limited choices; binary logic
  - **Low:** Tolerance for ambiguousness, complexity; fuzzy logic
- ▶ Navigation
  - **High:** Limited options; simple, limited controls
  - **Low:** Multiple options; varying, complex controls



## Culture vs. UI: Uncertainty Avoidance

- ▶ Interaction
  - **High:** Precise, complete, detailed input and feedback of status
  - **Low:** General, limited, or ambiguous input and feedback of status
- ▶ Appearance
  - **High:** Simple, clear, consistent imagery, terminology, sounds; highly redundant coding
  - **Low:** Varied, ambiguous, less consistent imagery, terminology, sounds



## Wagamama: only noodle



## Giraffe: Food from around the world



## Culture vs. UI: Long-Term Orientation

### ► Metaphors

- **Long:** Stable family, Father; Mafia, IBM in 1950s
- **Short:** Interchangeable roles, jobs, objects

### ► Mental Models

- **Long:** Love/devotion; social coherence, responsibility, support
- **Short:** Liberty; social incoherence/irresponsibility, efficiency

### ► Navigation

- **Long:** Tolerance for long paths, ambiguity; contemplation-oriented
- **Short:** Bread-crum trail, taxonomies; quick-results; action-oriented



## Culture vs. UI: Long-Term Orientation

### ► Interaction

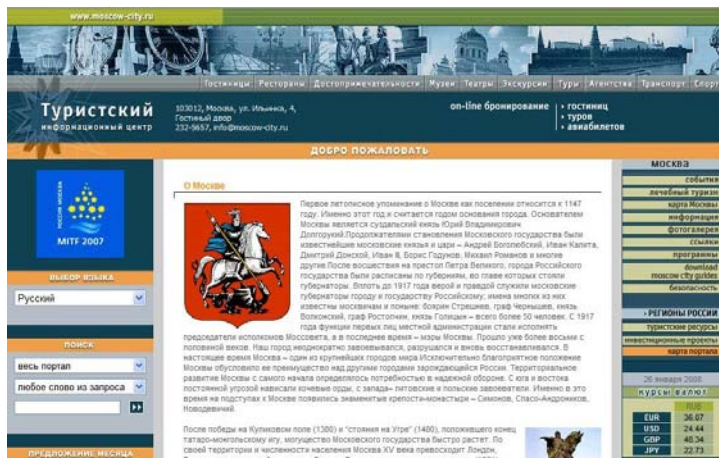
- **Long:** Preference for face-to-face communication, harmony; personalized messages; more links to people; live chats; interaction as "asking"
- **Short:** Distance communication accepted as more efficient; anonymous messages tolerated; conflict encouraged; performance critical communication

### ► Appearance

- **Long:** Cultural markers: flags, colors, atonal images; soft focus; warm, fuzzy images; pictures of groups inviting participation, suggestions of intimacy and close social distance
- **Short:** Minimal and focused images; short borders, lines, edges; concentration on showing product



## Moscow Tourism



## Thailand Tourism



## Ability differences: We're all disabled

### ► When?

- Environment: in a foreign country, in a bouncing vehicle, in the dark
- Non-optimal health: lack of sleep, drunk, fever
- Injury: hit a finger with a hammer
- At the two extremes of our lives
- Changing role of information technology: new products, unfamiliar interface

### ► Disability conditions:

- Transient: Noisy room
- Temporary: Broken arm
- Permanent: For most, this one is labeled a disability

