

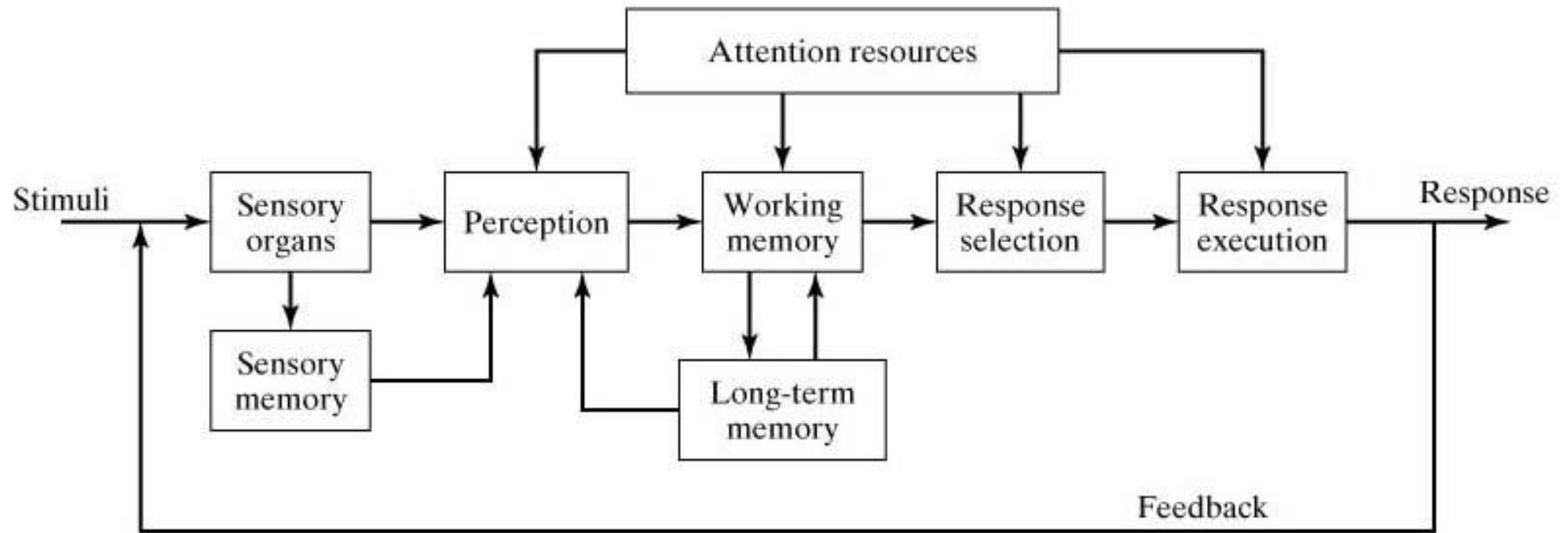
COGNITIVE ERGONOMICS

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SUMMARY OF PREVIOUS LECTURES

- 1. The Human Sensory System**
- 2. Perception**
- 3. Attention Resources**
- 4. Memory**

HUMAN INFORMATION PROCESSING MODEL





RESPONSE SELECTION AND EXECUTION

LECTURE OUTLINE

- Response selection
- Response execution
- Factors affecting response selection and execution
- Skill-Rule-Knowledge (SRK) model

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INTRODUCTION

RESPONSE SELECTION

Cognitive process of figuring out what actions to take in light of information perceived through sensory channels (bottom-up processing) and information stored in long-term memory (top-down processing)

- Accomplished in working memory as a series of information-processing transformations
 - Capability to perform these transformations is limited by the capacity of working memory as well as the time factor

RESPONSE EXECUTION

Carrying out the actions determined in response selection

- Actions are usually executed by the human effectors (fingers, hands, feet, and voice)
- Actions can also be passive, e.g., a person reading and the action is to continue reading
- Involves both cognitive and physical elements
 - Cognitive elements - coordinating the actions of the musculoskeletal system
 - Physical elements - expending the necessary strength and energy for the action



FACTORS AFFECTING RESPONSE SELECTION & EXECUTION

RESPONSE SELECTION AND EXECUTION

- Five factors that affect the difficulty and speed with which response selection and execution are carried out:
 1. Decision complexity
 2. Response expectancy
 3. Compatibility
 4. Tradeoff between speed and accuracy
 5. Feedback



DECISION COMPLEXITY

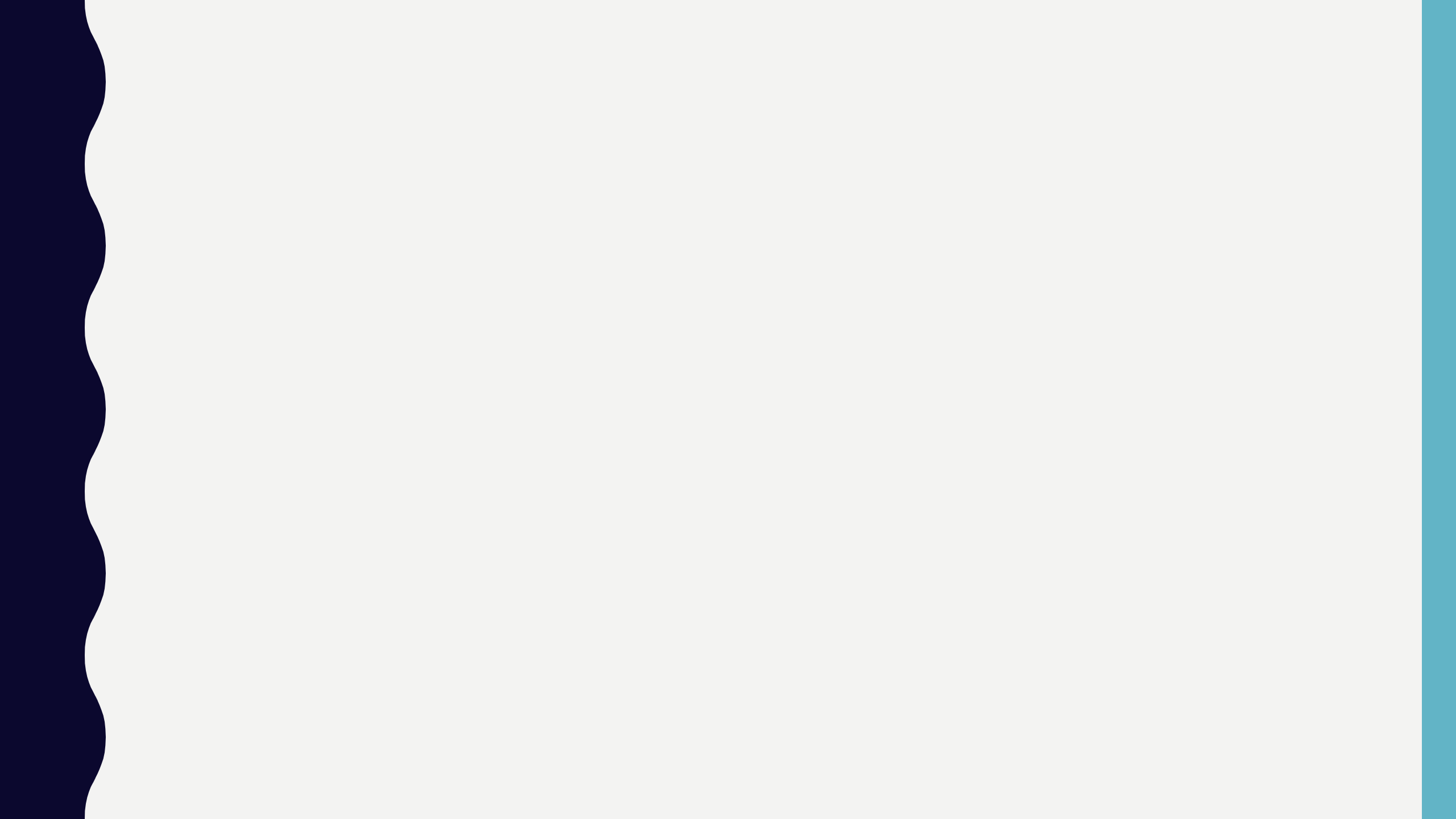
DECISION COMPLEXITY

Refers to the number of possible alternative responses that could be selected in response selection

- As more choices become available, the complexity of the decision process increases
 - And the time to make the selection increases
- Hick-Hyman law of reaction time:

$$RT = a + b \log_2 N$$

where RT = reaction time, N = number of possible choices



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RESPONSE EXPECTANCY

RESPONSE EXPECTANCY

Refers to the fact that humans can process information they are expecting much faster than information they are not expecting

- Similarly, humans can select a response they are expecting to choose more quickly than one that is unexpected
- Example: Machine operator must press a start button to begin each work cycle when the green light goes on
 - But if the red light turns on, the response will be delayed because it was unexpected

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COMPATIBILITY

RESPONSE COMPATIBILITY

Refers to the relationship between a stimulus and the expected consequence of a given response to that stimulus

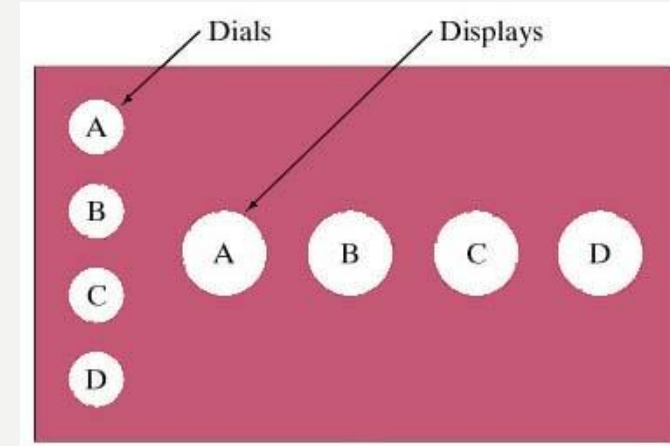
- Closely related to expectancy
- Example: When flipping a wall switch for a light, we expect the up position to turn on the light and the down position to turn off the light
 - Response compatibility means that the possible responses should be consistent with one's expectations

TYPES OF COMPATIBILITY

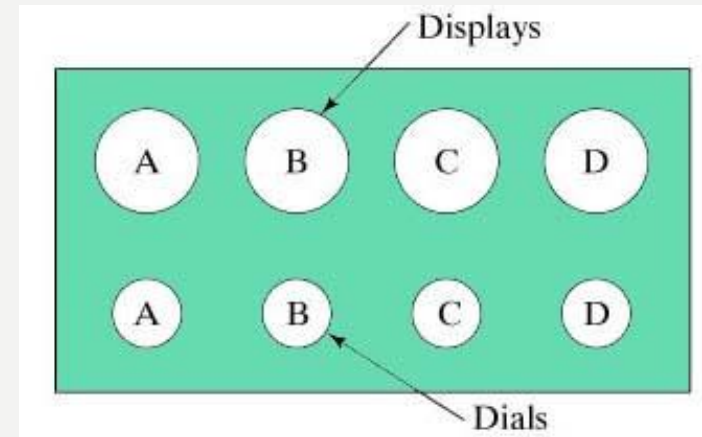
- Conceptual compatibility - concerned with associations people have between codes or symbols and the things they are supposed to represent
 - Example: octagonal shape of a stop sign
- Spatial compatibility - Physical arrangement of controls and their corresponding labels
- Movement compatibility - refers to relationship between moving a control in a certain direction and the expected result due to the movement
 - Example: radio volume dial

SPATIAL COMPATIBILITY ILLUSTRATED

Poor spatial compatibility -
dials do not match up with
displays



Good spatial compatibility -
dials and displays match up



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TRADEOFF B/W SPEED AND ACCURACY

SPEED-ACCURACY TRADE-OFF

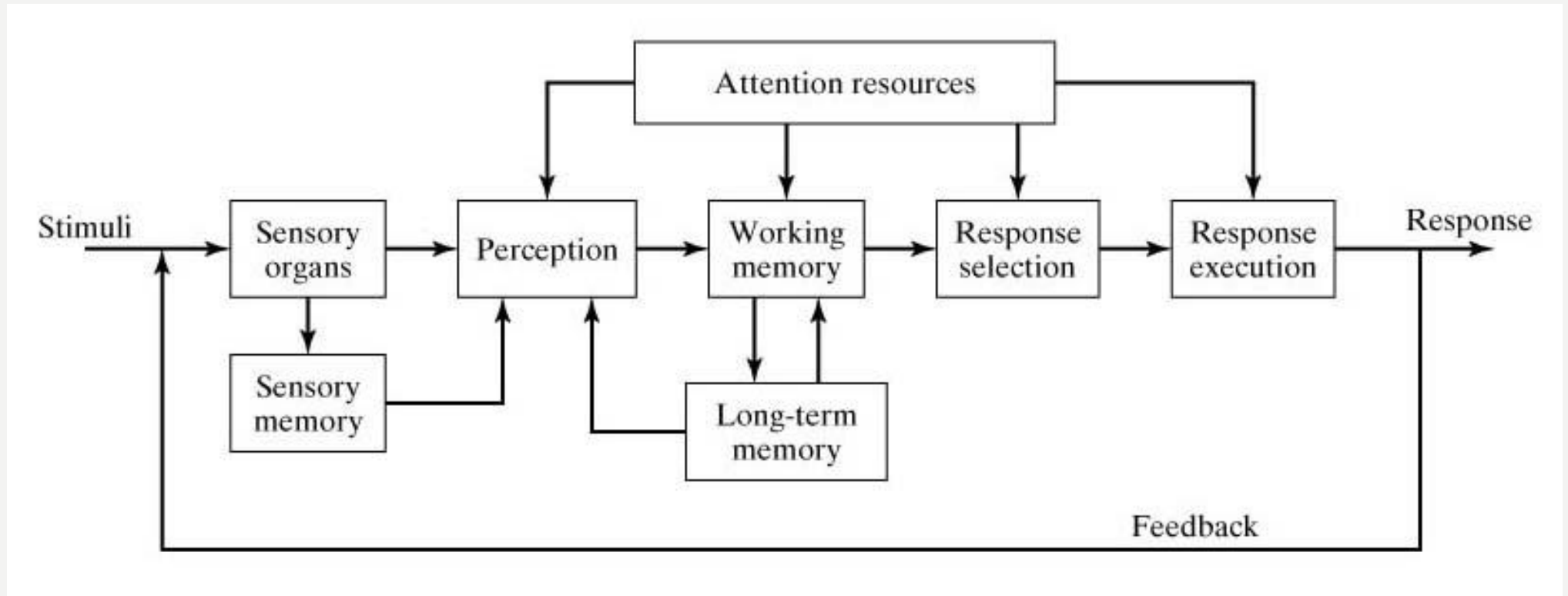
Refers to the negative correlation between speed and accuracy in response selection and execution

- In most situations, the faster a person selects a response, the more likely it is that an error will be made
- Example: An air-traffic controller must be allowed sufficient time to make sure mistakes are avoided

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FEEDBACK


HUMAN INFORMATION PROCESSING MODEL



FEEDBACK

Allows a person to see and/or hear the effect of his or her actions

- Important because it provides verification that the action taken in response selection and execution had the anticipated effect
- Time delay between response action and feedback should be as small as possible

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LECTURE CLOSING

DID YOU KNOW.....?????

- Psychology says that people who are lying to you tend to look up and to their left



A BRIEF HISTORY OF COGNITIVE PSYCHOLOGY & ERGONOMICS

EARLY 20TH CENTURY

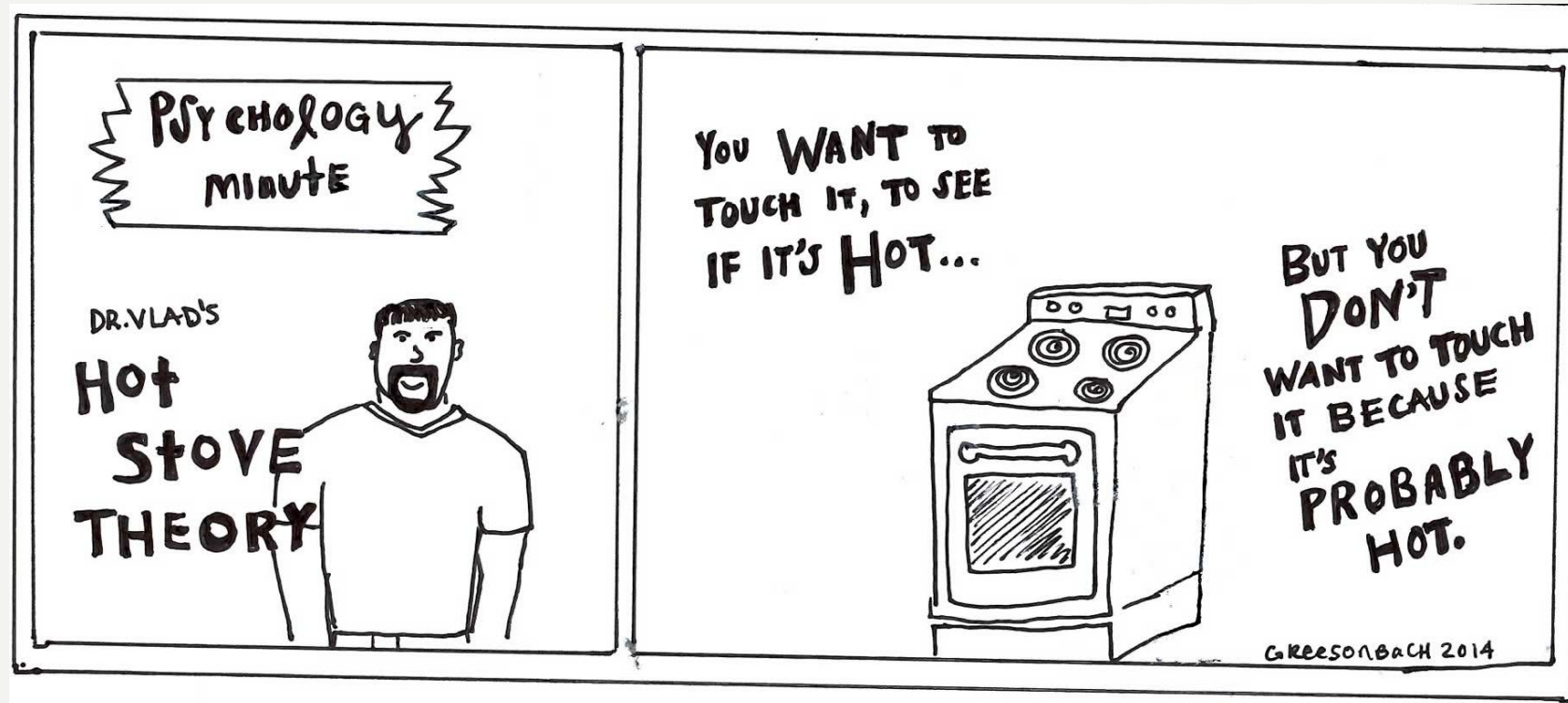
Sir Frederick Bartlett

- Sir Frederick Bartlett was known for his study of memory. He placed his emphasis on studies under natural conditions. Therefore, he rejected laboratory research. He felt that past experiences helped reconstruct the material able to be retrieved. He used a method called serial reproduction. This method allowed subjects to recall stories on more than one occasion with varying retention intervals. He focused on information that was remembered and "misremembered". His results showed that overtime the subjects' recall was progressively more distorted. Therefore "He rejected that the idea of long term memory where material is stored unchanged until retrieval". He saw memory as an active and often inaccurate process. The famous story he used was "The War of the Ghosts."

Skinner, B. F. (1904-1995)

- Skinner is famous for his theory of operant conditioning. He believed that behaviors and language were learned through reinforcement (Solso, 317-318). He invented the Skinner box, which was used to control and measure learned animal behavior. He believed that behavioral changes resulted from responses of the individual to environmental stimuli. He believed that the cognitive revolution was a backward, rather than a forward, step in the history of psychology (Murray, 415). Among his main scientific works were *The Behavior of Organisms* (1938) and *Verbal Behavior* (1957). Behaviorism caused the study of mental events to be put aside. In many ways it was a reaction against introspection. There was a behavioral revolution in America. Behaviorists believed that psychology should be only concerned with external behavior and "should not try to analyze the workings of the mind that underlay this behavior" (Anderson, 1995). Watson (1930) said that "Behaviorism claims that consciousness is neither a definite nor a usable concept." "The behaviorist program and the issues it spawned all but eliminated any serious research in cognitive psychology for 40 years....Perhaps the most important lasting contribution of behaviorism is a set of sophisticated and rigorous techniques and principles for experimental study in all fields of psychology, including cognitive psychology." (Anderson, 1995)

GRAFFITI



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THANK YOU

