

2021-2022

1. a) Explain how the Cognitive Computational Model, MHP can be used to compute the followings:
- A user sits before a computer display terminal. Whenever any symbol appears, s/he is to press the space bar. **What is the time between the stimulus and the response?**
 - The user is presented with two symbols, one at a time. If the second symbol is identical to the first, the user is to push the key labeled 'YES', otherwise the user is to push 'NO'. **What is the time between the stimulus and the response for the 'YES' case?**

10
(CO2)
(PO1)

i)

Processors have a cycle time

- $T_p \sim 100 \text{ ms}$ [50-200 ms]
- $T_c \sim 70 \text{ ms}$ [30-100 ms]
- $T_m \sim 70 \text{ ms}$ [25-170 ms]



Perceptual cycle time= 100 ms

Cognitive time need =70 ms

Motor time=70 ms

$$T_p + T_c + T_m =$$

$$100 + 70 + 70 = 240 \text{ ms}$$

ii) Perceptual cycle time=100 ms

Cognitive time =70 ms

Here you need 2 cognitive time: 1. For thinking and comparison —>70ms

2.generating response—————>70ms

Motor: you need to press Yes/no -----> 70 ms

Total time between stimulus and the response for the YES case:

$$100 + 2*70 + 70 = 310$$

$$T_p + 2T_c (\text{compare} + \text{decide}) + T_m =$$

$$100 + 2*70 + 70 = 310$$

- b) According to KFF Health tracking poll from July 2020, many subjects reported negative impacts on their mental health and well-being over the ongoing period of COVID-19. They reported difficulties in sleeping, eating, stress related to isolation and job loss, symptoms of anxiety, depressions, suicidal attempts and so on.
Briefly discuss on the types of HCI applications and data domains including different technologies required to address the Mental Health issues for this scenario.

15
(CO1)
(PO1)

HCI Applications:

1. **Telehealth Platforms:** Allowing for remote consultations, therapy sessions, and support groups.
2. **Mental Health Apps:** Providing self-help tools, mood tracking, and stress management exercises.
3. **Online Communities:** Offering support through forums or social media groups for sharing experiences and advice.

Data Domains:

1. **Behavioral Data:** Collected from apps and wearables to monitor sleep patterns, physical activity, and other health metrics.
2. **Self-Reported Data:** From mood tracking applications and symptom diaries.
3. **Social Interaction Data:** Understanding how users interact with others online could provide insights into social support structures or isolation.

Technologies Required:

1. **Data Analytics and AI:** To personalize interventions and identify patterns that may indicate a decline in mental health.
2. **Security and Privacy Technology:** To protect sensitive health information.
3. **UX/UI Design:** To create accessible, user-friendly tools that can be used by individuals experiencing mental distress.

The goal would be to use HCI to bridge the gap between individuals and mental health resources, offering support and tracking progress, while ensuring data privacy and personalized care.

2. a) Cues related to human depth perception can be utilized for visual scene understanding in various real-life applications. Explain with example how depth cues could be effectively utilized in solving computer vision-based sign language recognition problem.

15
(CO2)
(PO2)

Visual perception – Depth

- Human visual system perceives depth using both physiological and psychological cues
- Depth cues can be based on binocular (two eyes) or monocular (one eye) vision
- Physiological cues
 - Accommodation
 - Convergence
 - Binocular parallax
 - Monocular movement parallax
- Psychological cues
 - Retinal image size
 - Linear perspective
 - Texture gradient
 - Overlapping
 - Aerial perspective
 - Shades and shadow



ChatGPT

To answer question 2a about how cues related to human depth perception can be utilized for visual scene understanding in various real-life applications, and specifically how depth cues could be effectively utilized in solving computer vision-based sign language recognition problems, we can refer to the physiological and psychological cues listed in the first image.

For sign language recognition, depth cues are vital for distinguishing the position and movement of the hands in space. Using binocular depth cues like convergence and binocular parallax, a computer vision system can gauge the distance between the hands and their position relative to the signer's body, improving the system's ability to interpret signs correctly. Psychological cues like texture gradient and shadows can help the system discern the orientation of the hands and fingers, which is crucial since the angle and position of the fingers can change the meaning of a sign. By integrating these depth cues, the system can create a more accurate 3D representation of the signer's gestures, leading to better recognition and interpretation of the sign language.



- b) Define Fitts' Law and how it applies to user interface design. Apply your knowledge of this law to Figure 1 below and identify which target you think is the fastest to reach with the mouse starting at location M . Provide a brief reasoning for your choice. Assume that you can move your hand equally well in all directions, and that none of the targets are near a screen edge. Show the necessary calculations in your answer.

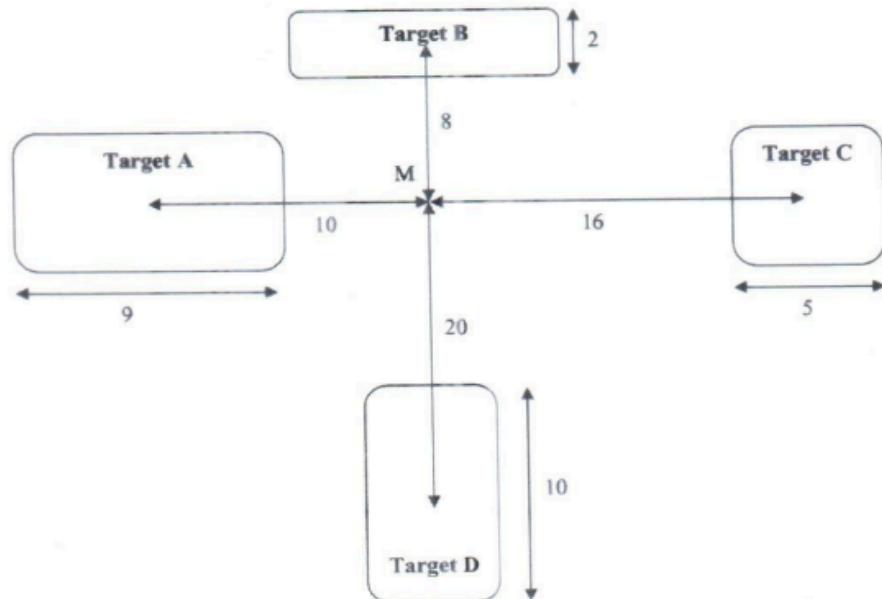


Figure 1: Design implication of Fitts' law

- **Fitts' Law** predicts that the time to point at an object using a device is a function of the distance from the target object and the object's size.
- **Fitts' Law** predicts the time taken in pointing tasks to hit/reach a specific screen target:

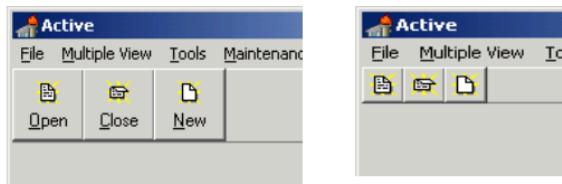
where: $Mt = a + b \log_2(D/(S+1))$
 a and b are empirically determined constants
 Mt is movement time
 D is Distance
 S is Size of target

⇒ targets as large as possible distances as small as possible

As the distance increases, movement takes longer and as the size decreases selection again takes longer.

How it applies in user interface?

According to Fitts' Law, which is more efficient?



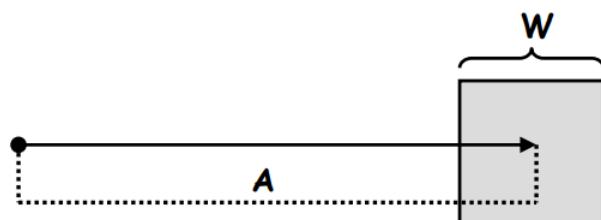
The label becomes part of the target. The target is therefore bigger. Bigger targets, all else being equal, can always be accessed faster, by Fitt's Law.

When labels are not used, the tool icons crowd together.

Fastest to reach which one?

Models movement of arm-hand to a target

- Hand is A cm from the target (Amplitude)
- Target is W cm wide (tolerance)
- Assume movement follows straight horizontal path



for target A:

$$\begin{array}{l} S \text{ or } W = 9 \\ D \text{ or } A = 10 \end{array}$$

So,

$$\begin{aligned} MT &= a + b \log_2 \left(\frac{D}{S} + 1 \right) \\ &= 590 + 230 \times \log_2 \left(\frac{10}{9} + 1 \right) \\ &= 837.94 \end{aligned}$$

for Target B:

$$\begin{aligned} MT &= 590 + 230 \times \log_2 \left(\frac{8}{2} + 1 \right) \\ &= 1124.04362 \end{aligned}$$

for Target C:

$$\begin{aligned} MT &= 590 + 230 \times \log_2 \left(\frac{16}{5} + 1 \right) \\ &= 1066.1895 \end{aligned}$$

for Target D:

$$\begin{aligned} MT &= 590 + 230 \times \log_2 \left(\frac{20}{10} + 1 \right) \\ &= 954.54 \end{aligned}$$

Target A is fastest to reach.

Question 3 :

3. a) Consider the searching task in smartphone-based interfaces of an online courier service as shown in Figure 2 (a-d).

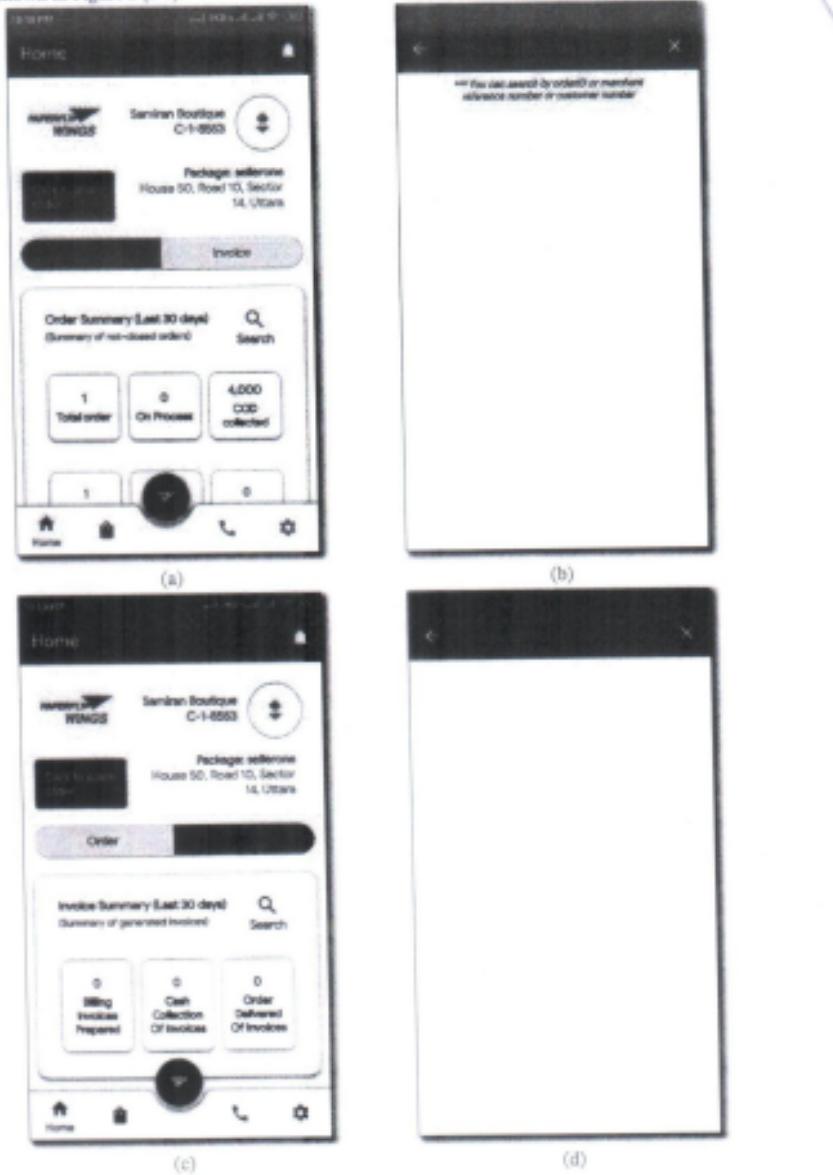


Figure 2: Example smartphone-based interfaces of an online courier service

a)i)

You are given a choice to select two interaction styles for the task. One is writing a query string in the search box and another one is giving voice commands using natural language. You are asked to use the interaction model to analyze interaction problems involved in the task. Answer the followings:

- i. Describe different gulfs with examples in each stage of the interactions for these two styles of interaction and justify which interaction style will give a better user experience.

6
(CO3)
(PO1)

Using Norman's model

Some systems are harder to use than others

Gulf of Execution

user's formulation of actions to reach the goal

≠ actions allowed by the system

Gulf of Evaluation

Physical presentation of the system state

≠ the expectation of the user

i. Describe different gulfs with examples in each stage of the interactions for these two styles of interaction and justify which interaction style will give a better user experience.

Gulf of Execution: This refers to the gap between the users' goals and the means to execute those goals. In the provided interfaces, a user may want to search for order details but might not be sure what keyword or format to use in the search box. For voice commands, a user might not know the correct phrase or command structure to use.

Example: In figure 2(a), the user wants to find the status of an order but might not know whether to input an order ID, customer name, or other specific details. In figure 2(d), they might say "Show me the status of the last order," but the system may require more specific commands.

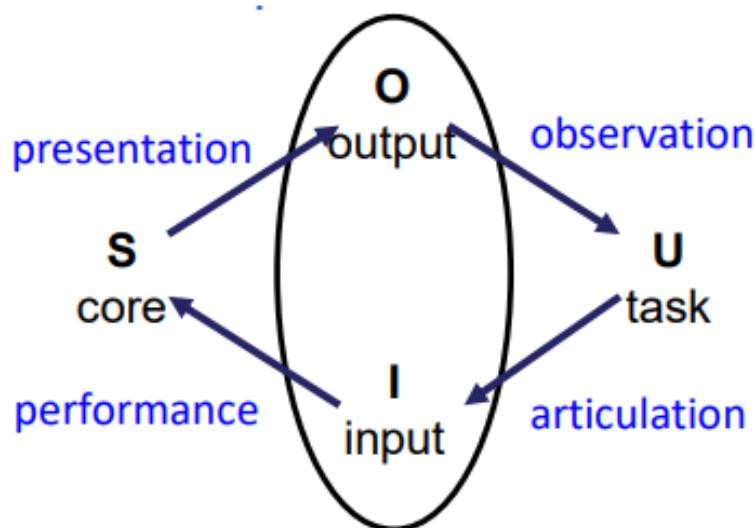
Gulf of Evaluation: This is the gap between the system's representation and the users' expectation of the response they should receive. In the visual interfaces, if the search results are not clearly labeled or are too numerous, users might struggle to evaluate which one is relevant. In the voice interface, if the system responds with multiple items without clear distinctions, it may be hard to evaluate as well.

Example: If a user searches for an order and the system displays both pending and completed orders without clear separation or prioritization in figure 2(b), that could confuse the user.

In terms of which interaction style provides a better user experience, it depends on the context and the user's needs. Typing might be better for users in a noisy environment or when precision is needed, while voice commands might be quicker and more convenient for users who are multi-tasking or have accessibility needs.

a)ii)

- ii. How can you assess the mappings of different translation languages through the interaction model for the searching task through the interfaces of Figure 2 (a-d)? Explain your answer. 6
(CO3)
(PO2)
- iii. Identify the tasks related to memory recall and recognition and list at least three problems related to concept of information retrieval in the search interfaces of Figure 2 (a-d) 5
(CO3)
(PO2)



Mappings/Assessing Interactions

- Psychological attributes/Task language → Input language
 - Assessed in terms of the coverage from tasks to input and the relative ease with which the translation can be accomplished
- Input language → Single or multiple system states/Core language
 - Assessed in terms of whether the translated input language can reach as many states of the system as possible using the system directly
- Domain specific system attributes/Core language → limited expressiveness of the output/output language
 - This translation must preserve the relevant system attributes from the domain in the limited expressiveness of the output devices
- Output response → interpretation of the output (stimuli for the user that triggers assessment)
 - Assess the results of the interaction relative to the original goal

ii. How can you assess the mappings of different translation languages through the interaction model for the searching task through the interfaces of Figure 2 (a-d)? Explain your answer.

Mapping refers to the relationship between controls and their effects in the world. The mapping in the interfaces of Figure 2 should be assessed based on how intuitively the input methods (search box or voice commands) lead to the desired outcome (retrieving the correct order information).

Example: Good mapping in figure 2(c) would mean that typing "Invoice Summary" would lead directly to a summary of generated invoices. For voice interaction, saying "Show invoice summary" should ideally lead to the same result. Poor mapping would be if typing or saying these phrases led to unrelated system actions, confusing the user.

The assessment can be done through usability testing to see if users can intuitively predict and understand the relationship between their input and the system's output.

iii. Identify the tasks related to memory recall and recognition and list at least three problems related to the concept of information retrieval in the search interfaces of Figure 2 (a-d).

Memory Recall: When users must remember information from their own experience to use the system, like recalling order numbers or specific terminology.

Memory Recognition: When users recognize items within the system that guide them to make a choice, like recognizing familiar icons or menu items.

Problems related to Information Retrieval:

1. **Ambiguity in Search:** If the search function does not provide suggestions or correct spelling errors, users might retrieve no results due to a typo.
2. **Overwhelming Information:** Without filters or sorting options, a broad search may return too many results, making it hard for users to find what they need.
3. **Lack of Feedback:** If the system does not give feedback when no results are found or why certain results are shown, users might be confused and not know how to refine their search.

LTM - retrieval

Recall ✓

- Information reproduced from memory can be assisted by cues, e.G. Categories, imagery

* Recognition ✓

- Information gives knowledge that it has been seen before
- Less complex than recall - information is cue

b)

- b) Visibility, feedback, constraints, consistency, affordance are the design principles used by interaction designers to aid their thinking when designing for the user experiences. Give one example of each of the design principles mentioned with their design implications.

8
(CO3)
(PO2)

Visibility: The search bar is clearly visible in figure 2(a), suggesting that searching is a primary function of the app.

Feedback: After a user performs a search, the system could display a loading icon or a message such as "Searching..." to indicate that it is processing the request.

Constraints: The search bar might limit input to certain characters or formats, preventing errors and guiding the user to input valid queries.

Consistency: The use of a magnifying glass icon in each search bar across different interfaces (2a-d) helps users understand that this is where to perform a search because it's a commonly used symbol for search functionality.

Affordance: The design of buttons and input fields suggests their functionality; for example, a rectangle with a border and shaded interior affords pressing, and a blinking cursor in a text field affords typing.

For a more specific analysis or a tailored example, the context of use and user requirements would need to be considered.



Chapter 3

The Interaction

Exercise 3.1

Choose two of the interaction styles (described in Section 3.3) that you have experience of using. Use the interaction framework to analyze the interaction involved in using these interface styles for a database selection task. Which of the distances is greatest in each case?

Answer

There is no single answer for this exercise, so we will provide an example of the style of answer that is suitable and the level of analysis which is appropriate. The students should be aware that although the term distance is used, we have not associated any real measures to any of the translations in the interaction framework. As a result, this analysis can only be informal and at this point is mainly informed by the student's intuition and experience with various interaction styles.

As was stated in Section 3.2.3, assessment of any interaction with the interaction framework can only be relative to some task. For this example we will choose a common database selection task — that of selecting records from an online library database. The two interaction styles we will analyze are a natural language interface and a command line interface.

The task is to select a set of references from the library database that satisfy some search criteria. Once the task has been formulated in the user's task language (for instance, the user wants to see all of the books written by Alan Dix since 1990), that task must be articulated in the input language. A natural language interaction style would allow the user simply to type in the selection query exactly as they think of it. The articulation distance is small because it is both easy to articulate (possibly even easier if a spoken interface is provided rather than typing) and the coverage is total (the user is allowed to articulate anything as a query). On the other hand, for a command line interface, the limited vocabulary of the input language makes it more difficult for the user to articulate a task even though the limited language provides complete coverage in terms of possible queries allowed. The

18 *The Interaction*

real difficulty for a natural language interface is how the system translates the input expression into the actual query that accesses the library records. This performance translation would be much easier for the command line interface since it may not even require any translation of an input expression, that language having already been constructed with the database engine in mind. Therefore, we can see that for a natural language interface, the performance distance is greatest, whereas for a command line interface it is the articulation distance which is greatest.

But the above analysis only really deals with the execution translations. On the evaluation side, a natural language interface must try to present the results of the database query in the form in which the user phrased the question. This could in general be a difficult translation for the system as it attempts to answer questions in the style in which an arbitrary user has posed that question. Having accomplished that, the observation by the user should be easy to perform. For a command line interface, there is no guarantee that the result of the query will be automatically displayed and the user may have to explicitly request a display (and they may have to express how the display be formatted). Neglecting that point, presentation by the system is made easier as the output language can be very constrained. Observation is made more difficult as the user must translate the output into the terms of their original task formulation. For example, having asked for books by Alan Dix published after 1990, the user may have a difficult time locating author name and year of publication to determine if the resulting records match their expectations. For evaluation, a natural language interface has a greater presentation distance and a command line interface a greater observation distance. In general, therefore, we would expect that a natural language interface would be easier from the user's perspective but more difficult from the system builder's perspective. The opposite should hold for a command language interface.

There are some issues that we haven't addressed in this example, such as displaying a large set of records that satisfy the query and being able to reuse the output of one query as the input to another to easily compound searches. Since the performance translation is so difficult for a natural language interaction style it is important for a natural language interface to present the results of the query in such a way that the user is able to determine if the system understood the original query in the way the user intended. This would involve the presentation translation both reiterating the user's query and the selected records simultaneously. In our example, since the user was interested in the author and date of publication (Dix, after 1990), it would help if that information was prominently presented in the result set.

We also have not considered what effect experience with the system provides. As users become more comfortable with the syntax and semantics of a command language, its perceived difficulty will decrease. Also, a verbose natural language output could limit the number of records from a result set that could be displayed. The moral of the story is that despite their intuitive allure, such informal analyses as suggested by this exercise cannot be the last word on analysis of an interactive system. Ultimately, our judgements must be made more precise and concrete.

Exercise 3.2

Find out all that you can about natural language interfaces. Are there any successful systems? For what applications are these most appropriate?

Answer

This exercise is intended to encourage the student to do some personal research in the form of a brief literature survey. Pointers can be given to appropriate places to begin such a search. For example, general text books on Artificial Intelligence will include basic information on natural language processing and famous systems such as SHRDLU; proceedings from conferences such as the AAAI and specialist journals will have more up to date research papers in the area; proceedings of HCI conferences such as CHI, Interact and HCI will include natural language systems particularly geared towards the interface. Other likely sources are popular journals such as BYTE and personal computer magazines which are likely to review commercial systems. The student's response to the second part of the question will depend upon what is unearthed, but it is likely that the systems that they find out about operate in very constrained domains and that the natural language used is restricted. There are as yet no general purpose natural language interfaces.

Exercise 3.3

What influence does the social environment in which you work have on your interaction with the computer? What effect does the organization (commercial or academic) to which you belong have on the interaction?

Answer

The aim of this exercise is to get the student to explore the social and environmental influences which effect interaction, often without the user being aware of them. The particular influences will vary from environment to environment but the student should be encouraged to consider some or all of the following.

- work context — is the work place shared? are the machines shared?
- peer pressure — is there pressure to compete or impress?
- management pressure — is there pressure to achieve? Is the interaction carried out in the presence of management?
- motivation - what motivates the interaction? Does this encourage or discourage experimentation?

- organizational goals — what is the objective of the organization? (profit? education? etc.) How does this effect the interaction?
- organizational decision making - who determines the systems that you use? Do you have any choice or influence? Does this influence the way you interact with the system?

In each case the student should discuss what influence this may have on the interaction. It may be helpful to consider other possible environments in order to identify how the interaction would differ under these different circumstances. For example, if the student currently shares a machine with colleagues, would his/her interaction practice change if s/he was given a private machine? Chapter 14 also discusses the influence of groups of workers within an organization on the interaction, and is suggested as further reading material on this topic.

Chapter 1

The Human

Exercise 1.1

Suggest ideas for an interface which uses the properties of sound effectively.

Answer

This is an opportunity for the student both to use his/her imagination and/or to do a literature survey (starting with the references in Chapter 15). One possibility for tackling the exercise is to encourage the student to think how sound could be added to an application with which s/he is familiar.

Speech sounds can obviously be used to convey information. This is useful not only for the visually impaired but also for any application where the user's attention has to be divided (for example, power plant control, flight control etc.). Uses of non-speech sounds include

- Attention — to attract the user's attention to a critical situation or to the end of a process for example.
- Status information — continuous background sounds can be used to convey status information. For example, monitoring the progress of a process (without the need for visual attention).
- Confirmation — a sound associated with an action to confirm that the action has been carried out. For example, associating a sound with deleting a file.
- Navigation — using changing sound to indicate where the user is in a system. For example, what about sound to support navigation in hypertext?



Exercise 1.2

Devise experiments to test the properties of (i) short-term memory (ii) long-term memory, using the experiments described in this chapter to help you. Try out your experiments on your friends. Are your results consistent with the properties described in this chapter?

Answer

The aim of this exercise is to get the student to think about experimental design. The experiments devised can effectively be repeats of the originals. Chapter 11 can be used for reference on experimental design.

(i) Short term memory (STM)

The student should first choose an aspect to investigate, for example, digit span, recency effect, decay.

Example solution: STM decay

Subjects ideally selected to represent population, more probably undergraduate students (try to get a range of academic subjects). Sample size: 10+

Experiment split subjects into two groups. Each subject studies list of 15-20 words (could try with both nonsense words and actual words to see any difference). Subject has to recall list either (a) immediately or (b) after 20 second delay. Measure the number (or percentage) of the words remembered correctly. A within groups design can be used to avoid individual bias or group variation (as long as different lists are used for each attempt).

independent variable — delay in recall
dependent variable — number correctly recalled.

Group (b) should be given a task to do during the delay period in order to avoid rehearsal. If possible this task should occupy a different channel to minimise interference, e.g., a visual recognition task.

Hypothesis Those in (b) will perform worse than those in (a) since STM will decay.

Analysis graphs to see decay. T test

(ii) Long term memory (LTM)

The student should first choose an aspect to investigate, for example, the total time hypothesis or the distribution of practice effect.

Example solution: distribution of practice effect

Subjects as above. Should have no prior experience of the skill to be learned.

Experiment split subjects into 3 groups. Each subject must learn a skill (for example short hand or typing — must be measurable). Group A learns for 1 hour a week for 6 weeks. Group B learns for 2 hours a week for 3 weeks. Group C learns for 3 hours a week for 2 weeks. After each group's training is complete the subjects are tested and the number of mistakes made noted.

independent variable — style of learning
dependent variable — accuracy

Between groups design.

Hypothesis Group A will be best (due to the distribution of practice effect)

Analysis ANOVA

(N.B. This one is not easy to run but could be done with cooperation from friends)

Exercise 1.3

Identify the goals and operators involved in the problem 'delete the second paragraph of the document' on a word-processor. Now use a word-processor to delete a paragraph and note your actions, goals and sub-goals. How well did they match your earlier description?

Answer

Assume you have a document open and you are at some arbitrary position within it. You also need to decide which operators are available and what their preconditions and results are. Based on an imaginary word processor we assume the following operators (you may wish to use your own WP package):

Operator	Precondition	Result
delete_paragraph	cursor at start of paragraph	paragraph deleted
move_to_paragraph	cursor anywhere in document	cursor moves to start of next paragraph (except where there is no next paragraph when no effect)
move_to_start	cursor anywhere in document	cursor at start of document

Goal: *delete second paragraph in document*

Looking at the operators an obvious one to resolve this goal is *delete_paragraph* which has the pre-condition 'cursor at start of paragraph'. We therefore have a new sub-goal: *move_to_paragraph*. The pre-condition is 'cursor anywhere in document' (which we can meet) but we want the second paragraph so must initially be in the first.

We set up a new subgoal, *move_to_start*, with pre-condition 'cursor anywhere in document' and result 'cursor at start of document'. We can then apply *move_to_paragraph* and finally *delete_paragraph*.

We assume some knowledge here (that the second paragraph is the paragraph after the first one).

and finally *delete*-*paragraph*.

We assume some knowledge here (that the second paragraph is the paragraph after the first one).

Exercise 1.4

Observe skilled and novice operators in a familiar domain, for example, touch and 'hunt-and-peck' typists, expert and novice game players, or expert and novice users of a computer application. What differences can you discern between their behaviours?

Answer

This is an exercise in observation. The student should think about skill acquisition, proceduralization, chunking etc. Is there any evidence of this in practice? How do the groups differ (speed, error, style, strategy)? Do the differences suggest different skill levels.

June 4, 1993 17:34 exercises Sheet number 11 Page number 9

The Human 9

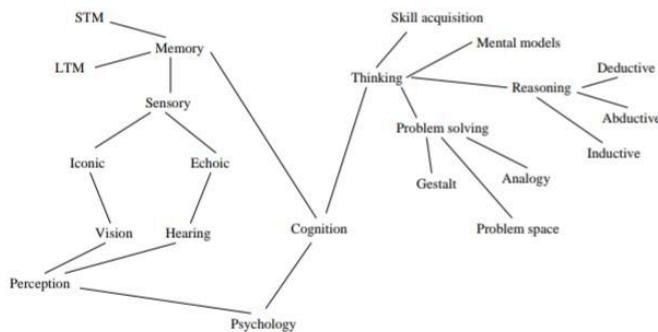


Figure 1.x1 The top-down view

Exercise 1.5

Produce a semantic network of the main information in this chapter.

Answer

This network is potentially huge so it is probably unnecessary to devise the whole thing! Encourage the student to be selective. One helpful way to tackle the exercise is to approach it in both a top down and a bottom up manner. Top down will give you a general overview of topics and how they relate; bottom up can fill in the details of a particular field. These can then be 'glued' together to build up the whole picture. Perhaps a group of students could tackle the problem together, each taking one part of it. We will not provide the full network here but will give examples of the level of detail anticipated for the overview and the detailed versions. In the overview we have not included labels on the arcs for clarity.

Figure 1.x1 *The top-down view***Exercise 1.5**

Produce a semantic network of the main information in this chapter.

Answer

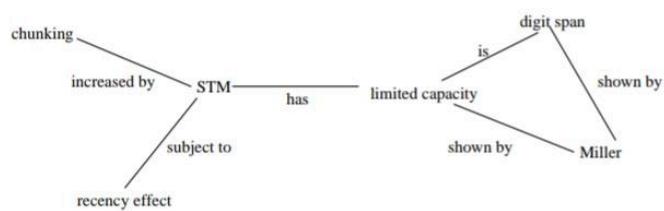
This network is potentially huge so it is probably unnecessary to devise the whole thing! Encourage the student to be selective. One helpful way to tackle the exercise is to approach it in both a top down and a bottom up manner. Top down will give you a general overview of topics and how they relate; bottom up can fill in the details of a particular field. These can then be 'glued' together to build up the whole picture. Perhaps a group of students could tackle the problem together, each taking one part of it. We will not provide the full network here but will give examples of the level of detail anticipated for the overview and the detailed versions. In the overview we have not included labels on the arcs for clarity.

12 / 104



June 4, 1993 17:34 exercises Sheet number 12 Page number 10

10 *The Human*

**Figure 1.x2** *The bottom-up view*

South Carolina

City	Motel/Hotel	Area code	Phone	Rates	
				Single	Double
Charleston	Best Western	803	747-0961	\$126	\$130
Charleston	Days Inn	803	881-1000	\$118	\$124
Charleston	Holiday Inn N	803	744-1621	\$136	\$146
Charleston	Holiday Inn SW	803	556-7100	\$133	\$147
Charleston	Howard Johnsons	803	524-4148	\$131	\$136
Charleston	Ramada Inn	803	774-8281	\$133	\$140
Charleston	Sheraton Inn	803	744-2401	\$134	\$142
Columbia	Best Western	803	796-9400	\$129	\$134
Columbia	Carolina Inn	803	799-8200	\$142	\$148
Columbia	Days Inn	803	736-0000	\$123	\$127
Columbia	Holiday Inn NW	803	794-9440	\$132	\$139
Columbia	Howard Johnsons	803	772-7200	\$125	\$127
Columbia	Quality Inn	803	772-0270	\$134	\$141
Columbia	Ramada Inn	803	796-2700	\$136	\$144
Columbia	Vagabond Inn	803	796-6240	\$127	\$130

Pennsylvania

Bedford Motel/Hotel: Crinaline Courts
(814) 623-9511 S: \$118 D: \$120
Bedford Motel/Hotel: Holiday Inn
(814) 623-9006 S: \$129 D: \$136
Bedford Motel/Hotel: Midway
(814) 623-8107 S: \$121 D: \$126
Bedford Motel/Hotel: Penn Manor
(814) 623-8177 S: \$119 D: \$125
Bedford Motel/Hotel: Quality Inn
(814) 623-5189 S: \$123 D: \$128
Bedford Motel/Hotel: Terrace
(814) 623-5111 S: \$122 D: \$124
Bradley Motel/Hotel: De Soto
(814) 362-3567 S: \$120 D: \$124
Bradley Motel/Hotel: Holiday House
(814) 362-4511 S: \$122 D: \$125
Bradley Motel/Hotel: Holiday Inn
(814) 362-4501 S: \$132 D: \$140
Breezewood Motel/Hotel: Best Western Plaza
(814) 735-4352 S: \$120 D: \$127
Breezewood Motel/Hotel: Motel 70
(814) 735-4385 S: \$116 D: \$118

Figure 3.1 Two different ways of structuring the same information at the interface: one makes it much easier to find information than the other

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Activity 3.1

Look at the top screen of [Figure 3.1](#) and (i) find the price for a double room at the Quality Inn in Columbia, and (ii) find the phone number of the Days Inn in Charleston. Then look at the bottom screen in [Figure 3.1](#) and (i) find the price of a double room at the Holiday Inn in Bradley and (ii) find the phone number of the Quality Inn in Bedford. Which took longer to do?

In an early study, Tullis found that the two screens produced quite different results: it took an average of 3.2 seconds to search the top screen and 5.5 seconds to find the same kind of information in the bottom screen. Why is this so, considering that both displays have the same density of information (31%)?

Comment

The primary reason is the way the characters are grouped in the display. In the top screen, they are grouped into vertical categories of information – i.e. place, kind of accommodation, phone number, and rates – that have columns of space between them. In the bottom screen, the information is bunched up together, making it much harder to search through.

Activity 3.2

Try to remember the dates of all the members of your family's and your closest friends' birthdays. How many can you remember? Then try to describe the image/graphic of the latest app you downloaded.

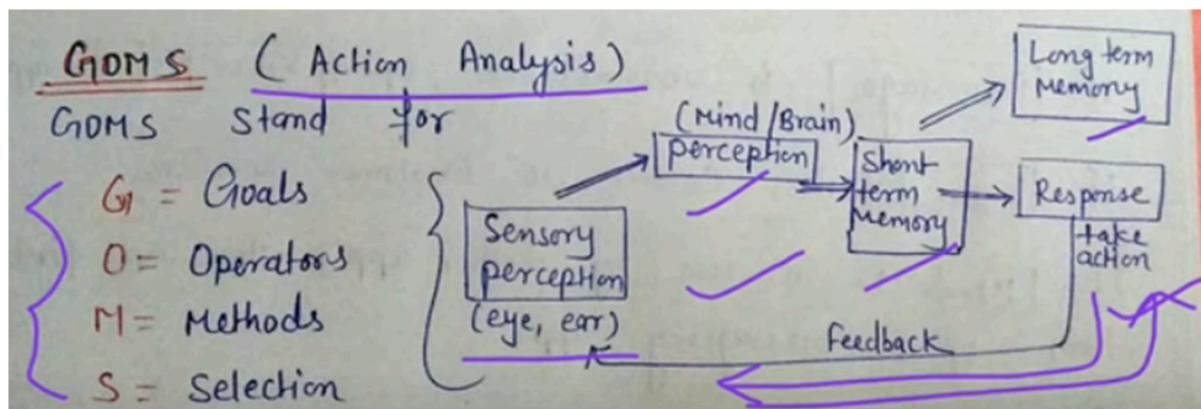
Comment

It is likely that you remembered much better the image, the colors, and the name of the app you downloaded than the birthdays of your family and friends (which most people now rely on Facebook or other online app to remind them of). People are very good at remembering visual cues about things, for example the color of items, the location of objects (e.g. a book being on the top shelf), and marks on an object (e.g. a scratch on a watch, a chip on a cup). In contrast, people find other kinds of information persistently difficult to learn and remember, especially arbitrary material like birthdays and phone numbers.

2018-19

1. a) Suppose an ATM cash machine has several information which it displays through a set of user interfaces. For any operation the first page in the UI allows the user to enter their PIN (Personal Identification Number). If this is correct for the customer's card, the machine shows the next page which allows the user to select one of several functionalities. If they select the withdraw cash service they are presented with a page from which they can select a predetermined amount of cash, or can select an option to allow them to determine how much they want. If they select this option they are then presented with a page which allows them to enter a value up to 20000 Taka in BDT. Once the amount of money has been entered (either by selecting a predetermined amount or entering their own amount) the machine returns the card and then the cash to the customer. Answer the followings:
- Explain the relationship between GOMS model and MHP for the scenario. 5
 - Construct a GOMS model of a customer withdrawing money from an ATM cash machine. 10
 - How can you measure human performance based on MHP for this task? Explain. 5

i)



ii)

GOMS model:

1. Goal: Withdraw Money from ATM

- The overall goal is to successfully withdraw money from the ATM.

2. Operators:

• O1: Observe Screen

- User observes the ATM screen for instructions.

• O2: Insert Card

- User inserts their ATM card into the card reader.

• O3: Enter PIN

- User enters their personal identification number (PIN).

• O4: Select Withdrawal

- User selects the withdrawal option on the screen.

• O5: Enter Amount

- User enters the desired withdrawal amount.

• O6: Confirm Transaction

- User confirms the withdrawal transaction.

• O7: Receive Cash



- User collects the dispensed cash from the ATM.
-

3. Methods:

• M1: Normal Withdrawal

- Observe Screen (O1) > Insert Card (O2) > Enter PIN (O3) > Select Withdrawal (O4) > Enter Amount (O5) > Confirm Transaction (O6) > Receive Cash (O7) > Take Receipt (O8, optional).

• M2: Fast Cash Withdrawal

- Observe Screen (O1) > Insert Card (O2) > Enter PIN (O3) > Select Fast Cash Option (O4) > Confirm Transaction (O6) > Receive Cash (O7) > Take Receipt (O8, optional).

4. Selection Rules:

- If the user wants a specific amount, they follow the Normal Withdrawal method (M1).
- If the user wants a predefined amount (fast cash), they follow the Fast Cash Withdrawal method (M2).
- If the ATM encounters an issue (e.g., insufficient funds, technical error), the transaction is canceled, and the user is notified to contact their bank.

iii)

- Human performance P, is the function of different information processing stages S,

$$P = f(S)$$

- b) Consider that a user has perceptual processing time $\tau_p = 150 \text{ ms}$, cognitive processing time $\tau_c = 50 \text{ ms}$, and motor processing time $\tau_m = 50 \text{ ms}$. Two symbols appear on the computer terminal. If the second symbol matches the first, the user presses "Y" and presses "N" otherwise. What is the time between the second signal and response? 5

150+2*50+50=300 ?

2. a) How do we perceive color? Considering the design implications of color in UI design, give justification of the following statements: 7
- We should avoid Green and Red in the periphery
 - Older users required brighter color
 - Blue color should be avoided for text, lines, and small shapes.

Color is emotional, for segmentation and for drawing attention. Physiological -some colors excite neurons, Segmentation reduce amount of time for searching

- Lens yellows & absorbs shorter wavelengths that is sensitivity to blue is even more reduced
- Fluid between lens and retina absorbs more light
- Perceive a lower level of brightness

- i) No we shouldn't. we should use blue and yellow in periphery
 ii) True
 iii) True

- b) Suppose you want to design a text-based interaction where the font size will be changed according to the distance from the user to display screen. If the screen resolution is 120 dpi, distance is 15 inch, and the visual angle is 30 minutes of the arc then what will be the font size of the text? 6

We know,

$$\text{visual angle} = 2 \tan^{-1} \frac{\text{object size}}{2 \text{object distance}}$$

$$\Rightarrow \tan \left(\frac{\text{visual angle}}{2} \right) * \text{object Distance} = \frac{\text{object size}}{2}$$

$$\Rightarrow \text{object size} = 2 * \tan \left(\frac{\text{visual angle}}{2} \right) * \text{object distance}$$

$$\left. \begin{aligned} & 30 \text{ minutes} \\ & = \frac{30}{60} = 0.5 \text{ degree} \end{aligned} \right\} \Rightarrow \text{object size} = 2 * \tan \left(\frac{0.5}{2} \right) * 15 \\ = 0.1309 \text{ inches}$$

c) What are binocular and monocular depth cues of visual perception? Explain with example.

12

Binocular Depth Cues:

Binocular depth cues require **both eyes** and are critical for perceiving depth in the space that is closer to the viewer.

- ***Binocular Disparity***: This cue is based on the slightly different images that each eye perceives due to their horizontal separation (about 6 cm apart). The brain fuses these images to create a sense of depth.

- Example: Hold a finger in front of you and blink one eye at a time. Your finger seems to shift position against the background; this shift, or disparity, is used by the brain to perceive depth.

Monocular Depth Cues:

Monocular cues can be perceived with **one eye** and are often used to infer depth in pictures or distant views.

1. ***Linear Perspective***: Parallel lines appear to converge at a point in the distance, known as the vanishing point.

- Example: Railroad tracks seem to come together the farther they are from the viewer.

2. ***Texture Gradient***: The texture of surfaces appears finer as the distance increases.

- Example: A pebbly beach will show individual stones nearby, but the pebbles will appear as a smooth texture in the distance.

3. ***Interposition (Overlap)***: When one object overlaps another, the covered part is perceived as being farther away.

- Example: If a car is partially covered by another car, we perceive it as being behind the second car.

4. ***Relative Size***: Objects known to be of similar size appear smaller when they are farther away.

- Example: Pedestrians near the bottom of a skyscraper appear much smaller compared to those close to the viewer.

5. ***Height in Plane***: Objects closer to the horizon line appear farther away than objects away from the horizon line.

- Example: Boats near the horizon on the ocean appear farther away than boats near the shore.

6. ***Light and Shadow***: The pattern of light and shadows on an object can provide information about its three-dimensional form.

- Example: Shading on a sphere can indicate its spherical shape, even in a two-dimensional drawing.

7. ***Aerial Perspective***: Distant objects may appear more blurry and blue due to the scattering of light by the atmosphere.

- Example: Mountains in the distance appear bluer and less detailed than nearby trees or structures.

Artists, designers, and user interface developers utilize these depth cues to create the illusion of three-dimensionality on two-dimensional surfaces. For example, a UI designer might use shadows and overlapping elements to convey a sense of hierarchy and depth in a flat design.

Physiological:

Binocular depth cue:

- **Accommodation**
- **Convergence**
- **Binocular parallax**
- **Monocular movement parallax**

Psychological:

Monocular:

- **Texture and gradient**
- **Shapes and shadows**
- **Linear perspective**
- **Retinal Image size**
- **Overlapping**
- **Aerial perspective**

3. a) Consider the musical note signal in Figure 1.

6

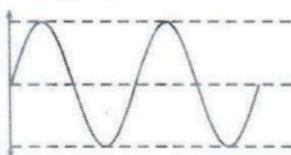


Figure 1: A musical note

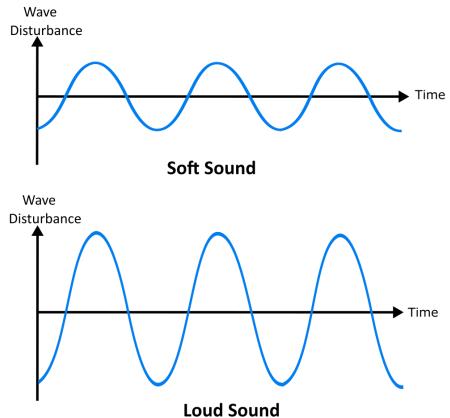
Redraw the diagram for a note:

- i. With higher pitch
- ii. That is louder
- iii. That is softer

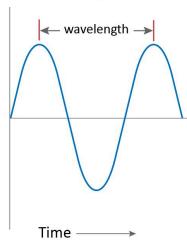
teachoo.com

Soft sound has small amplitude

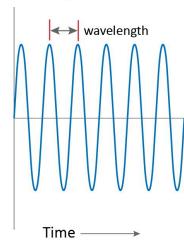
Louder sound has large amplitude



Low pitch



High pitch



- c) Humans are capable of retaining 7 ± 2 items in the short-term memory. This phenomenon raises design implications to many user interface considering the design principle, 'Recognition is better than recall'. Figure 2 (a) and 2 (b) shows Search box interfaces in a mobile application.



Figure 2: Search interfaces in a mobile application

Answer the followings:

- For Figure 2(a) and 2(b), identify the tasks related to memory recall and recognition and list at least two problems related to concept of information retrieval. 6
- Redesign the interfaces of Figure 2(a) and 2(b) by drawing hand sketches. 6

i) Problem 1:

- Problem:* Users may fail to recall specific information even if it is stored in their memory. This can result in incomplete or inaccurate search queries, leading to the retrieval of irrelevant or insufficient information.
- Example:* A person trying to remember a specific fact about a historical event may not recall the exact details, leading to a vague search query and potentially inaccurate results.

Problem 2: increase cognitive load

LTM - retrieval

Recall ✓

- Information reproduced from memory can be assisted by cues, e.G. Categories, imagery

Recognition ✗

- Information gives knowledge that it has been seen before
- Less complex than recall - information is cue

- ii) in "figure a" we can add search bar with recent items or popular items are being already displayed

- b) What is Fitts' law? According to Fitts' law, answer the followings:
- i. Microsoft Toolbars offer the user the option of displaying a label below each tool. Name at least one reason why labeled tools can be accessed faster. (Assume, for this, that the user knows the tool and does not need the label just simply to identify the tool.)
 - ii. What is the bottleneck in hierarchical menus and what techniques could make that bottleneck less of a problem?

i)

- **bigger target object**
- **Increase icon size**
- **Lesser distance between icons**
- **Organize icon in more user friendly way**

ii)



ChatGPT

The bottleneck in hierarchical menus often arises from the need for users to navigate through multiple levels of menu options, which can lead to cognitive overload and slow down the user experience. To make this less of a problem, techniques such as:

1. **Streamlining Navigation:** Reduce the number of levels in the hierarchy by grouping related options together or using alternative navigation structures like tabs or a search function.
2. **Progressive Disclosure:** Display only the most relevant or commonly used options at first, with the ability to reveal more detailed options through progressive disclosure techniques like expandable menus or tooltips.
3. **Clear Labeling and Organization:** Ensure menu labels are clear, concise, and organized logically to help users quickly locate the desired options.
4. **Visual Cues and Feedback:** Use visual cues such as indentation, icons, or highlighting to signify hierarchy and provide feedback on the user's current location within the menu structure.
5. **Predictive and Adaptive Menus:** Employ techniques like predictive search or adaptive menus that anticipate users' needs based on their past behavior or context to streamline navigation.
6. **Keyboard Shortcuts and Accelerators:** Offer keyboard shortcuts or accelerators for frequently used menu options to expedite navigation for power users.
7. **User Testing and Iteration:** Continuously gather feedback from users through usability testing and iterate on the menu design to identify and address any usability issues or pain points.