




APA 2120

Lecture 4: Information Processing II
Sept 17, 2012





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Review

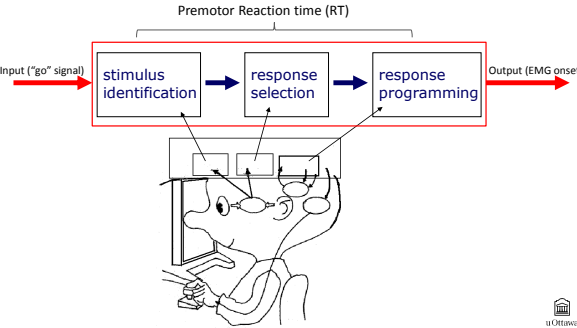


Input (stimulus) → [Brain icon with question mark] → Output (response)



3-stage model

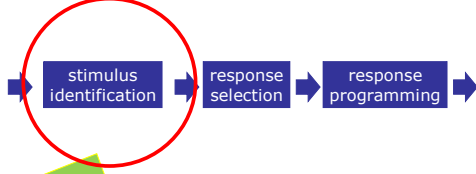
Premotor Reaction time (RT)



Input ("go" signal) → stimulus identification → response selection → response programming → Output (EMG onset)

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Factors Affecting Stimulus Identification

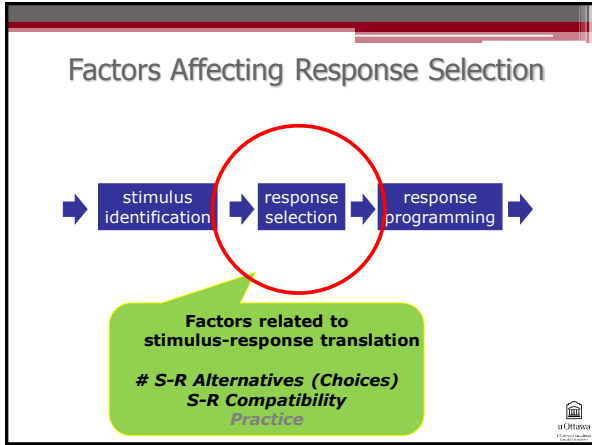


stimulus identification → response selection → response programming →

Factors related to stimulus identification

- Stimulus modality
- Stimulus intensity



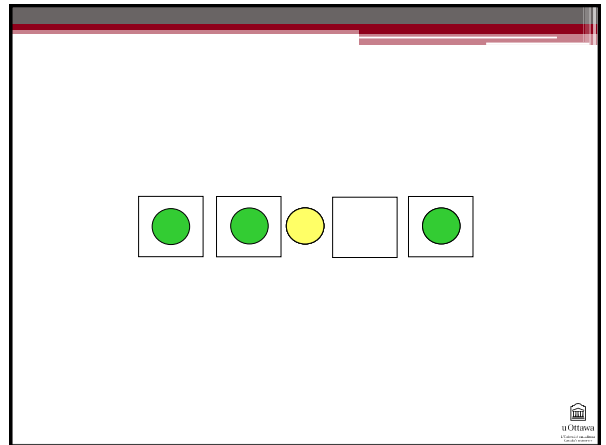
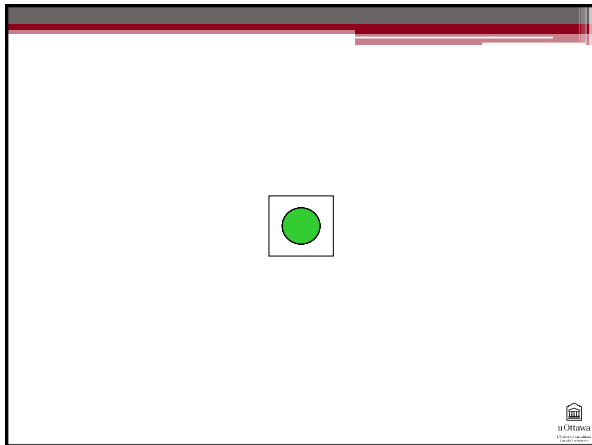


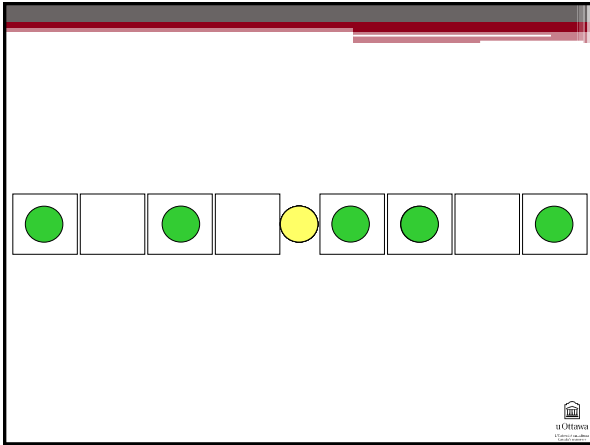
Factors Affecting Response Selection

1) Choices

The number of Stimulus-Response (S-R) alternatives affects reaction time (RT)

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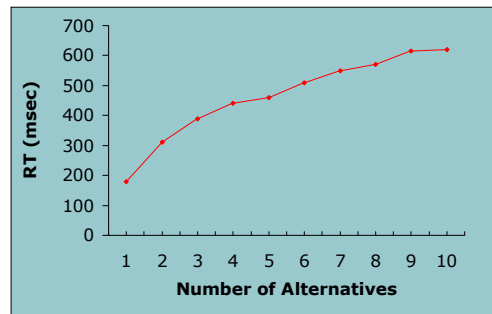
Stimulus-Response Alternatives

- S-R Alternatives
 - How is reaction time affected by the number of S-R choices?
 - How is reaction time affected by the amount of information that has to be processed?

The Number of Stimulus-Responses Affects Reaction Time

- Fastest situation = simple RT (1 S-R)
- As # of S-R alternative choices increase, RT increases (due to increased processing/preparation)
- ie. choice RT is longer than simple RT
- Exactly how is reaction time affected by the number of S-R choices?

RT vs. # of S-R Alternatives



“Bits” of Information

- *bit* of information
 - amount of information required to reduce uncertainty by half
 - least amount of “yes/no” decisions
 - Bits = $\log_2(N)$

1 Choice = 0 bits (Questions)



2 Choices = 1 Bit (Question)



4 Choices = 2 Bits (Questions)

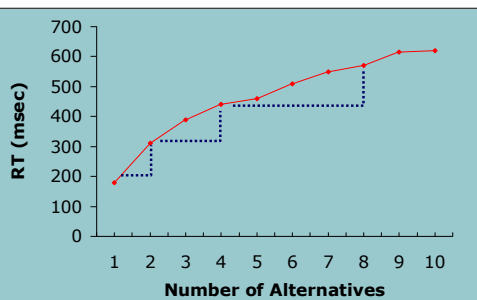


8 Choices = 3 Bits (Questions)



Hick-Hyman Law (Hick's Law)

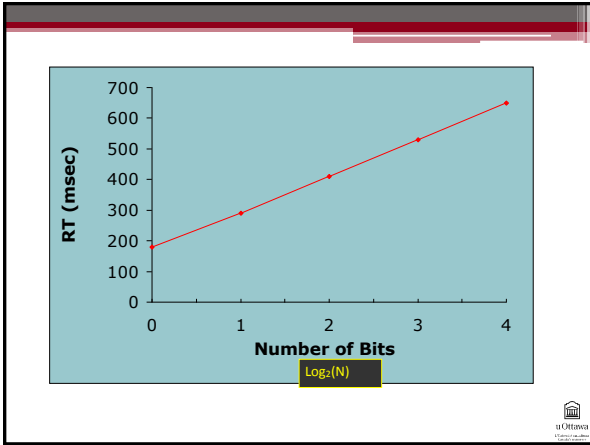
- RT increases proportionally every time the number of alternatives is doubled
- increase in RT is related to the amount of information to be processed



Hick's Law

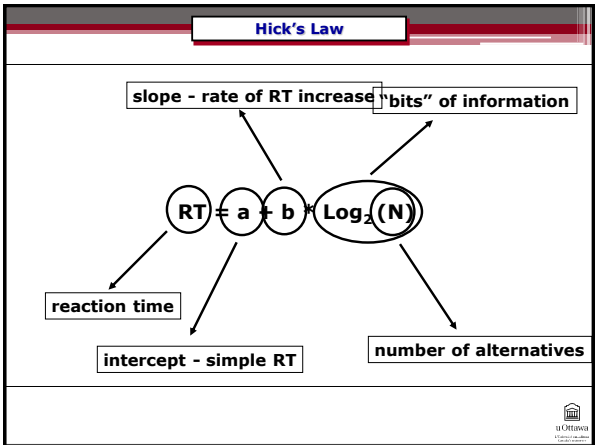
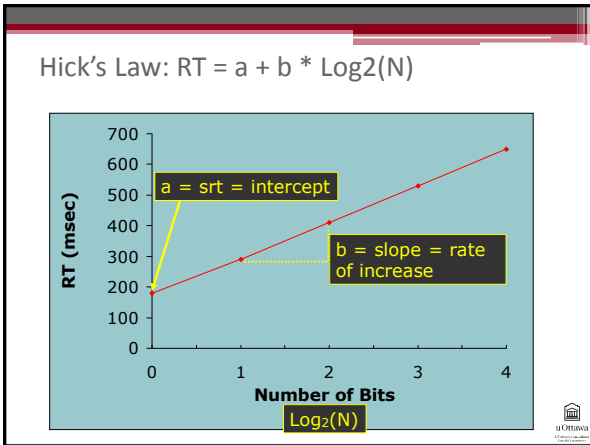
- RT increases proportionally every time the number of alternatives is doubled
 - i.e., every time the # of bits of information to be processed increases by 1
- relationship between choice RT and the *logarithm** of number of S-R pairs is *linear*





Hick's Law

- RT increases proportionally every time the number of alternatives is doubled
 - i.e., every time the # of bits of information to be processed increases by 1
- relationship between choice RT and the **logarithm*** of number of S-R pairs is **linear**
- **This means**: The change in RT is related to the amount of information to be processed



Factors Affecting Response Selection

Stimulus Selection → Response Selection → Response Organization

Factors related to stimulus-response translation
 # S-R Alternatives (Choices)
 S-R Compatibility

2) Stimulus-Response (S-R) Compatibility

What is S-R compatibility?

- Degree of natural or learned correspondence between a stimulus and a response
 - Affects how easy it is to translate input to the response you need to give (output)
-




To move the arrow indicator to the center of the display, how would you turn the knob?

Again, here is a different set of bathroom sink knobs, and you are looking down at them. How would you operate these knobs to turn the water on?





Ambiguous Stimuli

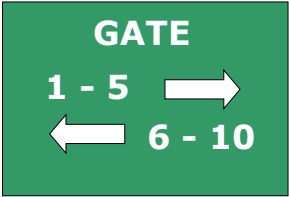

A
12 13 14
C



Ambiguous Stimuli may slow processing and/or increase errors

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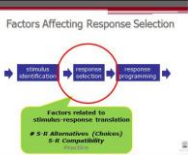
Confusion over Palm Beach County ballot

Although the Democrats are listed second in the column on the left, they are the third hole on the ballot.

(REPUBLICAN)	3		
GEORGE W. BUSH - PRESIDENT DICK CHENEY - VICE PRESIDENT			
(DEMOCRATIC)	5	4	(REFORM)
AL GORE - PRESIDENT JOE LIEBERMAN - VICE PRESIDENT			PAT BUCHANAN - PRESIDENT EZOLA FOSTER - VICE PRESIDENT
(LIBERTARIAN)	7	6	(SOCIALIST)
HARRY BROWNE - PRESIDENT ART OLIVER - VICE PRESIDENT			DAVID McREYNOLDS - PRESIDENT MARY CAL HOLLIS - VICE PRESIDENT
(GREEN)	8	8	(CONSTITUTION)
RALPH NADER - PRESIDENT WINONA LA DUKE - VICE PRESIDENT			HOWARD PHILLIPS - PRESIDENT J. CURTIS FRAZIER - VICE PRESIDENT
(SOCIALIST WORKERS)	11	10	(WORKERS WORLD)
JAMES HARRIS - PRESIDENT MARGARET TROWE - VICE PRESIDENT			MORICA MODRHEAD - PRESIDENT GLORIA LA RIVA - VICE PRESIDENT
(NATURAL LAW)	13		WRITE IN CANDIDATE
JOHN HAGELIN - PRESIDENT NAT GOLDMABER - VICE PRESIDENT			To vote for a write-in candidate, follow the directions on the long stub of your ballot card.

Punching the second hole casts a vote for the Reform Party.

Sun-Sentinel graphic/Daniel Niblock



2) Stimulus-Response (S-R) Compatibility

Effects of Spatial mapping



Movement compatibility

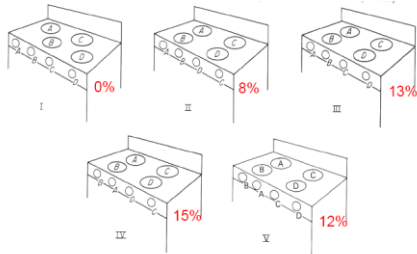
- Relationship between the movement of a control and the response of system / corresponding display being controlled



Physical arrangement of displays and controls

Average error rates

Chaparis and Lindenbaum, Ray and Ray



(Sanders and McCormick, 1993, after Chaparis and Lindenbaum, 1959)

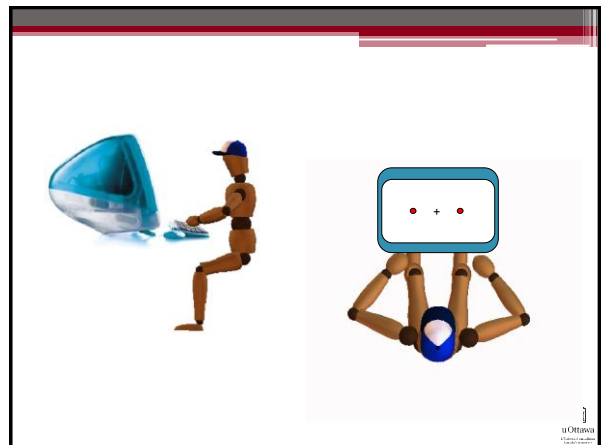
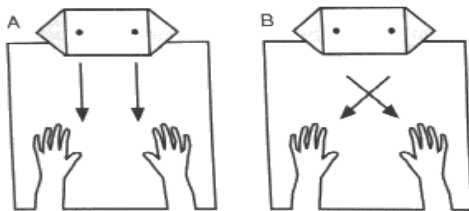


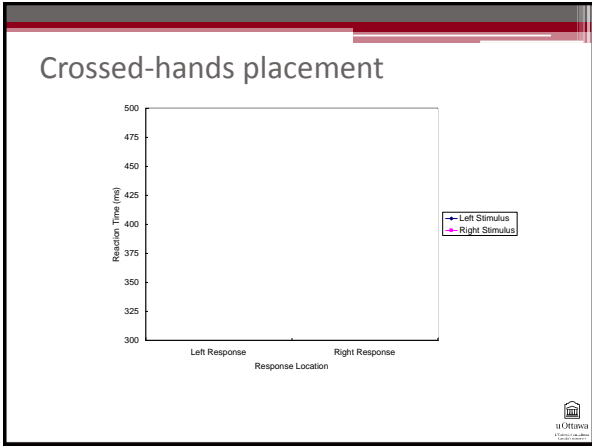
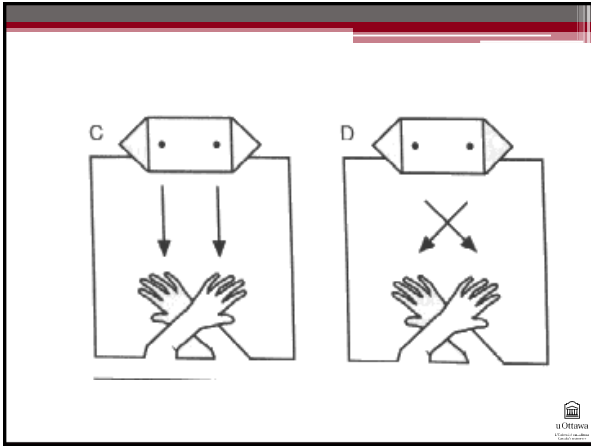
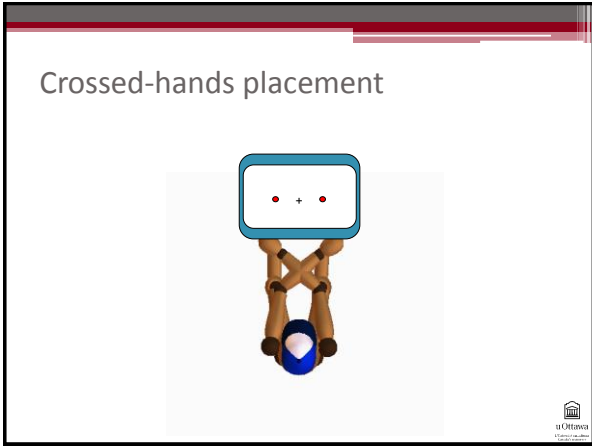
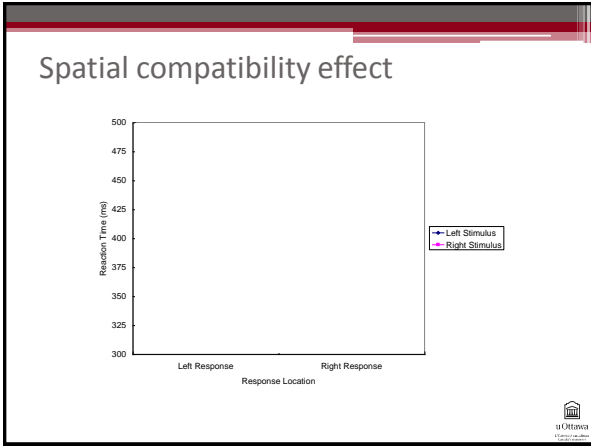
Design lessons from the stove

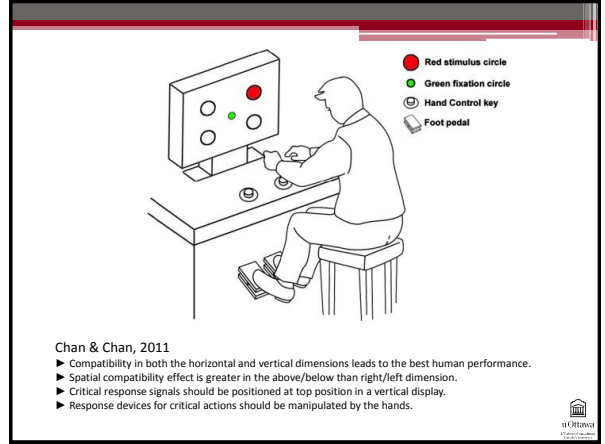
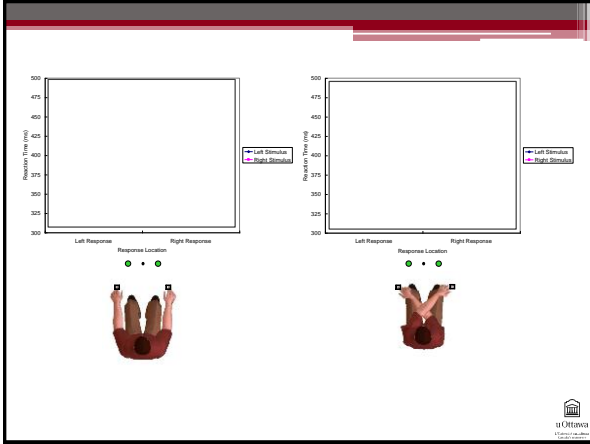
- Performance data clearly shows benefits of spatial compatibility
- Preference data is not always the same as performance data –take preference data with a grain of salt
- Availability of strong data does not mean it is used



Spatial mapping

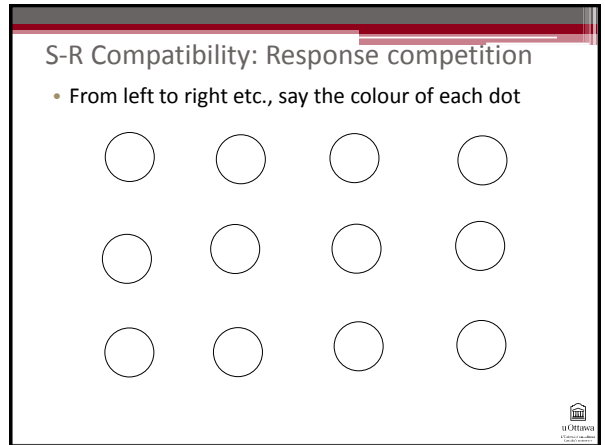


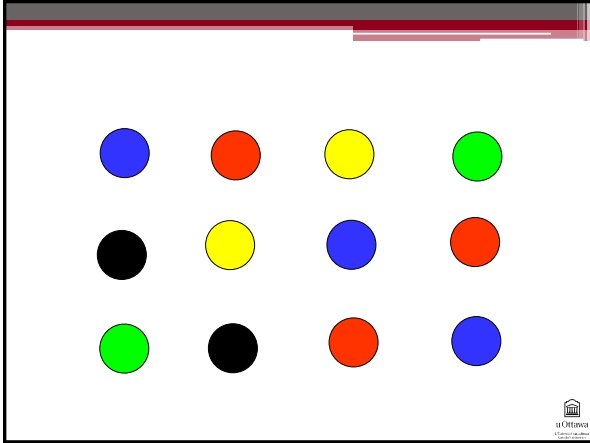




S-R compatibility

- Compatibility effects are regarded as:
 - _____ phenomena that reflect the mental codes used to translate between stimuli and responses





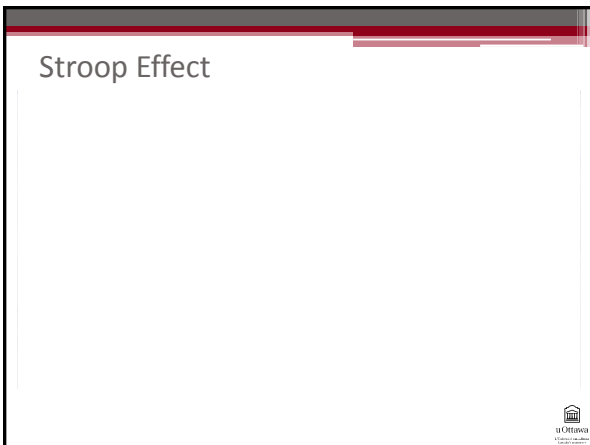
Response competition: Stroop effect

- From left to right etc., say the colour of each word... ignore the actual word

word word word word

word word word word

word word word word



Stroop effect

- When an irrelevant stimulus feature has an effect
- Due to automatic activation of word response code
- Because both the word and the color compete for processing time, the response is slowed
- When both the word and color are congruent (match), no competition occurs

Yellow

Blue

Red



Assignment is due next class: Written /
Typed

~~IRA2 Due before next class~~
IRA2 will now be due next week
(Sept 24th)



Assignment #1
Hicks Law Calculations

