UNIT 2: USER ORIENTED PERSPECTIVE OF HUMAN COMPUTER INTERACTION: COGNITIVE HUMAN THRUST

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1.0 Introduction

Cognitive Human Thrust incorporates cognitive psychology and cognitive modeling. Cognitive psychology plays an important role in Human-computer Interaction. Perception, memory, mental models and metaphors, knowledge representations, problem solving, errors and learning, are all topics under cognitive psychology that have direct implications to HCI design.

Cognitive modeling involves creating a computational model to estimate how long it takes people to perform a given task. Models are based on psychological principles and experimental studies to determine times for cognitive processing and motor movements. Cognitive models can be used to improve user interfaces or predict problem errors and pitfalls during the design process.

2.0 OBJECTIVES

By the end of this unit, the student should be able to:

•   Be familiar with different types of Cognitive models
•   Know available inspection methods
•   Know how to apply inquiry methods on problems of cognition
•   Explain prototyping methods
•   Carry out evaluation using the tests and metrics methods

3.0   MAIN CONTENT

3.1 Cognitive Models

3.1.1 Parallel Design

With parallel design, several people create an initial design from the same set of requirements. Each person works independently, and when finished, shares his/her concepts with the group. The design team   considers each solution, and each designer uses the best ideas to further improve their own solution. This process helps to generate many different, diverse ideas and ensures that the best ideas from each design   are integrated into the final concept. This process can be repeated several times until the team is satisfied with the final concept.

3.1.2   GOMS

GOMS is an acronym that stands for Goals, Operator, Methods, and Selection Rules. It is a family of techniques that analyzes the user complexity of interactive systems. Goals are what the user has to accomplish. An operator is an action performed in service of a goal. A method is a sequence of operations that accomplish a goal. Selection rules specify which method should be used to satisfy a given goal, based on the context.

3.1. 3 Human Processor Model

Sometimes it is useful to break a task down and analyze each individual aspect separately. This allows the tester to locate specific areas for improvement. To do this, it is necessary to understand how the human brain processes information. A model of the human processor is shown below
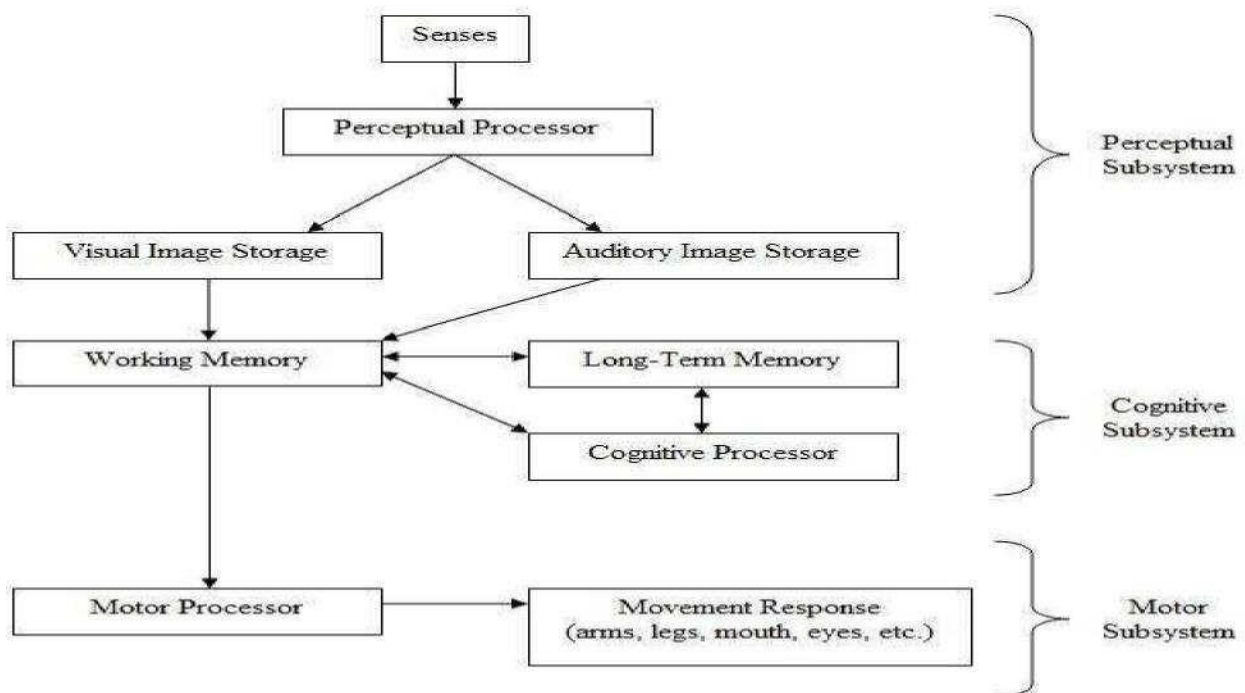
Many studies have been done to estimate the cycle times, decay times, and capacities of each of these processors. Variables that affect these can include subject age, ability, and the surrounding environment. For a younger adult, reasonable estimates are:

Parameter	Mean	Range
Eye movement time	230 ms	70-700 ms
Decay half-life of visual image storage 200		90-1000 ms
Perceptual processor cycle time	100 ms	50-200 ms
Cognitive processor cycle time	70 ms	25-170 ms
Motor processor cycle time	70 ms	30-100 ms
Effective working memory	7 items	5-9 items

Long-term memory is believed to have an infinite capacity and decay time. Keystroke level modeling

Keystroke level modeling is essentially a less comprehensive version of GOMS that makes simplifying assumptions in order to reduce calculation time and complexity.

3.2 Inspection methods

These usability evaluation methods involve observation of users by an experimenter, or the testing and evaluation of a program by an expert reviewer. They provide more quantitative data, as tasks can be timed and recorded.

3.2.1 Card Sorting

Card sorting is a way that involves users in grouping information for a website's usability review. Participants in a card sorting session are asked to organize the content from a Web site in a way that makes sense to them. Participants review items from a Web site and then group these items into categories. Card sorting helps to learn how users think about the content and how they would organize the information on the Web site. Card sorting helps to build the structure for a web site, decide what to put on the home page, and label the home page categories. It also helps to ensure that information is organized on the site in a way that is logical to users.

3.2.2 Ethnography

Ethnographic analysis is derived from anthropology. Field observations are taken at a site of a possible user, which track the artifacts of work such as Post-It notes, items on desktop, shortcuts, and items in trash bins. These observations also gather the sequence of work and interruptions that determine the user's typical day.

3.2. 3 Heuristic Evaluation

Heuristic Evaluation is a usability engineering method for finding and assessing usability problems in a user interface design as part of an iterative design process. It involves having a small set of evaluators examining the interface and using recognized usability principles (the "heuristics"). It is the most popular of the usability inspection methods, as it is quick, cheap, and easy.

Heuristic evaluation was developed to aid in the design of computer user-interface design. It relies on expert reviewers to discover usability problems and then categorize and rate them by a set of principles (heuristics.) It is widely used based on its speed and cost-effectiveness. Jakob Nielsen's list of ten heuristics

is the most commonly used in industry. By determining which guidelines are violated, the usability of a device can be determined.

3.2.4 Usability Inspection

Usability Inspection is a review of a system based on a set of guidelines. The review is conducted by a group of experts who are deeply familiar with the concepts of usability in design. The experts focus on a list of areas in design that have been shown to be troublesome for users.

3.2.5 Pluralistic Inspection

Pluralistic Inspections are meetings where users, developers, and human factors people meet together to discuss and evaluate step by step of a task scenario. As more people inspect the scenario for problems, the higher the probability to find problems. In addition, the more interaction in the team, the faster the usability issues are resolved.

3.2.6 Consistency Inspection

In consistency inspection, expert designers review products or projects to ensure consistency across multiple products to look if it does things in the same way as their own designs.

3.2.7 Activity Analysis

Activity analysis is a usability method used in preliminary stages of development to get a sense of a situation. It involves an investigator observing users as they work in the field. Also referred to as user observation, it is useful for specifying user requirements and studying currently used tasks and subtasks. The data collected is qualitative and useful for defining the problem. It should be used when you wish to frame what is needed, or "What do we want to know?"

3. 3 Inquiry methods

The following usability evaluation methods involve collecting qualitative data from users. Although the data collected is subjective, it provides valuable information on what the user wants.

3. 3.1 Task Analysis

Task analysis means learning about users' goals and users' ways of working. Task analysis can also mean figuring out what more specific tasks users must do to meet those goals and what steps they must take to accomplish those tasks. Along with user and task analysis, we often do a third analysis: understanding users' environments (physical, social, cultural, and technological environments).

3. 3.2 Focus Groups

A focus group is a focused discussion where a moderator leads a group of participants through a set of questions on a particular topic. Although typically used as a marketing tool, Focus Groups are sometimes used to evaluate usability. Used in the product definition stage, a group of 6 to 10 users are gathered to discuss what they desire in a product. An experienced focus group facilitator is hired to guide the discussion to areas of interest for the developers. Focus groups are typically videotaped to help get verbatim quotes, and clips are often used to summarize opinions. The data gathered not usually quantitative, but can help get an idea of a target group's opinion.

3. 3. 3 Questionnaires/Surveys

Surveys have the advantages of being inexpensive, require no testing equipment, and results reflect the users' opinions. When written carefully and given to actual users who have experience with the product and knowledge of design, surveys provide useful feedback on the strong and weak areas of the usability of a design. This is a very common method and often does not appear to be a survey, but just a warranty card.

3.4 Prototyping methods

3.4.1 Rapid Prototyping

Rapid prototyping is a method used in the early stages of development to validate and refine the usability of a system. It can be used to quickly and cheaply evaluate user-interface designs without the need for an expensive working model. This can help remove hesitation to change the design, since it is implemented before any real programming begins. One such method of rapid prototyping is paper prototyping.

3.4.2 Subject Testing methods

These usability evaluation methods involve testing of subjects for the most quantitative data. Usually recorded on video, they provide task completion time and allow for observation of attitude.

3.4. 3 Remote usability testing

Remote usability testing is a technique that exploits users' environment (e.g. home or office), transforming it into a usability laboratory where user observation can be done with screen sharing applications.

3.4.4 Thinking Aloud Protocol

The Thinking Aloud Protocol is a method of gathering data that is used in both usability and psychology studies. It involves getting a user to verbalize their thought processes as they perform a task or set of tasks. Often an instructor is present to prompt the user into being more vocal as they work. Similar to the Subjects-in-Tandem method, it is useful in pinpointing problems and is relatively simple to set up.

Additionally, it can provide insight into the user's attitude, which can not usually be discerned from a survey or questionnaire.

3.4.5 Subjects-in-Tandem

Subjects-in-tandem is pairing of subjects in a usability test to gather important information on the ease of use of a product. Subjects tend to think out loud and through their verbalized thoughts designers learn where the problem areas of a design are. Subjects very often provide solutions to the problem areas to make the product easier to use.

3.5 Other methods

3.5.1 Cognitive walkthrough

Cognitive walkthrough is a method of evaluating the user interaction of a working prototype or final product. It is used to evaluate the system's ease of learning. Cognitive walkthrough is useful to understand the user's thought processes and decision making when interacting with a system, specially for first-time or infrequent users.

3.5.2 Benchmarking

Benchmarking creates standardized test materials for a specific type of design. Four key characteristics are considered when establishing a benchmark: time to do the core task, time to fix errors, time to learn applications, and the functionality of the system. Once there is a benchmark, other designs can be compared to it to determine the usability of the system.

3.5. 3 Meta-Analysis

Meta-Analysis is a statistical procedure to combine results across studies to integrate the findings. This phrase was coined in 1976 as a quantitative literature review. This type of evaluation is very powerful for determining the usability of a device because it combines multiple studies to provide very accurate quantitative support.

3.5.4 Persona
Personas are fictitious characters that are created to represent the different user types within a targeted demography that might use a site or product. Alan Cooper introduced the concept of using personas as a part of interactive design in 1998 in his book *The Inmates Are Running the Asylum*, but had used this concept since as early as 1975.Personas is a usability evaluation method that can be used at various   design stages. The most typical time to create personas is at the beginning of designing so that designers have a tangible idea of who the users of their product will be. Personas are the archetypes that represent actual groups of users and their needs, which can be a general description of person, context, or usage scenario. This technique turns marketing data on target user population into a few physical concepts of users to create empathy among the design team.

3.6   Evaluating with tests and metrics
Regardless of how carefully a system is designed, all theories must be tested using usability tests. Usability tests involve typical users using the system (or product) in a realistic environment. Observation of the user's behavior, emotions, and difficulties while performing different tasks, often identify areas of improvement for the system.

3.6.1 Prototypes
It is often very difficult for designers to conduct usability tests with the exact system being designed. Cost constraints, size, and design constraints usually lead the designer to creating a prototype of the system. Instead of creating the complete final system, the designer may test different sections of the system, thus making several small models of each component of the system. The types of usability prototypes may vary from using paper models, index cards, hand drawn models, or storyboards.
Prototypes are able to be modified quickly, often are faster and easier to create with less time invested by designers and are more apt to change design; although sometimes are not an adequate representation of the whole system, are often not durable and testing results may not be parallel to those of the actual system.

3.6.2 Metrics
Designers must use usability metrics to identify what it is they are going to measure, or the usability metrics. These metrics are often variable, and change in conjunction with the scope and goals of the project. The number of subjects being tested can also affect usability metrics, as it is often easier to focus on specific demographics. Qualitative design phases, such as general usability (can the task be accomplished?), and user satisfaction are also typically done with smaller groups of subjects. Using inexpensive prototype on small user groups, provide more detailed information, because of the more interactive atmosphere, and the designers ability to focus more on the individual user.

Testing the metrics
As the designs become more complex, the testing must become more formalized. Testing equipment will become more sophisticated and testing metrics become more quantitative. With a more refined
prototype, designers often test effectiveness, efficiency, and subjective satisfaction, by asking the user to complete various tasks. These categories are measured by the percentage that complete the task, how long   it takes to complete the tasks, ratios of success to failure to

complete the task, time spent on errors, the number of errors, rating scale of satisfactions, number of times user seems frustrated, etc. Additional observations of the users give designers insight on navigation difficulties, controls, conceptual models, etc. The ultimate goal of analyzing these metrics is to discover a prototype design that users like to successfully perform given tasks.

Documenting metrics
After conducting usability tests, it is important for a designer to record what was observed, in addition to why such behavior occurred and modify the model according to the results. Often it is quite difficult to distinguish the source of the design errors, and what the user did wrong. However, effective usability tests will not generate a solution to the problems, but provide modified design guidelines for continued testing.

3.7 Benefits of usability
The key benefits of usability are:
Increased user efficiency Reduced development costs Reduced support costs Corporate integration
By working to improve said factors, corporations can achieve their goals of increased output at lower costs, while potentially creating optimal levels of customer satisfaction. There are numerous reasons why each of these factors correlates to overall improvement. For example, making a piece of software's user interface easier to understand would reduce the need for extensive training. The improved interface would also tend to lower the time needed to perform necessary tasks, and so would both raise the productivity levels for employees and reduce development time and costs.

4.0 Conclusion
All the factors analysed above aid the design process and Increase usability in the workplace. They aid in fostering several responses from employees. Along with any positive feedback, workers who enjoy their work do it better, stay longer in the face of temptation, and contribute ideas and enthusiasm to the evolution of enhanced productivity.

5.0 Summary
Cognitive human thrust comprises cognitive psychology and modeling. Cognitive psychology studies human traits such as perception, memory, mental models and metaphors, among others- those that have direct implications to HCI design.
Cognitive modeling enables estimation of how long it takes people to perform a given task.
Inspection method is the process of observing users by an experimenter, or the testing and evaluation of a program by an expert reviewer.
Inquiry methods involve collecting qualitative data from users; such data provides valuable information on what the user wants.
Prototypes enable the designer test different sections of the system by making several small models of each component of the system.
Evaluation methods test and correct errors in implemented design.

6.0 Tutor Marked Assignment
1. What is the full meaning of the acronym GOMS as a cognitive model? Explain each of the terms in the GOMS

Distinguish between the following Cognitive models: (i) Parallel Design, (ii) Human Processor and (iii) Keystroke level

2.   What is the primary benefit of the inspection methods used to evaluate usability in HCI? Briefly explain the following inspection methods:

(i) Card sorting (ii) Ethnography (iii) Heuristic evaluation (iv) Usability inspection (v) Activity analysis

3. What is the value of a Usability inspection and its focus?

4.   Explain the following methods of inquiry in usability evaluation: Task analysis, Group Focus, Questionnaire and Survey methods.

5 (a) What do you understand by the term Prototype as related to the design of Human Computer Interaction?

    (b) In designing and evaluating usability, prototyping methods have been very valuable. Show your understanding of the following Prototyping methods:

(i)Rapid Prototyping, (ii) Testing methods, (iii) Remote Usability testing, (iv)Thinking aloud Protocol, (v) Subjects in Tandem

6. The following are methods used to evaluate the design of the user interaction with the Computer before and /or after implementation: Cognitive Walkthrough, Benchmarking Meta analysis and Persona.

Which of the four above do you consider as the most suitable method and why?

7.0 Further Readings / References

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