1.3 Cognitive ergonomics and human error

Name: _____ Class: _____ Date: _____ **Total: 30 marks**

KEY WORDS cognitive ergonomics • affordance • signifier • mapping • feedback • mental model • information overload

Objective

Build the skills to answer exam questions on **cognitive ergonomics** : affordance, signifiers, mapping, feedback, constraints and consistency, **mental models** , slips and mistakes, and information overload.

You must be able to:

- define affordance, signifier, mapping, feedback, constraint and consistency, with examples
- explain how a mental model helps or misleads a user
- distinguish a slip from a mistake and suggest design changes that reduce each
- explain information overload and how interfaces group and limit information
- evaluate an interface and suggest improvements

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1 Key knowledge and worked examples

Principles for usable products

principle	meaning	good example
affordance	what actions a design allows	a flat plate on a door affords pushing
signifier	a signal of where and how to act	a "push" label, an arrow
mapping	the link between controls and effects	cooker knobs laid out like the burners
feedback	shows that an action has worked	a click, a light, a progress bar
constraint	limits actions to prevent errors	a USB-C plug that fits either way; a keyed connector
consistency	similar things work the same way	standard icons for save and delete

A **mental model** is the user's idea of how a product works. A good design matches it, so users can predict what will happen. A door that people pull when they should push is a **design** failure, not a user failure.

Human error

- **Slip:** the right goal, but the wrong action (pressing the button next to the right one). Reduce with larger, well-spaced controls and a confirmation step for important actions.
- **Mistake:** the wrong goal or plan, often from a poor mental model. Reduce with clear signifiers, feedback and a simple, consistent interface.

Information overload : too much information at once slows people down and causes errors. Short-term memory holds only a few chunks (traditionally about 7 ± 2), and each extra choice makes decisions slower (Hick's law). Good interfaces group information, show only what is needed now and use recognition (menus, icons) rather than recall.

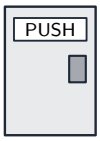
Worked example. A cooker has four burners in a square but four knobs in a row, so users turn on the wrong burner (poor mapping). Fix: place the knobs in a square that matches the burners, or label each knob with a small burner diagram (a signifier).

Answer shapes: name the principle → point to the feature → say what the user does → suggest a change.

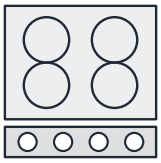
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2 Practice

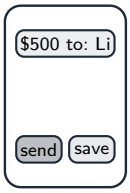
2.1 Define **affordance** and **signifier**. [2]



2.2 A cooker has four burners in a square and four knobs in a row. Explain why users often turn on the wrong burner, and suggest an improvement. [3]



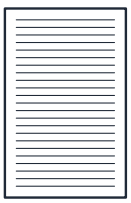
2.3 Distinguish between a **slip** and a **mistake**, with an example of each when using a banking app. [4]



2.4 Explain how **feedback** helps a person using a ticket machine. [2]



2.5 A settings menu shows 24 options in one long list. Using **information overload** and **Hick's law**, explain how it could be redesigned. [3]



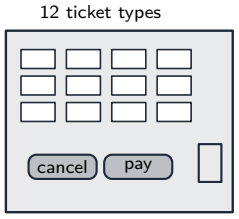
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3 Exam-style questions

3.1 Many passengers buy the wrong ticket from a railway ticket machine, and some press **cancel** by accident when they want to pay.

(a) State what is meant by a **mental model**. [1]

(b) Explain how **one** slip and **one** mistake could happen with this machine. [4]



(c) Suggest **two** design changes that use feedback or constraints to reduce errors. Explain each change. [4]

(d) The redesigned machine will be tested. Evaluate using user trials rather than expert appraisal for this test. [7]

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Solutions

Marking: **M1** a correct method, **A1** the correct answer, **B1** an independent mark.

Each answer shows the steps, then the **result**.

2.1

affordance: the actions that a design allows / suggests, e.g. a flat plate affords pushing; signifier: a signal that shows where or how to act, e.g. a "push" sign

2.2

poor mapping: the layout of the knobs does not match the layout of the burners; so users cannot tell which knob controls which burner; improvement: knobs arranged in a square like the burners / a burner diagram next to each knob

2.3

slip: the right intention but the wrong action; e.g. tapping "send" instead of the button next to it; mistake: the wrong goal or plan, from a poor mental model; e.g. sending money to a saved contact the user thought was someone else

2.4

feedback shows that an action has worked, e.g. a beep and "payment accepted" on the screen; so the user does not press again or pay twice / knows what to do next

2.5

Hick's law: each extra choice makes a decision slower, so 24 options are slow to scan; group the options into a few labelled categories / show the most-used options first; so users recognize what they need instead of holding many options in memory

3.1

(a) the user's own idea of how the product works, which they use to predict what will happen

(b) slip: the cancel and pay buttons are next to each other and look the same, so a user aiming at pay presses cancel; mistake: 12 similar ticket buttons with unclear labels, so a user who misunderstands the ticket types chooses the wrong one

(c) any two, explained: a summary screen of the chosen ticket and price before payment, so users can check (feedback); cancel asks "are you sure?" / is moved away from pay (constraint); pay is disabled until a ticket is chosen (constraint)

(d) award up to [7]: user trials use real passengers, including tourists, older people and people in a hurry; they show real errors and give measurable data, e.g. wrong tickets per 100 sales, time to buy; but they take time, need many users and informed consent; expert appraisal is quick and cheap and uses knowledge of usability principles; but experts are not typical users and may miss problems; judgement: use expert appraisal first to fix obvious problems, then user trials, because only trials show whether passengers' errors really fall