CMPE 233: Human Factors

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 Relevant to Organizations

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

► 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

► **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

► **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

► **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

► **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

► **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]

► 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

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

Cognitive Theory

Meaningful material and coding schemes enhance storage and recall of training. Noe (2008)

Training Transfer Model

<table>
<thead>
<tr>
<th>Learner Characteristics</th>
<th>Cognitive Ability</th>
<th>Self-efficacy</th>
<th>Motivation (personality, job/career)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention Design</td>
<td>Development of Learning Goals</td>
<td>Adult Learning Principles</td>
<td>Instructional Methods &amp; Media</td>
</tr>
<tr>
<td>Strategy</td>
<td>Self-Management Strategies</td>
<td>Work Environment</td>
<td>Strategic Link of Training</td>
</tr>
<tr>
<td>Org Climate &amp; Accountability</td>
<td>Opportunity to Perform</td>
<td>Technological Support</td>
<td>Individual &amp; Organizational Performance</td>
</tr>
</tbody>
</table>

Training Evaluation Process: Kirkpatrick’s Framework

► 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 exists 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

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: 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

Hofstede’s model

Context (shared vs. transmitted information)

Explicit, direct, formal, written

Indirect, informal, symbolical, pictures

Communication style
## Power Distance vs. Individualism-Collectivism

<table>
<thead>
<tr>
<th>Country</th>
<th>Power Distance Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>

- USA
- Germany
- Finland
- Israel

- France
- South Africa
- Japan
- Brazil
- Korea
- Mexico
- Singapore

## Singapore Management 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

<table>
<thead>
<tr>
<th>Country</th>
<th>Masculinity Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>

- Japan
- Italy
- South Africa
- Singapore
- South Korea
- Austria
- USA
- Finland
- Norway
- Sweden
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

Giraffe: Food from around the world

Wagamama: only noodle
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 trails, taxonomies; quick-results; action-oriented

► 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