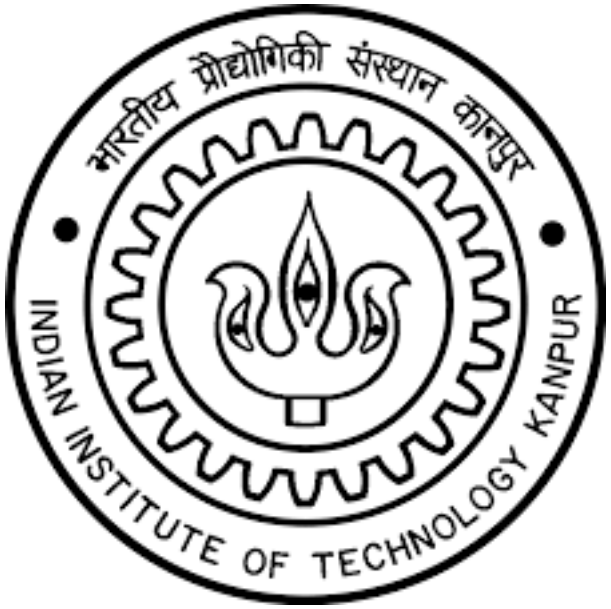

Indian Institute of Technology
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Presents

Course Title:

Basic Cognitive Processes

By: Dr. Ark Verma,
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Lecture 24: Attention - I

Some Key Questions…

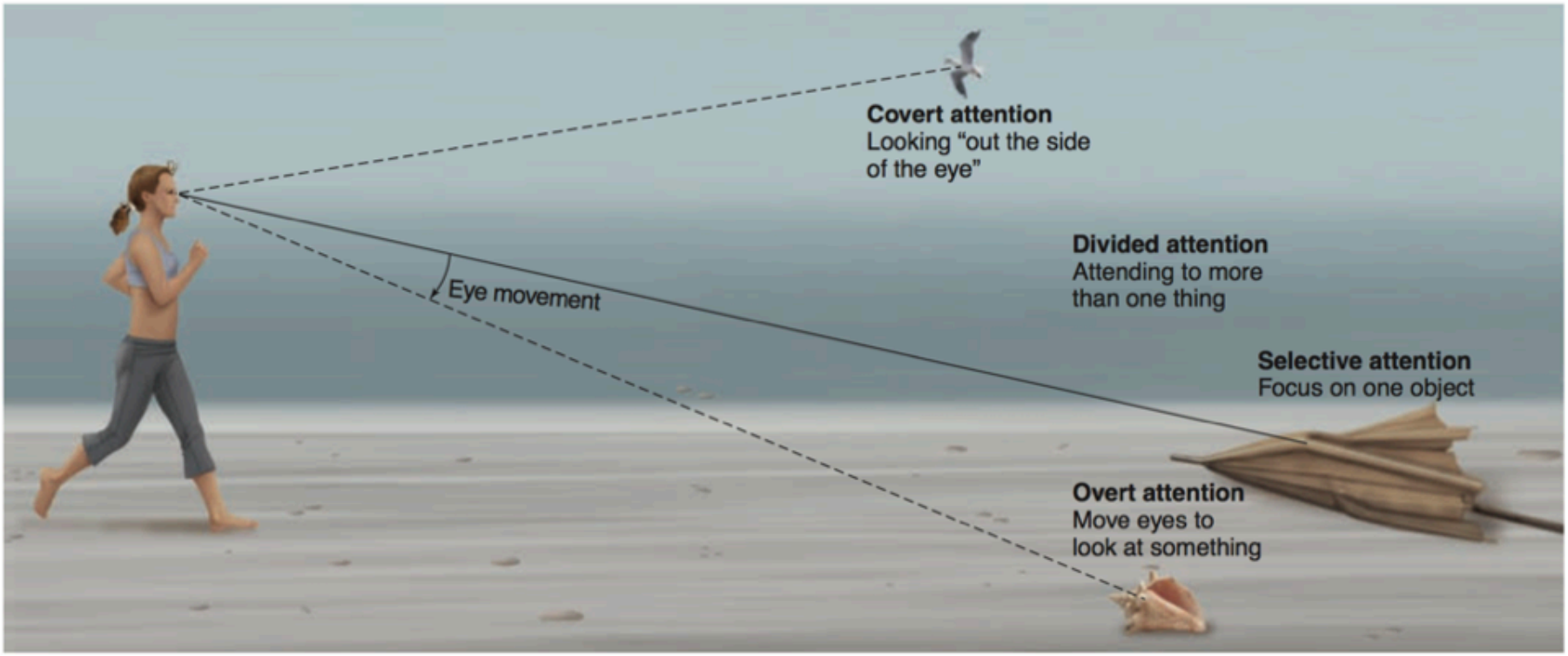
- Is it possible to selectively focus on one object/event, while many others are simultaneously going on?
- If yes, then under what conditions?
- What does research on attention tell us about multi – tasking?
- Is it that we are not attending to all other information that we are not focusing on?

Preliminary Definitions…

- *Attention*: the ability to focus on specific stimuli or spatial locations.
- *Selective Attention:* focusing attention on a specific object, event or location.
- *Overt Attention*: the process of shifting attention from one place to another by moving of eyes to those specific objects or locations.

- *Covert Attention*: when attention is shifted without the actual movement of the eyes.

- *Divided Attention*: the ability of attending two objects at the same time.



● **FIGURE 4.1** Crystal attends to various objects on the beach, illustrating a number of different types of attention.

Image Source: Goldstein (2011). Cognitive Psychology_Connecting Mind, research & Eveyday Experience. *Cengage Learning*

Attentional Processes: Visual Search

- ***Search*** refers to our behaviour of scanning the environment looking for particular features – i.e. actively looking for something when one is not aware of the location it will appear.

- ***Search*** becomes more difficult by ***distracters,*** i.e. non – target stimuli that divert our attention away from the target stimulus.
  - False alarms usually arise when we encounter such distracters while looking for the target stimulus. for e.g. counterfeits.

- the number of targets & distracters affects the difficulty of the task.
    - e.g. try to find T in the two figures, Panel A & B
- An interesting finding is the *display size* (i.e. the number of items in a given visual array) *effect,* which is the degree to which the number of items in a display hinders the search process).

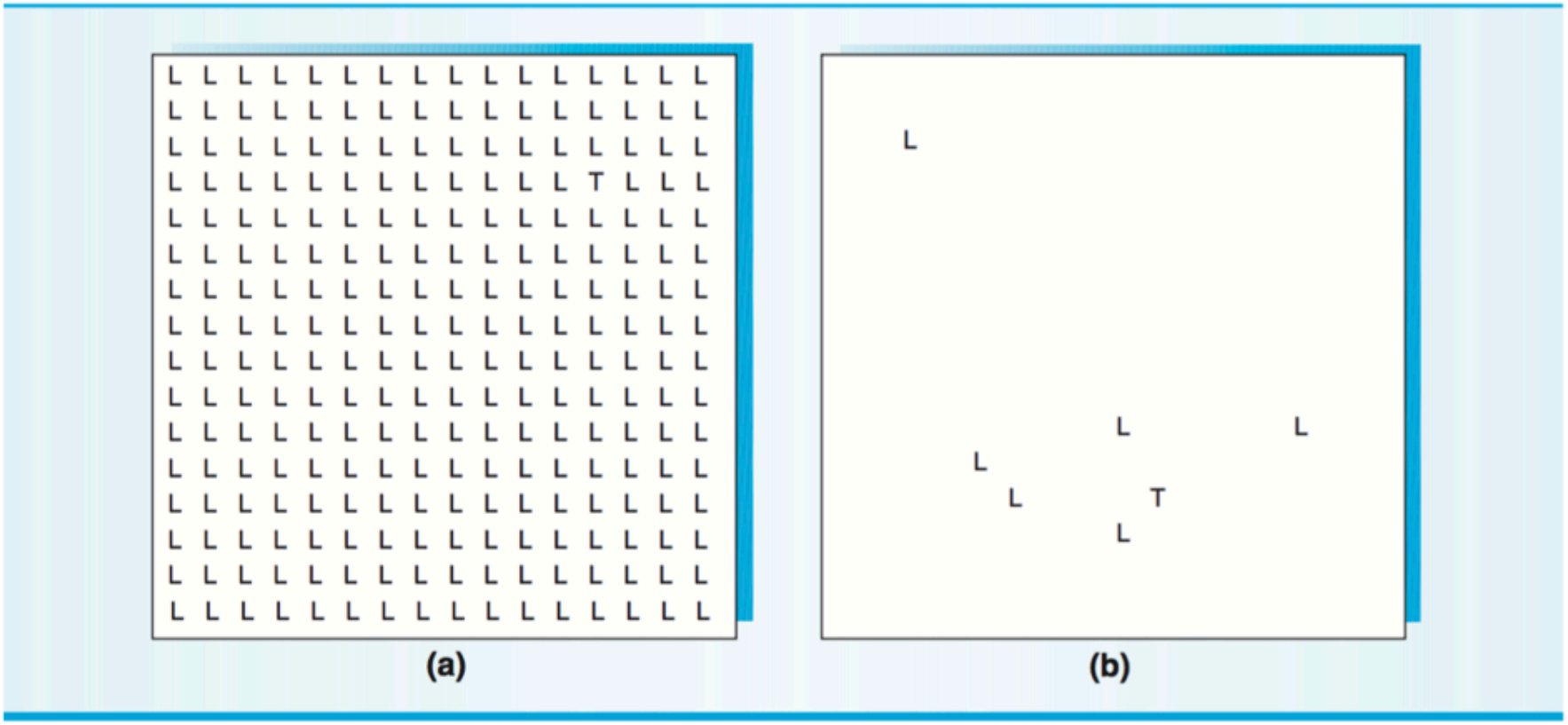


Figure 4.2 **Display Size.**

Compare the relative difficulty in finding the T in panels (a) and (b). The display size affects your ease of performing the task.

Image Source: Sternberg & Sternberg (2011). Cognitive Psychology. *Wadsworth Publishing*. 6th Ed. (p. 143).

- Distracters cause more trouble under some conditions than under others.
    - we conduct a **feature search**, when we simply scan the environment for a specific feature (Treisman, 1993). Distracters play little role in slowing our search in this case. for example, finding O in the panel c.
- because O has a distinctive form as compared to the rest of the items in the display; it pops out.
- Features singletons, i.e. items with distinctive features stand out in the display (Yantis, 1993); when feature singletons are targets, they seem to grab our attention; even those that may be distracting.

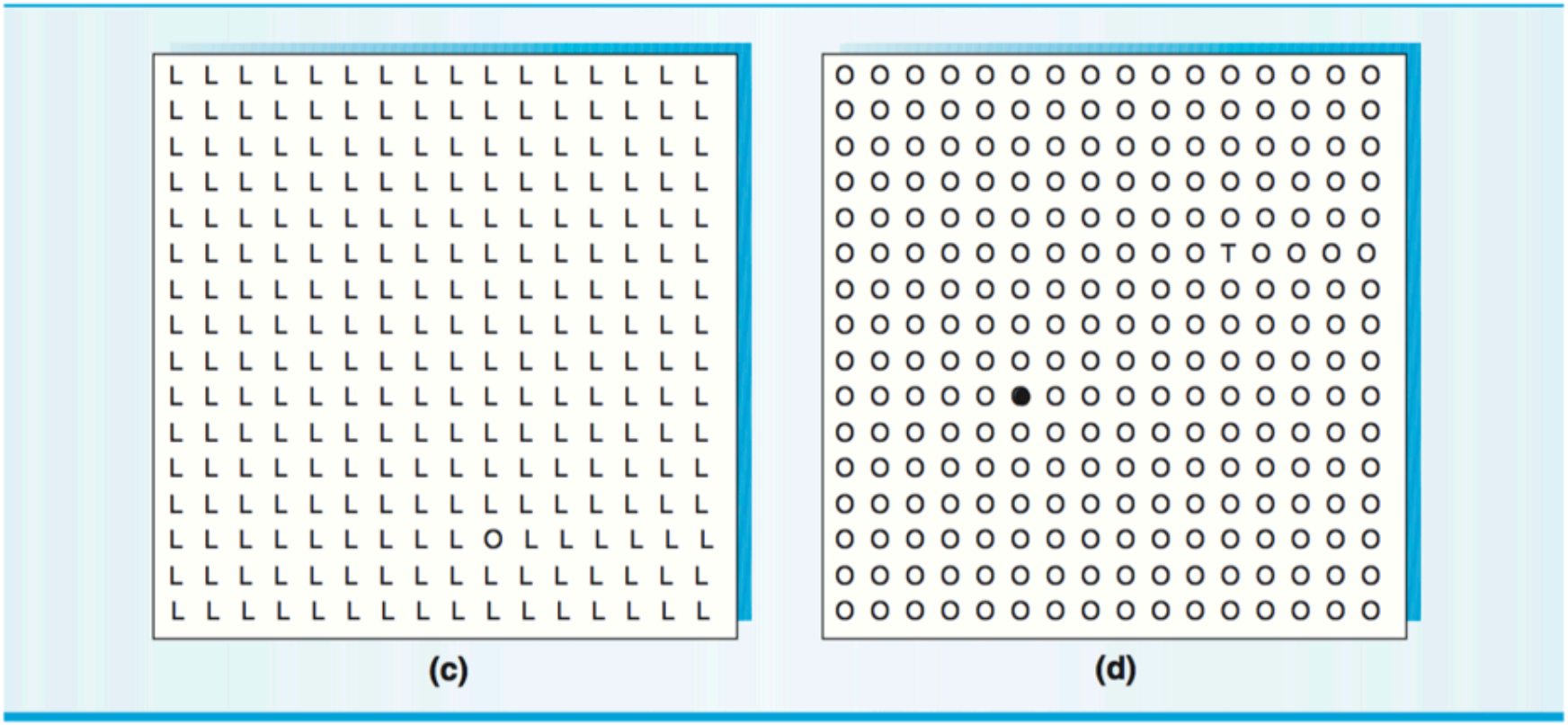


Figure 4.3 **Feature Search.**
In panel (c), find the O, and in panel (d), find the T.

Image Source: Sternberg & Sternberg (2011). Cognitive Psychology. *Wadsworth Publishing*. 6th Ed. (p. 144).

- on the other hand, when the target stimulus has no unique or even distinctive features.

- In these situations, the only way we can find such items is by **conjunction search**, i.e. we look for a particular combination (conjunction) of features. for e.g. the only difference between a T & a L is the particular integration of line segments. Both letters comprise a horizontal line and a vertical line.

- The dorsolateral prefrontal cortex as well as both frontal eye fields & the posterior parietal cortex play a role only in conjunction searches, but not so in feature searches (Kalla et el., 2009).

- **Theories of Visual Search**

  - **Feature - Integration Theory** explains the relative ease of conducting feature searches and the relative difficulty of conducting conjunction searches.

  - Going by Treisman's (1986) model of visual search, for each possible feature of a stimulus, each of us has a mental map for representing the given feature across the visual field. Say, there is a map for every colour, size, shape or orientation. there is no added time required for additional cognitive processing. Thus during feature searchers, we monitor the relevant feature map for the presence of any activation anywhere in the visual field.

  - This monitoring process can be done in parallel (all at once). This will therefore show no display size effects.

- However, during conjunction searchers; an additional stage of processing is needed. During this stage, we must use our attentional resources as a sort of mental glue; where in the two or more features are conjoined into an object representation at a particular location. In this stage, we can conjoin the features representation of only one object at a time. This stage, must be carried out sequentially, conjoining each object one by one. Effects of display size (i.e. a larger number of objects with features to be conjoined) therefore appear.

- Such a model of visual search is supported by the work of Hubel & Wiesel, (1979), who identified specific neural feature detectors.
    - these are cortical neurons that respond differentially to visual stimuli of particular orientations (e.g. vertical, horizontal, or diagonal).
- More recent research has indicated that the best search strategy is not for the brain to increase the activity of neurons that respond to the particular target stimuli; in fact the brain seems to use the more nearly optimal strategy of activating neurons that best distinguish the targets from the distracters, while at the same time ignoring the neurons that are tuned best to the target (Navalpakkam & Itty, 2007).

- **Similarity Theory:** According to similarity theory, Treisman's data can be reinterpreted; as being a result of the fact that as the similarity between target & distracter stimuli increases, so does the difficulty in detecting the target stimuli (Duncan & Humphreys, 1992).

- Thus targets that are highly similar to distracters are relatively harder to detect. Targets that are highly disparate from distracters are relatively easy to detect. (e.g. finding the black circle in panel E).

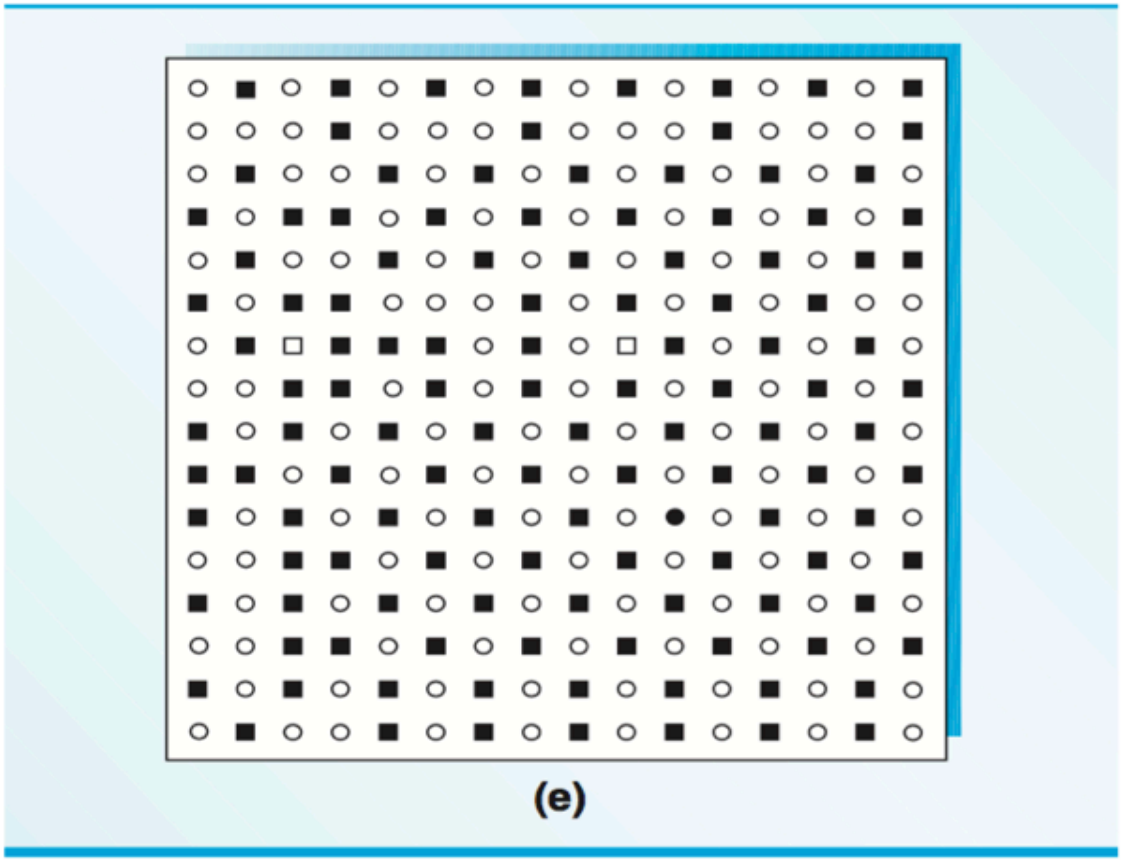


Figure 4.4 **Similarity Theory.**
In panel (e), find the black circle.

Image Source: Sternberg & Sternberg (2011). Cognitive Psychology. *Wadsworth Publishing*. 6th Ed. (p. 146).

- The target is highly similar to the distracters (black squares or white circles); therefore it is very difficult to find.

- Further, the difficulty of search tasks depends upon the the degree of disparity among the distracters; but it does not depend on the number of features to be integrated. for instance, one reason it is easier to read long strings of text written in lower case letters than text written in capital letters is that capital letters tend to be more similar to one another in appearance. Lowercase letters, in contrast, have more distinguishing features. e.g. try to find R in panels F & G.

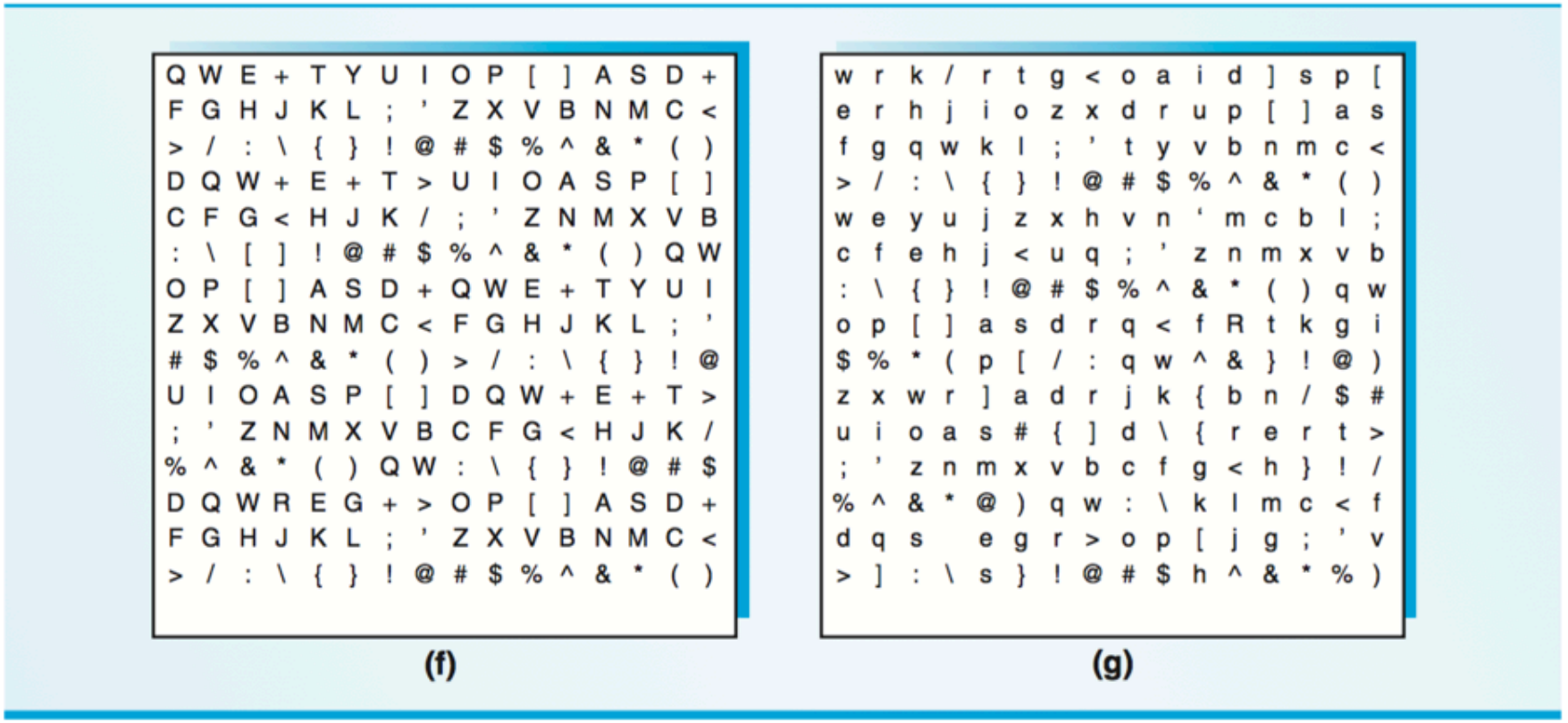


Figure 4.5 **Similarity Theory.**
In panels (f) and (g), find the R.

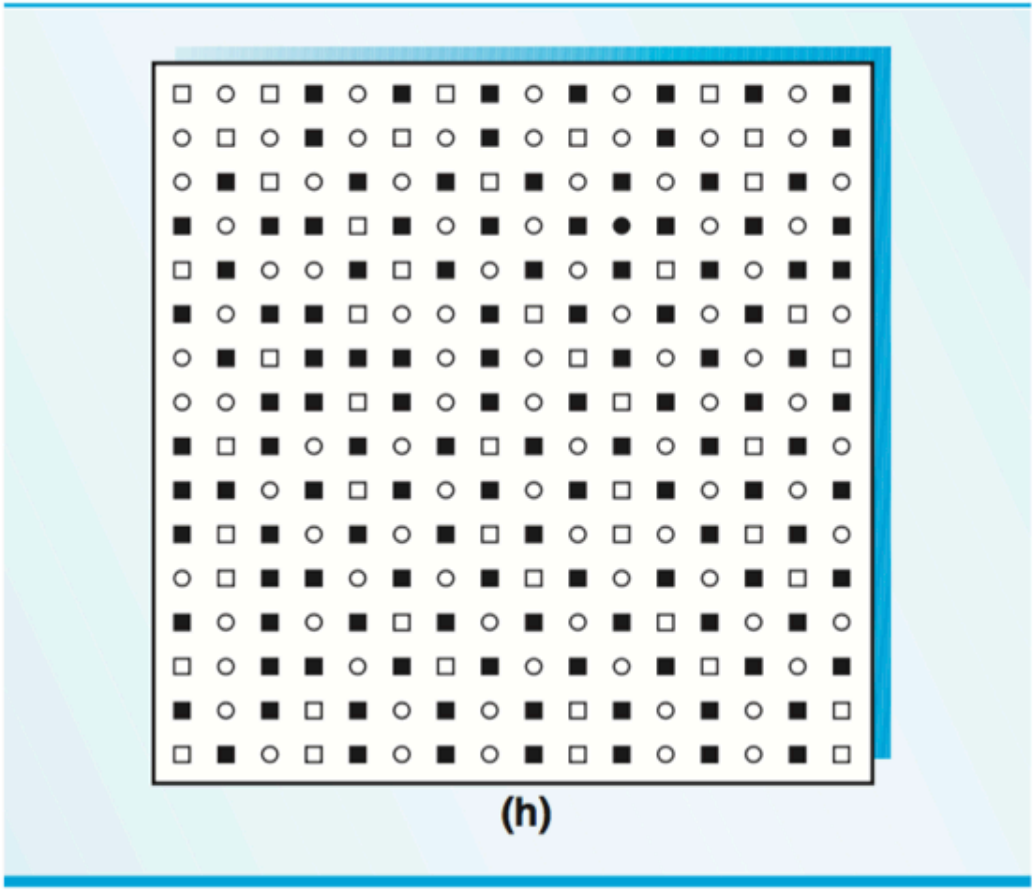
Image Source: Sternberg & Sternberg (2011). Cognitive Psychology. *Wadsworth Publishing*. 6th Ed. (p. 146).

- **Guided Search Theory**: An alternative to Treisman's model is offered as the *guided search theory* (Cave & Wolfe, 1990; Wolfe, 2007).

- The guided search model suggests that all searches, whether feature searchers or conjunction searchers involve two consecutive stage. The first is a parallel stage: the individual simultaneously activates a mental representation of all the potential targets. The representation is based on the simultaneous activation of each of the features of the target.

- In a subsequent serial stage, the individual sequentially evaluates each of the activated elements, according to the degree of activation. After that, the person chooses the true targets from the activated elements.

- Acc. to this model, the activation process of the parallel initial stage helps to guide the evaluation and the selection process of the serial second stage of the search.
    - For example; try to find the black circle in panel H.
        - the parallel stage will activate a mental map that contains all the features of the target (circle, black). Thus black circles, white circles & black squares will be activated.
        - during the serial stage, one will first evaluate the black circle, which was highly activated. You will also evaluate the black squares & white circles as they are less activated & dismiss them as distracters.



4.6 Guided Search Theory.

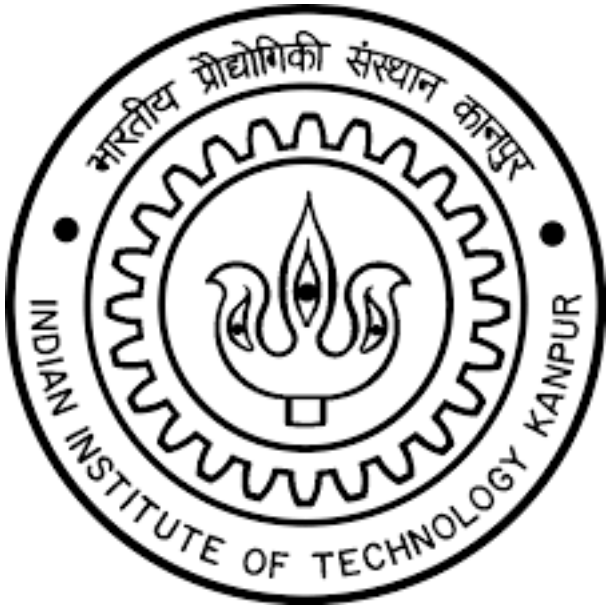
(h), find the black circle.

Image Source: Sternberg & Sternberg (2011). Cognitive Psychology. *Wadsworth Publishing*. 6th Ed. (p. 147).

To Sum Up

References

- Sternberg & Sternberg (2011). Cognitive Psychology *Wadsworth Publishing*. 6th Ed.



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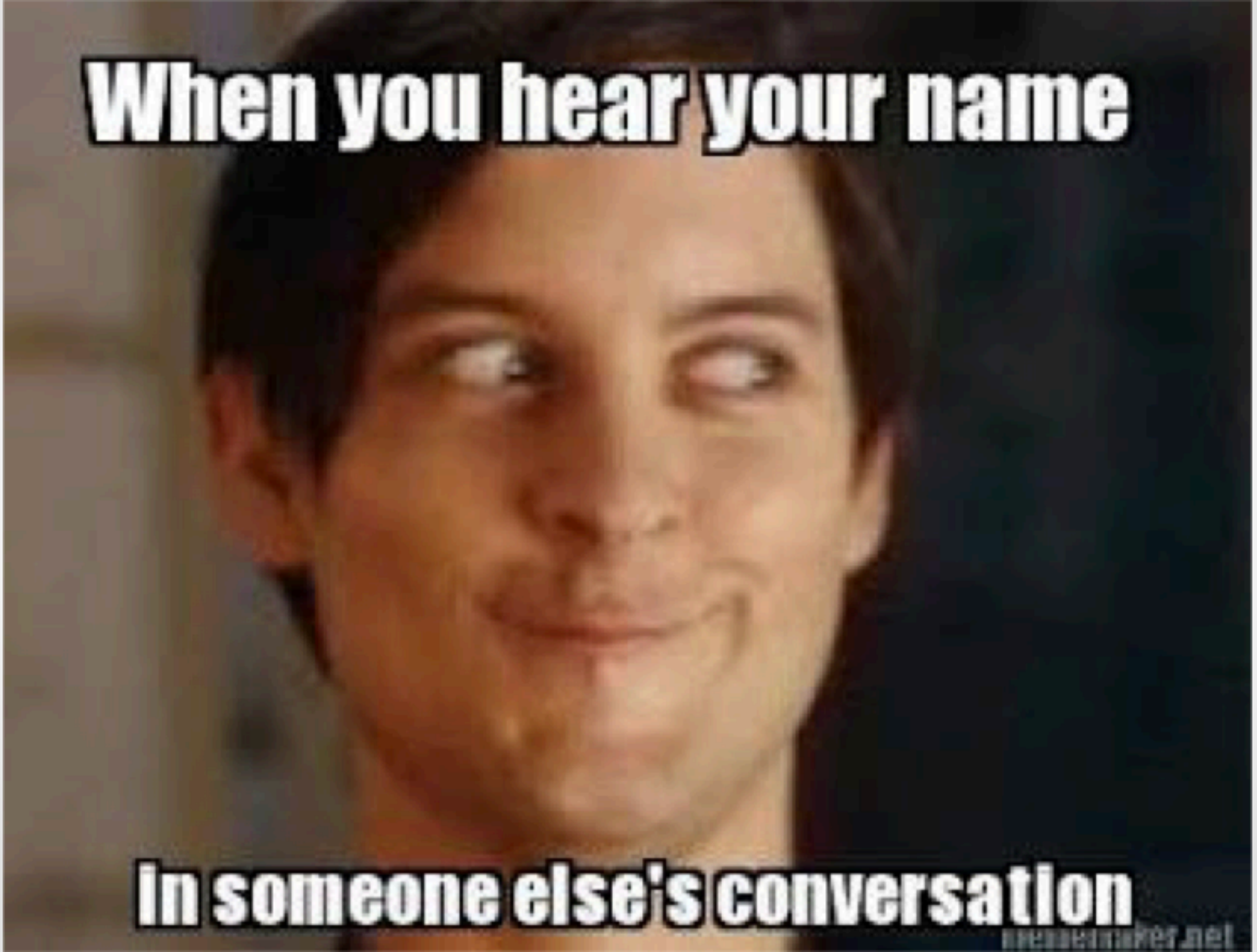
Lecture 25: Attention - II

Selective Attention

- it often happens in public gatherings like in parties or restaurants etc.; that some other ongoing conversations than the one you are currently involved in grabs our attention.

- Colin Cherry (1953) referred to this phenomenon as the **cocktail party effect**, i.e. the process of tracking one conversation in the face of the distractions from other conversations.

- Cherry observed that cocktail parties are often settings in which selective attention is salient.


When you hear your name
In someone else's conversation

- Cherry studied selective attention in a carefully controlled experimental setting; task known as **shadowing**.

- In shadowing, one listens to two different messages. Cherry presented a separate message to each ear; known as **dichotic presentation**; and asked the participants to repeat back only one of the messages as soon as possible after hearing it.

- Cherry's participants were quite successful in shadowing distinct messages in dichotic listening tasks, although such shadowing required a significant amount of concentration.

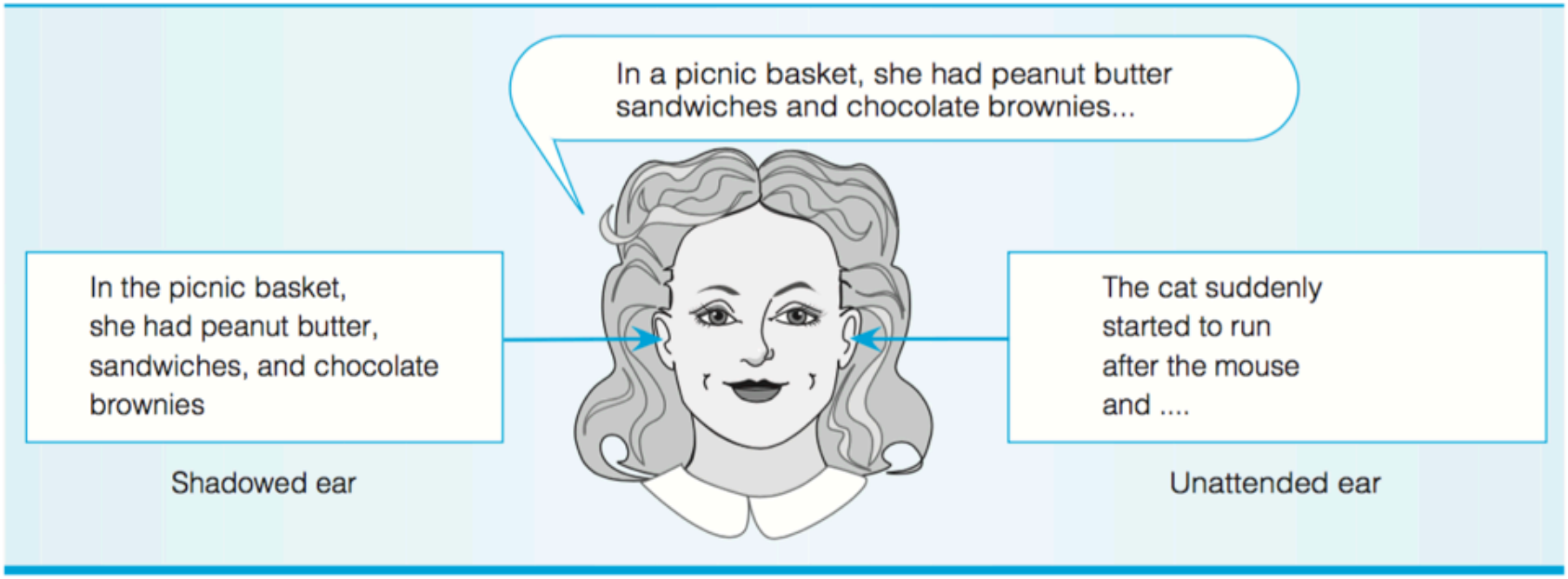


Figure 4.8 **Dichotic Presentation.**
In dichotic presentation, each ear is presented a separate message.

Image: Sternberg & Sternberg (2011) Cognitive Psychology. *Wadsworth Publishing.* 9th ed. (p. 149).

- The participants were also able to notice physical, sensory changes in the unattended message - for example, when the message was changed to a tone or the voice changed from a male to female voice.

- However, they did not notice they semantic changes in the unattended message. They also failed to notice even when the unattended message shifted from English to German or was played backward.

- Conversely, about 1/3 of the people, when their name is presented during these situations shifted their attention to their name. Some researchers have noticed that those who hear their name in the unattended message have limited working memory capacity & are thus easily distracted (Conway, Cowan & Bunting, 2000).

- Three factors could help one to selectively attend the target speaker, if you are caught in a busy restaurant among many conversations:
    - distinctive sensory characteristics of the target's speech. e.g. high vs low pitch, pacing & rhythm.
    - sound intensity (loudness)
    - location of the sound source (Brungard & Simpson, 200&0.

- **Theories of Selective Attention**

  - The theories of selective attention can be grouped into **filter** & **bottleneck** theories.

    - A filter blocks some of the information going though and thereby selects only a part of the total information to pass through the next stage.

    - A bottleneck slows down information passing through.

- Two questions:
  - Whether there is a distinct filter for incoming information?
  - Where in the processing does filtering occur, Early or Late?

- **Broadbent's Model**: Acc. to one of the earliest theories of attention, we filter information right after we notice it at the sensory level (Broadbent, 1958).

- Multiple channels of sensory input reach an attentional filter; those channels can be distinguished by their characteristics like loudness, pitch, or accent.

- The filter permits only one channel of sensory information to proceed and reach the process of perception.

- We thereby assign meaning to our sensations.

- Other stimuli will be filtered out at the sensory level and may never reach the level of perception.

- Broadbent's theory was supported by Colin Cherry's findings that sensory information sometimes may be noticed by an unattended ear if it does not have to be processed elaborately (e.g. voice shifts to tone); but information requiring higher perceptual processes is not noticed if not attended to (e.g. English shifts to German).

- **Selective Filter Model**: Moray found that even when participant's ignore most other high level aspects of an unattended message, they frequently still recognise their names in an unattended ear (Moray, 1959).

- He suggested that the reason for this effect is that messages that are of high importance to a person may anyways breakthrough the filter of selective attention; though other messages may not.

- To modify Broadbent's metaphor, one could say that, according to Moray, the selective filter blocks out most information at the sensory level; but some personally relevant information can still burst through.

- **Attenuation Model**: Treisman explored why some unattended messages pass through the filter by conducting some experiments.

- She had participants shadowing coherent messages, and at some point, switched the remainder of the message to the unattended ear.

- Participants picked up the first few words of the message they had been shadowing in the unattended ear (Treisman, 1960); so they somehow must have been somehow processing the content of the unattended message.

- Moreover, if the unattended message was identical to the amended one; all participants notice it. They noticed even if one of the messages was slightly out of temporal synchronisation with the other.

- Trainman also observed that some fluently bilingual participants noticed the identity of the messages if the unattended message was a translated version of the attended one.

- Her findings suggested that at least some information about unattended signals is being analysed.
- Treisman proposed a theory of selective attention that involves a later filtering mechanism.
- Instead of blocking stimuli out, the filter merely weakens the strength of the stimuli other than the target stimulus.
- So, when stimuli reach us, we analyse them at a low level for target properties like loudness & pitch; if the stimuli process those target properties, we pass the signal on to the next stage; if they do not posses the target properties a weakened version is passed on to the next stage.

- In a next step, we perceptually analyse the meaning of the stimuli and their relevance to us, so that even a message from the unattended ear that is supposedly irrelevant can come into awareness and influence actions if it has some meaning for us.

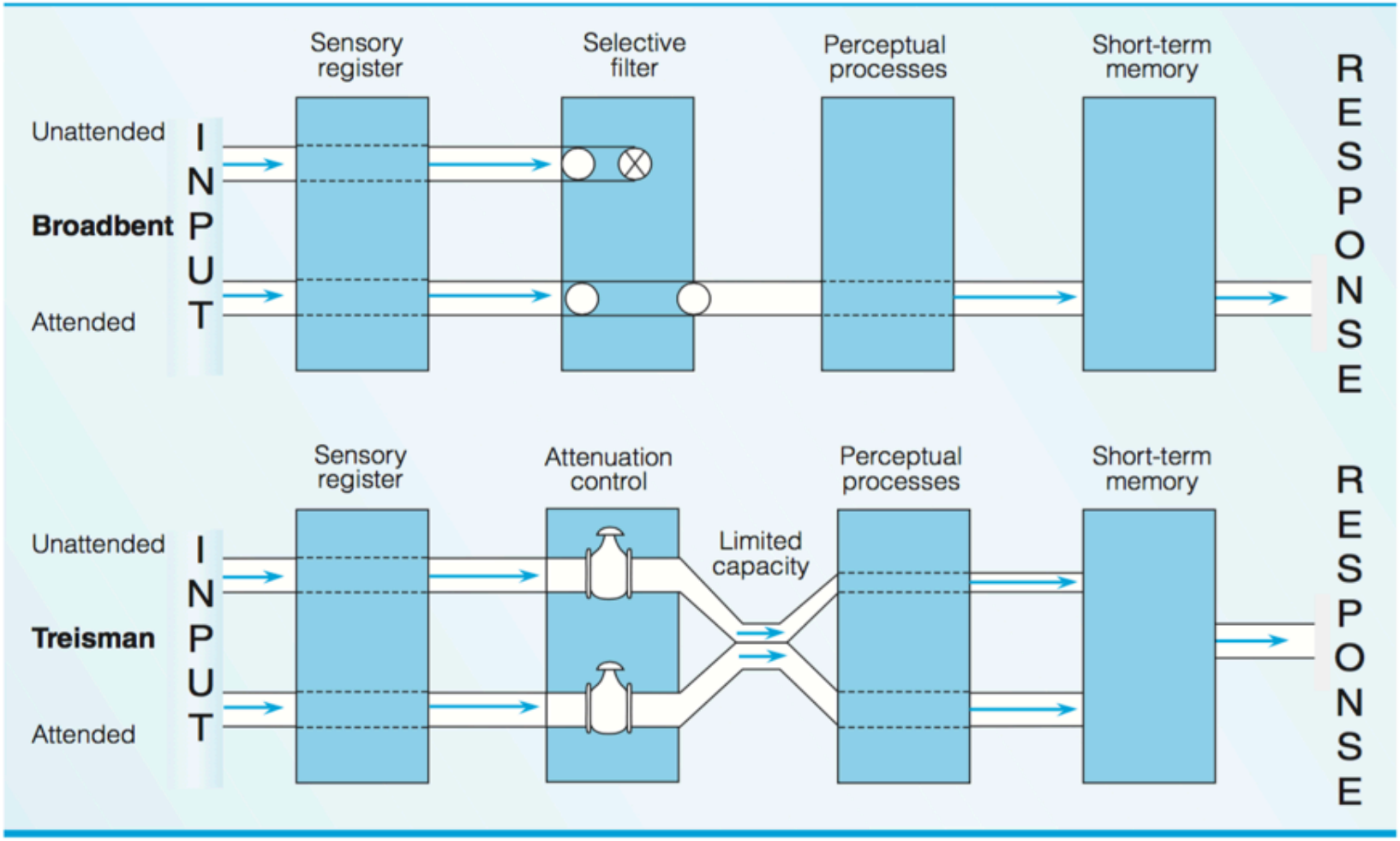


Figure 4.9 **Broadbent and Treisman's Models of Attention.**
Various mechanisms have been proposed suggesting a means by which incoming sensory information passes through the attentional system to reach high-level perceptual processes.

Image: Sternberg & Sternberg (2011) Cognitive Psychology. *Wadsworth Publishing.* 9th ed. (p. 150).

- **Late - Filter Model**: Deutsch & Deutsch (1963) developed a model in which the location of the filter is even later.

- They suggested that stimuli are filtered out only after they have been analysed for both their physical properties and their meaning.

- This late filtering would allow people to recognise information entering the unattended ear. for e.g. they might recognise the sound of their own names or a translation of the attended version.

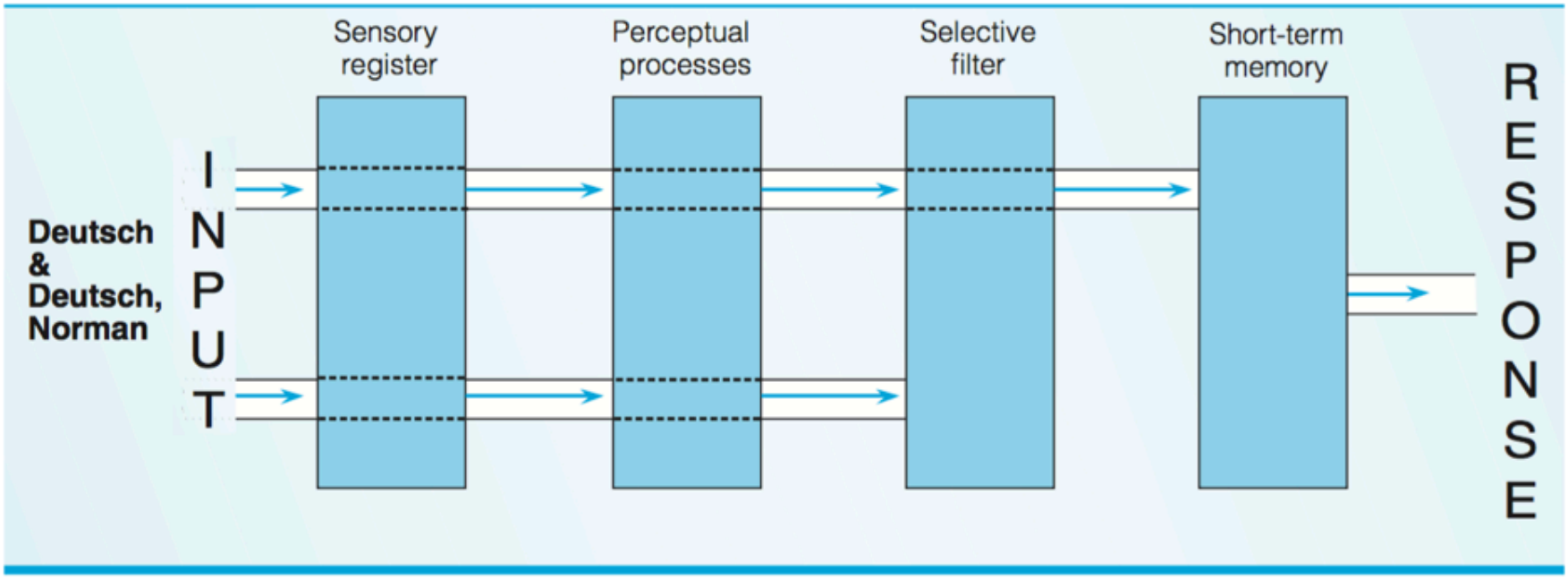


Figure 4.10 **Deutsch & Deutsch's Late-Filter Model.**

According to some cognitive psychologists, the attentional filtering mechanisms follow, rather than precede, preliminary perceptual processes.

Image: Sternberg & Sternberg (2011) Cognitive Psychology. *Wadsworth Publishing.* 9th ed. (p. 152).

- **A synthesis:**
  - Ulric Neisser synthesised the early filter and the late filter models and proposed that there are two processes governing selective attention:
    - **Pre attentive Processes:** These automatic processes are rapid & occur in parallel. They can be used to notice only physical sensory characteristics of the unattended message; but they do not discern meanings.
    - **Attentive, controlled processes:** These processes occur later. They are executed serially and consume time and attentional resources, such as working memory. They can cue used o observe relationships among features; synthesise fragments into mental representation of an object.

- This two - step model could easily account fro Cherry's, Moray's, & Treisman's data.

- Also, this model nicely incorporates aspects of Treisman's signal attenuation theory & her feature integration theory.

- Acc. to Treisman, discrete processes for feature detection & for feature integration occur during searches.

- **Neuroscience of selective attention**

  - Hillyard & colleagues (1973) conducted a ground - breaking study, exposing participants to two streams of tones; one in each ear.

  - Participants were asked to detect occasionally occurring target stimuli; when the target stimuli occurred in the attended ear, the first negative component of the ERP was larger than when the target occurred in the unattended ear.

    - The N1 wave is a negative wave appearing about 90ms after the onset of the target stimulus,

  - The researchers hypothesised that the N1 wave was a result of the enhancement of the target stimulus. At the same time here was a suppression of the other stimuli(distracters).

- This result is consistent with the filter theories of attention.

- Later studies (Woldorff et al., 1993) found an even earlier reaction to the target stimulus in the form of a positive wave that occurs about 20 - 50ms after the onset of the target. This wave originates in the Heschl's gyro, located in the auditory cortex.

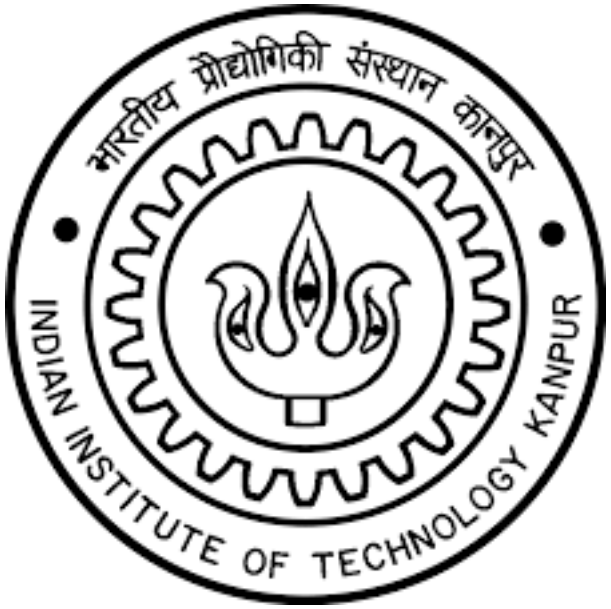
- Similar effects have also been found for visual attention.

    - If a target stimulus appears in an unattended region of the visual field, the occipital P1is larger than when the target appears in an unattended region (Van Voorhies & Hillyard, 1977).

To Sum Up

References

- Sternberg & Sternberg (2011). Cognitive Psychology. *Wadsworth Publishing. 6th Ed.*



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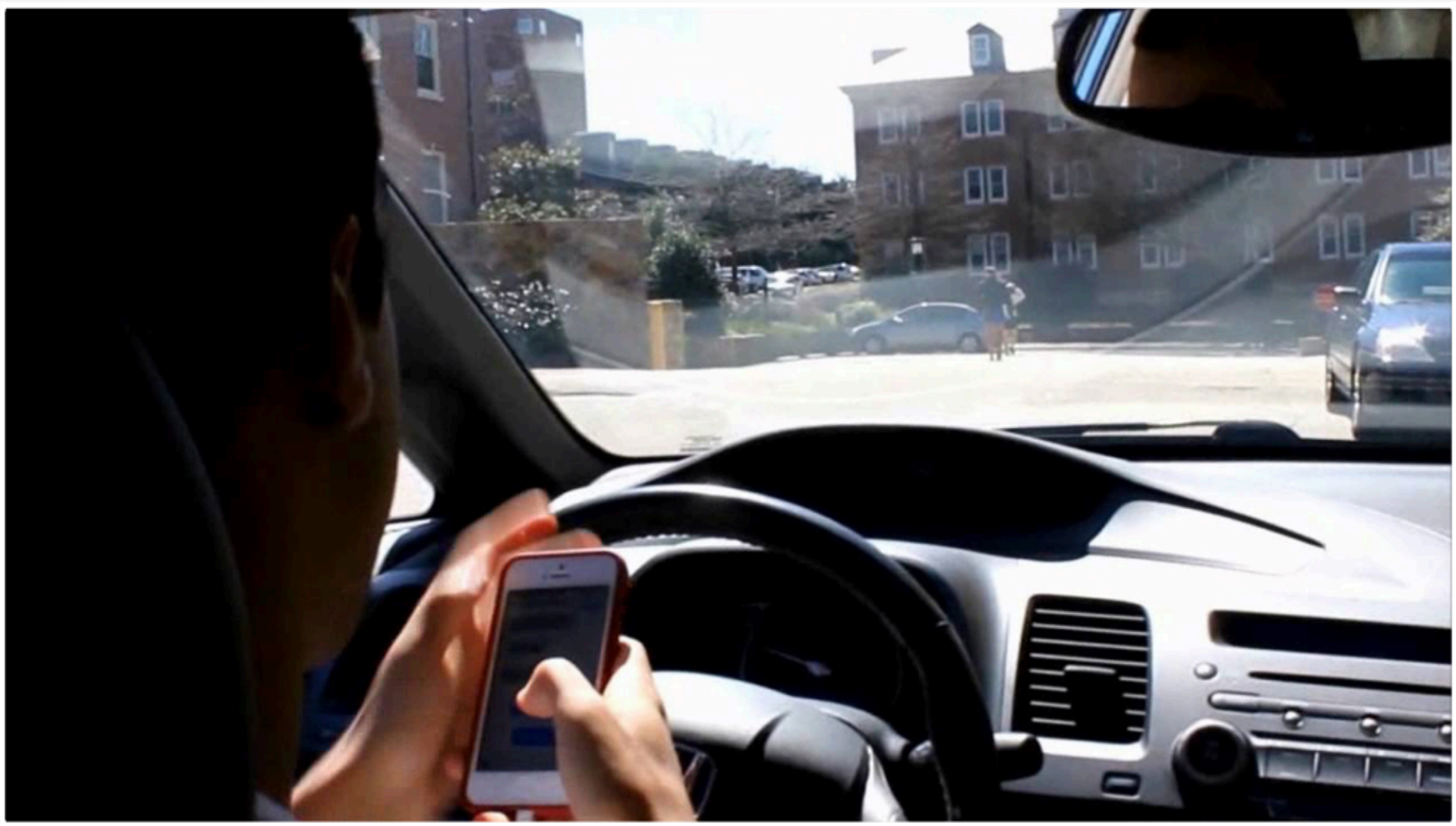
Lecture 26: Attention - III

Divided Attention



- **Investigating Divided Attention in the Lab**
  - One of the early works in the area of divided attention had participants view a videotape in which the display of a basketball game on the display of a hand slapping game.
  - Participants could successfully monitor one activity and ignore the other; but they had great difficulty in monitoring both activities at once; even if the basket ball game was watched by one eye & the hand - slapping game by the other eye (Neisser & Becklen, 1975).
  - Neisser & Becklen hypothesised that the improvement in performance would have occurred as a result of practice & also that the performance of multiple tasks was based on skill resulting from practice.

- the following year, investigators used a dual - task paradigm to study divided attention during the simultaneous performance of two activities: reading short stories and writing down dictated words (Spelke et al., 1976).

- the researchers would compare and contrast the response times and accuracy of performance in each of the three conditions.

- As expected, initial performance was quite poor for the two tasks, when they had to be performed at the same time.

- However, Spelke & colleagues had their participants practice to perform these two tasks 5 days a week for many weeks (85 sessions in all).

- To the surprise of many, the performance improved on both tasks after practice.

  - They showed improvements in their speed of reading and accuracy of reading comprehension, as measured by comprehension tests; also, they showed increases in their recognition memory for words they had written during dictation.

  - Eventually, participants performance on both tasks reached the same levels as when the participants had performed the tasks alone. They soon could perform both the tasks at the same time without a loss in performance.

- Speke and colleagues suggested that these findings showed that controlled tasks can be automatised so that they consume fewer attentional resources. Also, two discrete controlled tasks may be automatised to function together as a unit. However, they still continue to be intentional & conscious and involve high levels of cognitive processing.

- A rather different approach to study divided attention involves focussing on extremely simple tasks that require speedy responses.

- When people try to perform two overlapping speeded tasks, the responses for one or both tasks are almost always slower (Pashler, 1994).

- When a second task begins soon after the first task has started, speed of performance usually suffers; the slowing resulting from simultaneously engagement in speeded tasks; called the *psychological refractory period* effect, also called attentional blink.

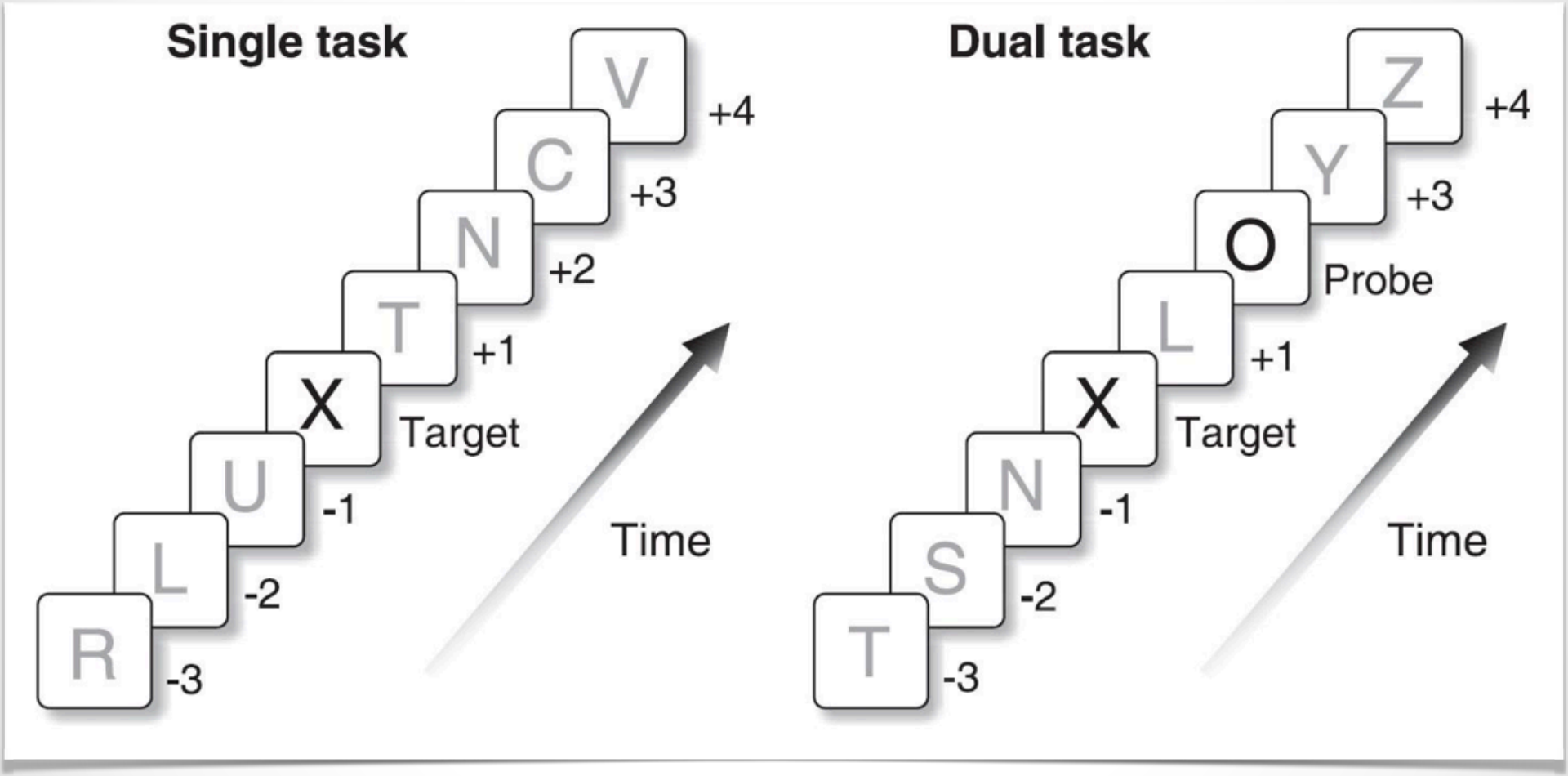


Image: Amador-Campos, Casanova, Bezerra, Torro-Alves & Sanchez (2015). Attentional Blink in Children With Attention deficit Hyperactivity Disorder. *Revista Brasileira de Psiquiatria. 37 (2).*

- Findings form PRP studies indicate that people can accommodate fairly easily perceptual processing of the physical properties of sensory stimuli when engaged in a second speeded task (Miller et al., 2009).

- However, they cannot readily accomplish more than one cognitive task requiring them to choose a response, retrieve information from memory, or engage in various other cognitive operations; one or both the tasks will show the PRP effect.

- **Theories of Divided Attention**
  - a number of researchers have developed capacity models of attention to understand our ability to divide our attention.
  - these models explain how we can perform more than one attention - demanding task at a time. they posit that people have a fixed amount of attention that they can choose to allocate according to what the task requires.
  - there are two different kinds: one kind of model suggests that there is one single pool of attentional sources that can be divided freely, and the other model suggests that there are multiple sources of attention.

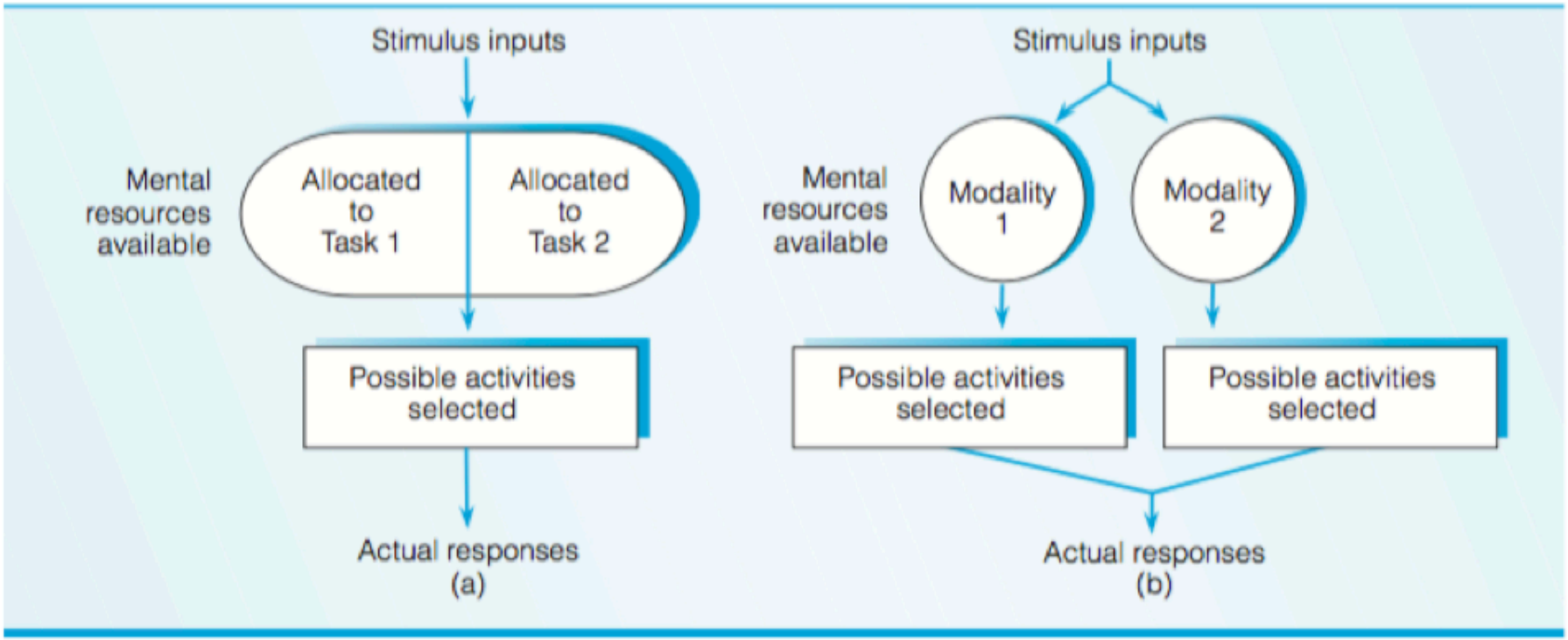


Figure 4.11 Allocation of Attentional Resources.

Attentional resources may involve either a single pool or a multiplicity of modality-specific pools. Although the attentional resources theory has been criticized for its imprecision, it seems to complement filter theories in explaining some aspects of attention.

Image: Sternberg & Sternberg (2011). Cognitive Psychology. *Wadsworth Publishing.* 6th Ed.(p. 156)

- it now appears that such models represent an oversimplification.

- people are much better at dividing their attention when competing tasks are in different modalities. at least some attentional resources may be specific to the modality (e.g. verbal or visual) in which a task is presented. for example: most people easily can listen to music and concentrate on writing simultaneously (the two being different tasks modality - wise).

- But it is harder to listen to the news station and concentrate on writing at the same time. because both are verbal tasks.

- Similarly two visual tasks are more likely to interfere with each other than are a visual task coupled with an auditory one.

- attentional resources theory has been criticized heavily as being overly broad & vague (Navon, 1984).

- Resource theory seems to be a better metaphor for explaining the phenomenon of divided attention on complex tasks. in these tasks, practice effects may be observed.

- Acc. to this metaphor, as each of the complex tasks becomes increasingly automatized, performance of each task makes fewer demands on limited capacity attentional resources.

- **Factors that Influence Our Ability to Pay Attention**

  - There are many other variables that have an impact on our ability to concentrate and pay attention:

    - **Anxiety:** Being anxious, either by nature (trait - based anxiety) or by situation,(state - based anxiety) places constraints on attention (Reinholdt - Dunne et al., 2009).

    - **Arousal:** One's overall state of arousal affects attention; being drowsy or drugged limits attention while being excited sometimes enhances attention (MacLean et al., 2009).

- **Task Difficulty:** Task difficulty particularly influences performance during divided attention.

- **Skills:** The more practiced & skilled one is in performing a task, the more one's attention is enhanced (Spelke et al., 1976).

- **Neuroscience of Attention**:
  - Acc. to Michael Posner, the attentional system in the brain "is neither a property of a single brain area nor of the entire brain" (Posner & Dehaene, 1994).
  - Posner & Mary Rothbart in 2007, conducted a series of neuroimaging studies in the area of attention to investigate whether the many diverse results of studies conducted pointed to a common direction.
  - They found that what at first seemed like an unclear pattern of activation could be effectively organised into areas associated with the three sub - functions of attention: alerting, orienting, and executive attention.

- **Alerting:** Alerting is defined as being prepared to attend to some incoming event, and maintaining this attention. Alerting also includes the process of getting to this state of preparedness.

    - The brain areas involved in alerting are the right frontal and parietal cortices as well as the locus coeruleus. The neurotransmitter norepinephrine is involved with the maintenance of alertness. If the alerting system does not work properly, people may develop symptoms of ADHD; in the process of regular raging dysfunctions of the alerting system may develop as well.

- **Orienting:** orienting is defined as the selection of stimuli to attend to. This kind of attention is needed when we perform visual search. The orienting network develops during the first year of life.

  - The brain areas involved in the orienting network are the superior parietal lobe, the temporal parietal junction, the frontal eye - fields, & the superior colliculus. The modulating neurotransmitter is acetylcholine.

  - Dysfunction with this system has been associated with autism.

- **Executive Attention**: executive attention includes processes for monitoring and resolving conflicts that arise among internal processes. These processes include thoughts, feelings, and responses.
    - The brain areas involved in this highest order of attentional processes are the anterior cingulate, lateral ventral, and prefrontal cortices; as well as the basal ganglia. The neurotransmitter most involved in executive attention is dopamine.
    - Dysfunction within this system is associated with Alzheimer's disease, borderline personality disorder, and schizophrenia.

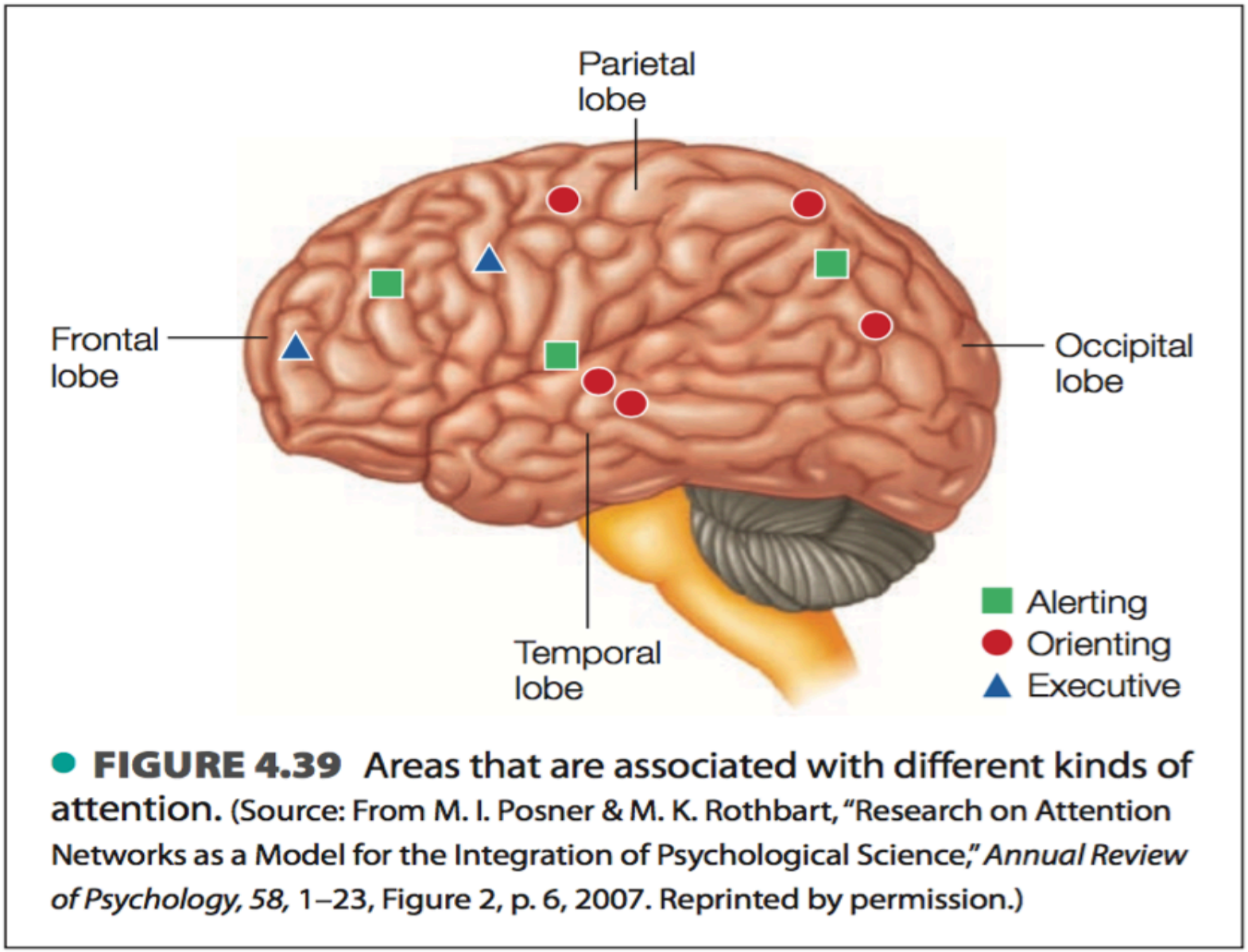


FIGURE 4.39 Areas that are associated with different kinds of attention. (Source: From M. I. Posner & M. K. Rothbart, "Research on Attention Networks as a Model for the Integration of Psychological Science," *Annual Review of Psychology, 58,* 1–23, Figure 2, p. 6, 2007. Reprinted by permission.)

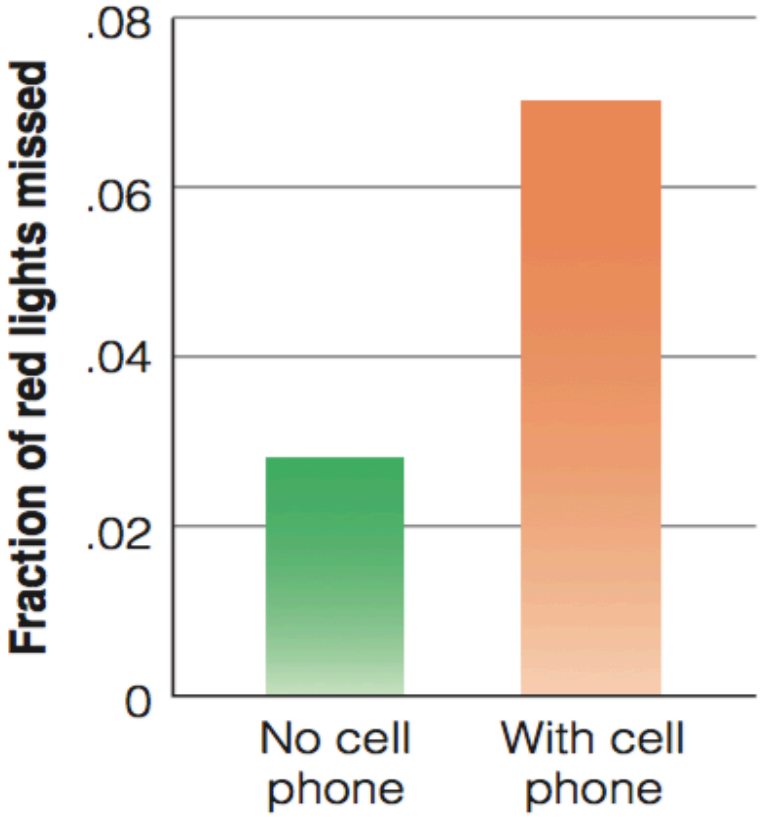
Goldstein (2010). Cognitive Psychology_ Connecting Mind, Research and Everyday Experience. *Wadsworth Publishing.* 3rd Ed. (p. 109).

Distractions While Driving

- Driving is one of the tasks that require constant attention; not being able to do the same due to fatigue or involvement in other tasks can have disastrous consequences.
  - in a naturalistic driving study (Dingus et al., 2006) video recorders in 100 vehicles documented records of both, what the drivers were doing & the outside view.
  - they found that in more than 80% (of 82) of the crashes & 67% (of 771) of the near crashes the driver was inattentive in some way 3 seconds before the crash.

- In a laboratory experiment on the effects of cell phones, Strayer, William & Johnston (2001) placed participants in a simulated driving task that required them to apply the brakes as quickly as possible in response to a red light.

- Doing this task while talking on a cell phone caused participants to miss twice as many of the red lights as when they weren't talking on the phone & also increased the time it took them to apply the brakes.



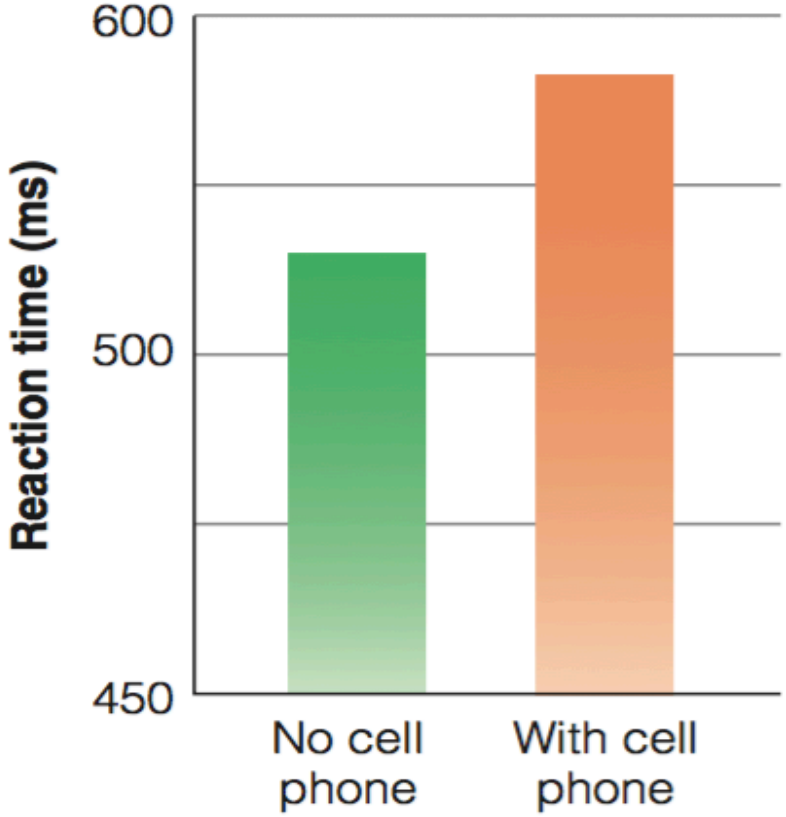


FIGURE 4.16 Result of Strayer and Johnston's (2001) cell phone experiment. When participants were talking on a cell phone, they (a) missed more red lights and (b) took longer to apply the brakes.

Goldstein (2010). Cognitive Psychology_ Connecting Mind, Research and Everyday Experience. *Wadsworth Publishing.* 3rd Ed. (p. 94).

- Strayer & Johnston concluded from this result that talking on the phone uses cognitive resources that would otherwise be used for driving the car (other studies include, Haringey & Western, 2001; Lamble et al., 1999; Spence & Read, 2003; Violanti, 1998)

To Sum Up.

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- Sternberg & Sternberg (2011). Cognitive Psychology. *Wadsworth Publishing*. 6th Ed.

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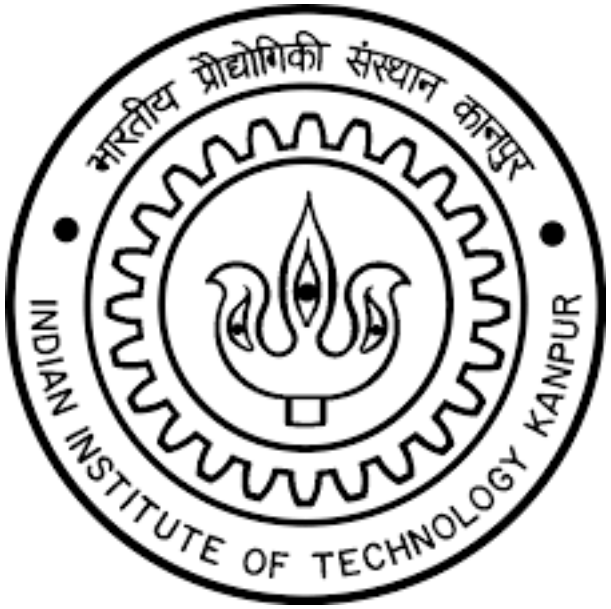

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Presents

Course Title:

Basic Cognitive Processes

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IIT Kanpur

Lecture 27: Attention - IV

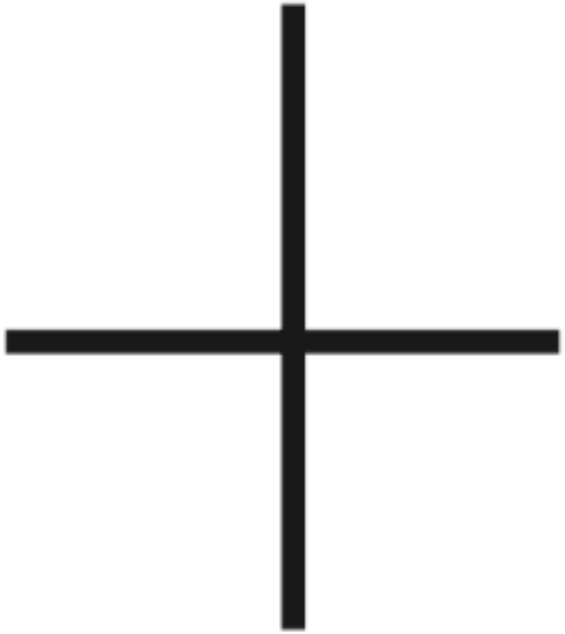
Attention and Visual Perception

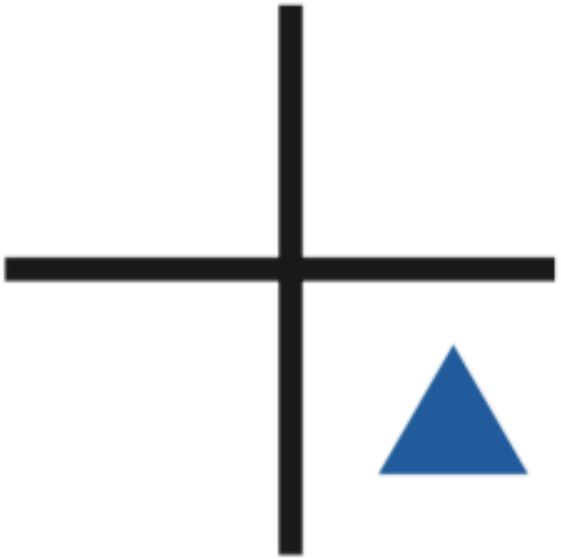
- **Inattentional Blindness:** Mack & Rock (1998) created a situation in which a person's attention is focused on one task and then determined whether the person perceived an easily visible nearby stimuli.

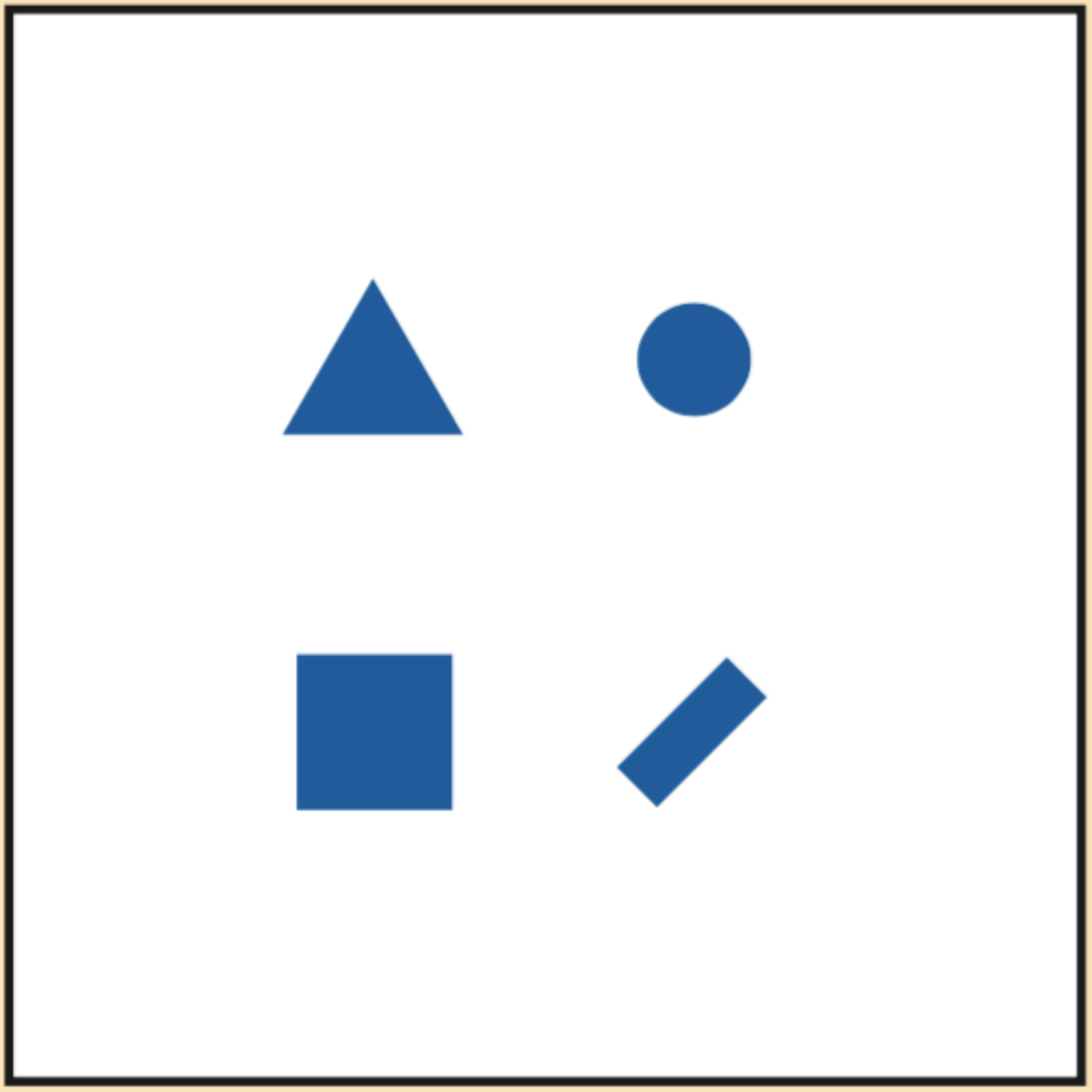
- The observer's task was to indicate which arm of the cross was longer, the horizontal arm or the vertical arm.

- Then, on one trial, a small test object, which was within the observer's field of clear vision, was added to the display.

- When observers were then given a recognition test in which they were asked to pick the object that had been presented, they were unable to do so.







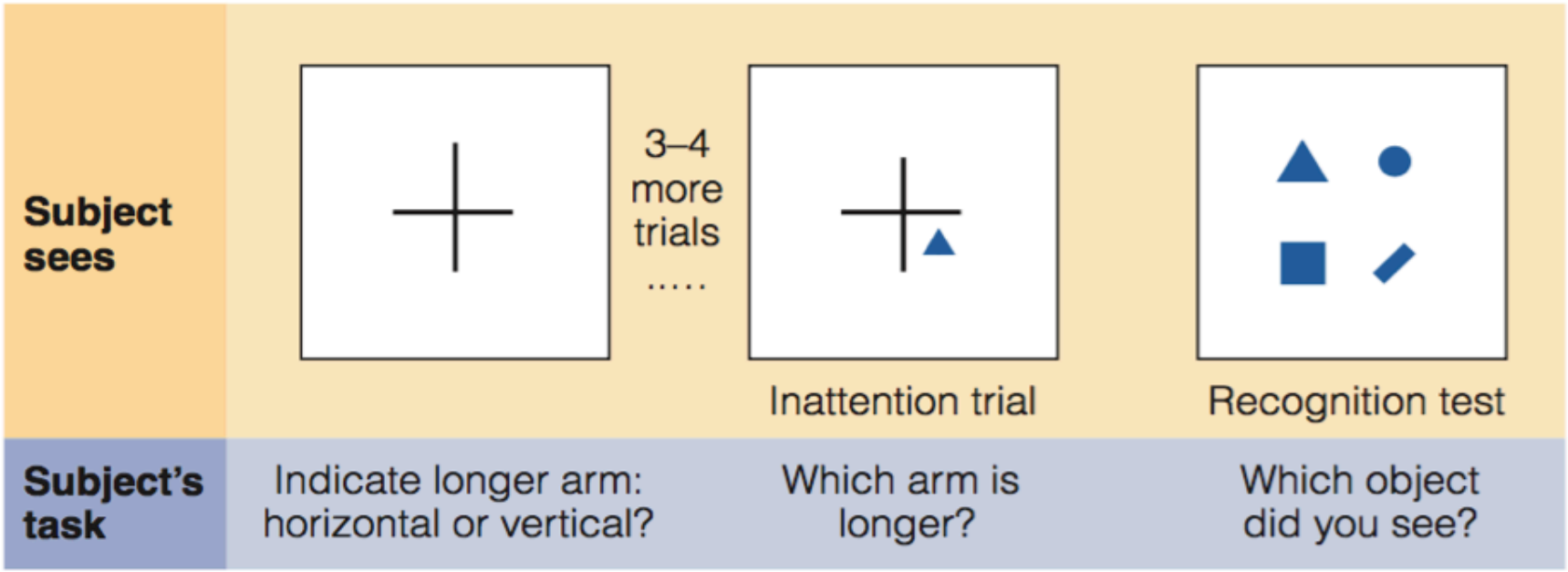


FIGURE 4.17 Inattentional blindness experiment. (a) On each trial, participants judge whether the horizontal or vertical arm is longer. (b) After a few trials, the inattention trial occurs, in which a geometric object is flashed along with the arms. (c) In the recognition test, the participant is asked to indicate which geometric object was presented. (Source: From E. B. Goldstein, *Sensation and Perception,* 8th ed., Fig. 6.9, p. 139. Copyright © 2010 Wadsworth, a part of Cengage Learning. Reproduced with permission. www.cengage.com/permissions.)

Image: E. B. Goldstein, *Cognitive Psychology_ Connecting Mind, Research and Everyday Experience.* Wadsworth Publishing. 3rd Ed. Fig. 4.17., (p. 95)

- Paying attention to the vertical and horizontal arms apparently made observers “blind” to the unattended test object. The phenomenon is termed **inattentional blindness.**

- Mack & Rock demonstrated inattention blindness using rapidly flashed geometrical stimuli; but other research has shown that similar effects can be achieved in more natural scenarios as well.

- Simons & Chabris (1999) created a situation in which one part of a scene is attended and the other is not. They created a 75 second film that showed two teams of 3 players each; & the one in white passing a basketball around. The other dressed in black was not handling the ball.

- Observers were told to count the number of passes, a task that focused their attention on the team in white.

- After about 45s, an event that took 5 seconds occurred, i.e. one of these events was a person dressed in a gorilla suit, walking through the scene.

- After seeing the video, observers were asked whether they had seen anything unusual happen or whether they see more than six players.

- Nearly half - 46% - of the observers failed to report having seen the event, even though it was clearly visible.

FIGURE 4.18 Frame from the film shown by Simons and Chablis in which a person in a gorilla suit walked through the "basketball" game. (Source: D. J. Simons & C. F. Chabris, "Gorillas in Our Midst: Sustained Inattentional Blindness for Dynamic Events," *Perception, 28,* 1059–1074, 1999. Figure provided by Daniel Simons.)

Image: E. B. Goldstein, *Cognitive Psychology_ Connecting Mind, Research and Everyday Experience.* Wadsworth Publishing. 3rd Ed. Fig. 4.17., (p. 95)

Further …

Bruce Goldstein

FIGURE 4.19 Look at this picture for about a second, cover it, and look at Figure 4.20 (at the top of the next page).

Image: E. B. Goldstein, *Cognitive Psychology_ Connecting Mind, Research and Everyday Experience.* Wadsworth Publishing. 3rd Ed. Fig. 4.17., (p. 96)

Bruce Goldstein

FIGURE 4.20 What is different in this picture?

Image: E. B. Goldstein, *Cognitive Psychology_ Connecting Mind, Research and Everyday Experience.* Wadsworth Publishing. 3rd Ed. Fig. 4.17., (p. 97)

- **Change Detection:** Could you detect the change in the picture?
  - Rensink & colleagues did a similar experiment; where the pictures were alternated in the same way until observers were able to determine what was different about the two pictures and found that the pictures had to be alternated back & forth a number of times before the difference was detected.
  - This difficulty in detecting changes in scenes is called **change blindness (Rensink, 2002).**
  - But when Rensink added a cue indicating which part of the scene had been changed, participants detected the changes much more quickly (Rensink, 2002).

- It's not always we miss out on such changes in the environment, there are cues to help us orient attention to such stimuli in the environment. These cues automatically attract our attention & increase the detection accuracy & speed.

- Automatic attraction of attention by a sudden visual or auditory stimulus is called **exogenous attention.**

- Attentional orientation that occurs when one consciously decides to scan the environment, to find a specific stimulus or just to track the environment is called **endogenous attention.**

- Both these types of attention can involve **overt attention**, i.e. shifting attention by moving the eyes (Carrasco, 2010).

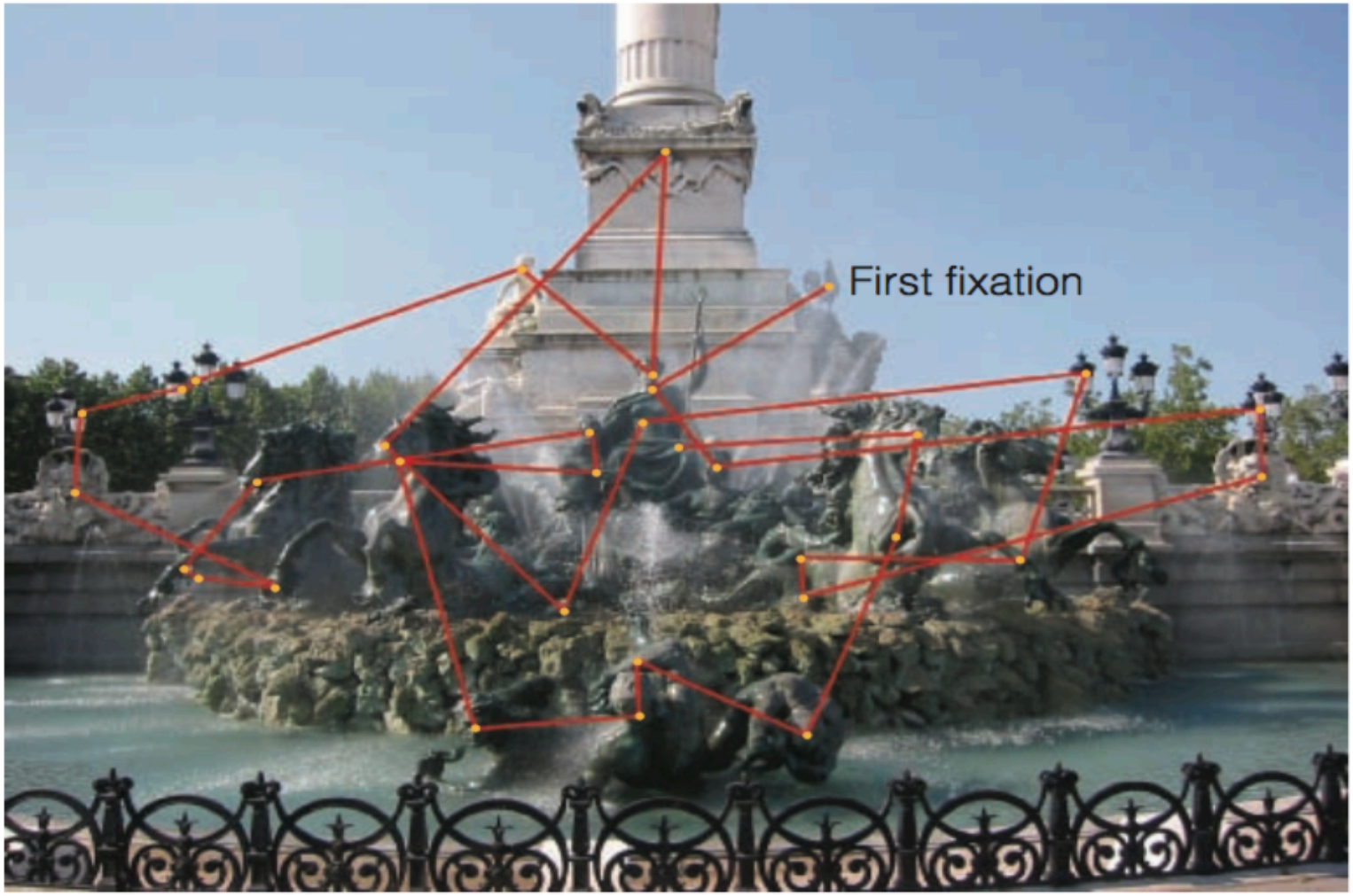
● **FIGURE 4.22** Find Bob Dylan's face in this group.

Image: E. B. Goldstein, *Cognitive Psychology_ Connecting Mind, Research and Everyday Experience.* Wadsworth Publishing. 3rd Ed. Fig. 4.17., (p. 99)

Overt Attention with Eye – Movements

- In order to look for Dylan's face, you would have had to move your eyes across the picture from face to face to see each one clearly.

- The shifting of eyes can be measured by using a device called an eye tracker, which tracks the movement of the eyes from one pint to another.



Courtesy of John M. Henderson, University of Edinburgh

FIGURE 4.23 Scan path of a person viewing a fountain in Bordeaux, France.

Image: E. B. Goldstein, *Cognitive Psychology_ Connecting Mind, Research and Everyday Experience.* Wadsworth Publishing. 3rd Ed. Fig. 4.17., (p. 100)

- the small dots indicate **fixations**, places where the eyes briefly paused.

- the lines indicate **saccadic eye - movements**, i.e. movement of the eye from one fixation to the next.

- Typically, people make about 3 fixations per second when viewing an unfamiliar scene.

- Two kinds of factors determine how people shift their attention by moving their eyes:
  - **bottom - up,** based primarily on the physical characteristics of the stimulus &
  - **top - down,** based on the relation between the observer and the scene - i.e. what the person knows about the scene and the demands of a task that involves the objects in the scene.

- **Top - Down Determinants**

- **Scene Schemas -** an obserever's knowledge about what is contained in physical scenes.

  - For e.g. when Vo & Henderson (2009) showed observers pictures like the ones (next slide), observers looked longer at the printer than the pan.

Image: E. B. Goldstein, *Cognitive Psychology_ Connecting Mind, Research and Everyday Experience.* Wadsworth Publishing. 3rd Ed. Fig. 4.17., (p. 100)

Image: E. B. Goldstein, *Cognitive Psychology_ Connecting Mind, Research and Everyday Experience.* Wadsworth Publishing. 3rd Ed. Fig. 4.17., (p. 100)

- the fact that people look longer at things that seem out of place in a scene means that attention is being affected by their knowledge of what is usually found in the scene.

Covert Attention: Without Eye - Movements

- **Covert Attention** has been studies using a procedure called pre cueing, in which the participant is presented with a cue that indicates ahwer stimulus is most likely to appear.

- Pre cueing has been used to study two kinds of attention:

- **Location - Based Attention**: Michael Posner & colleagues were interested in answering the following question: Does attention to a specific location improve our ability to respond rapidly to a stimulus presented at that location?

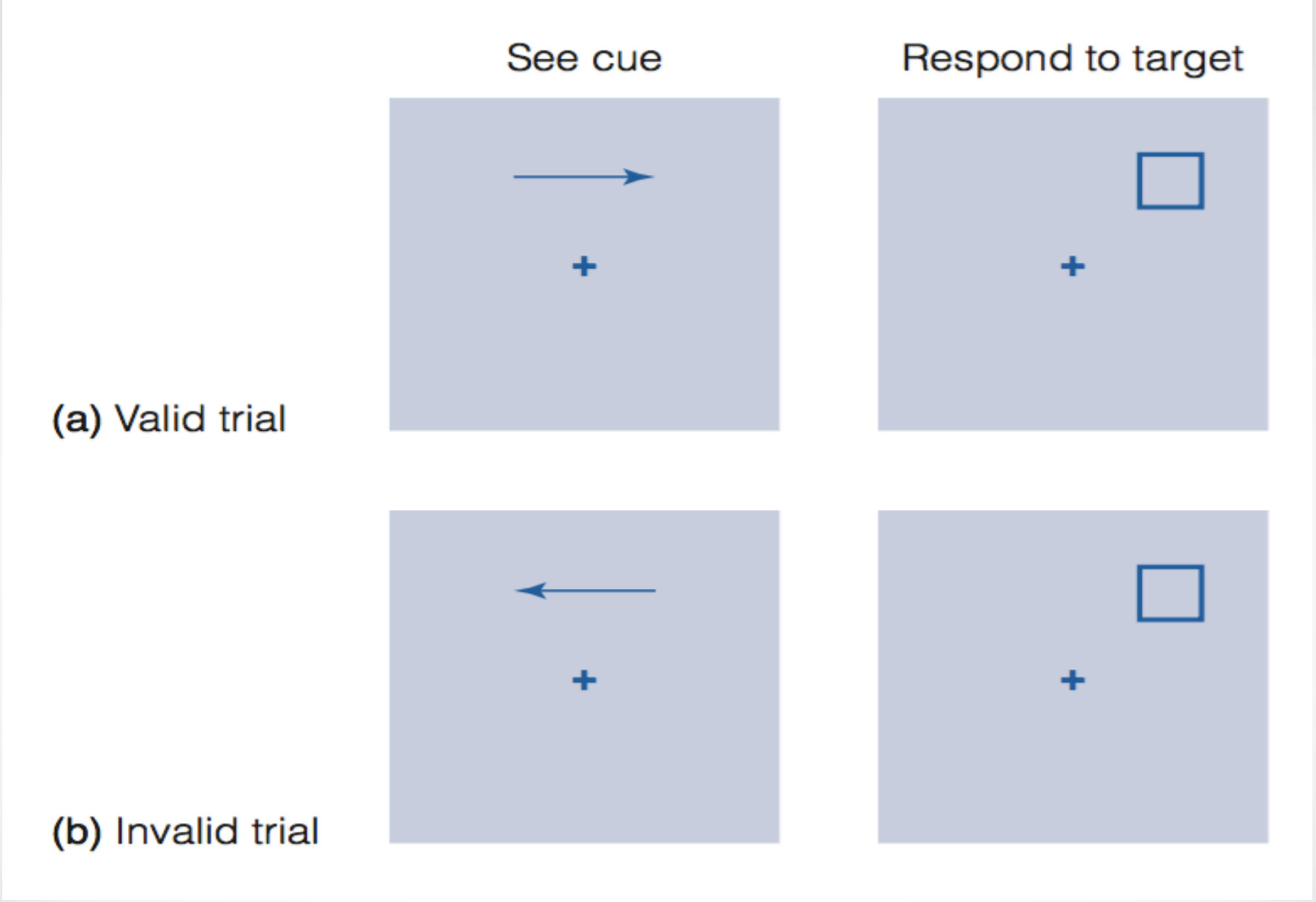


Image: E. B. Goldstein, *Cognitive Psychology_ Connecting Mind, Research and Everyday Experience.* Wadsworth Publishing. 3rd Ed. Fig. 4.17., (p. 102)

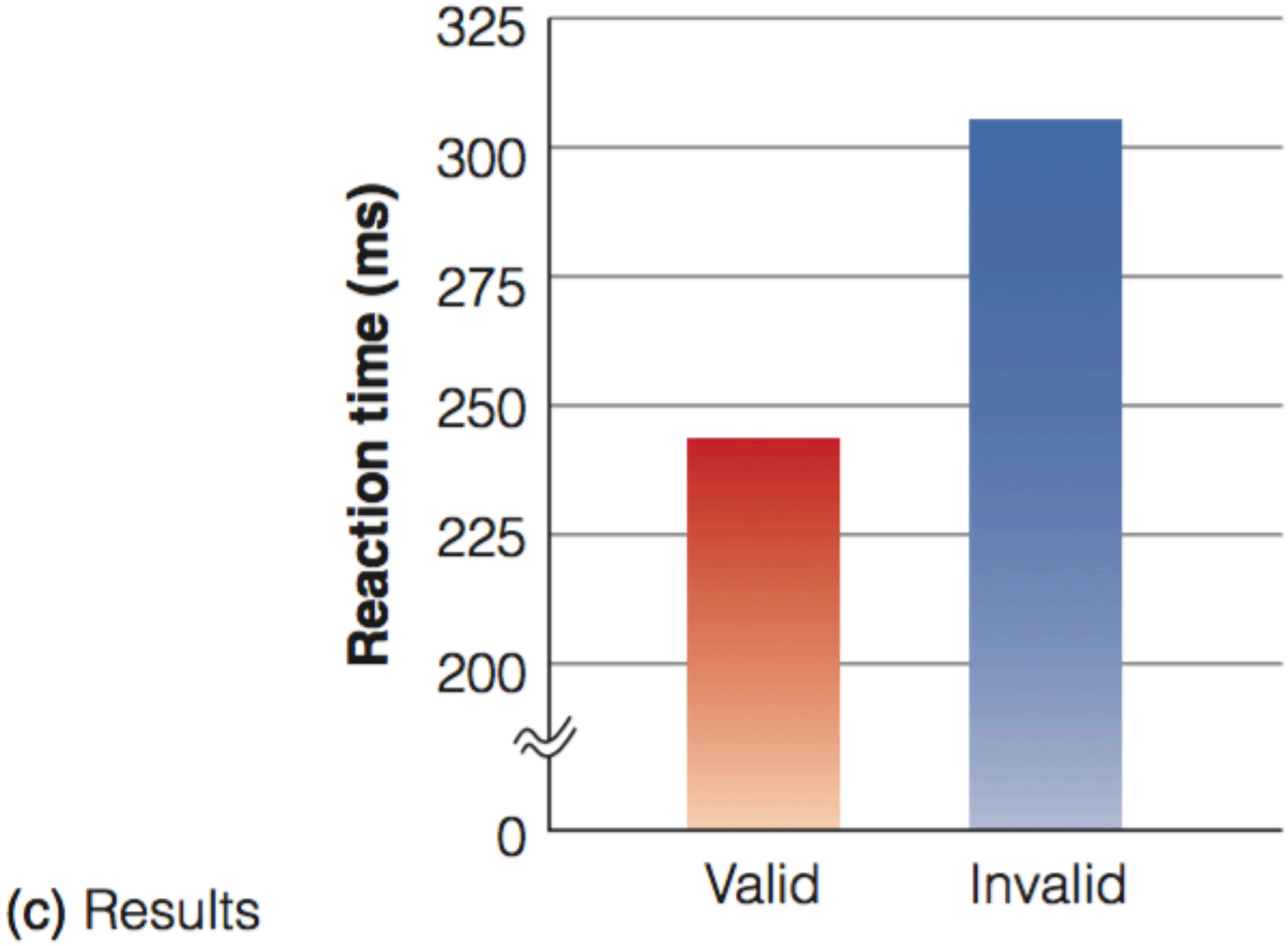


Image: E. B. Goldstein, *Cognitive Psychology_ Connecting Mind, Research and Everyday Experience.* Wadsworth Publishing. 3rd Ed. Fig. 4.17., (p. 102)

- The results of the experiment indicate that observers reacted more rapidly on valid trials than on invalid trials, leading to the conclusion that information processing is more effective at the place where attention is directed.

- These & similar results gave rise to the idea that attention is like a spotlight lens that improves processing when directed towards a particular location (Marino & Scholl, 2005).

- **Object - Based Attention:** Experiments have also shown that attention can also be associated with specific objects.

- Experiments studying object - based attention have shown that when attention is directed to one place on an object, the enhancing effect of this attention spreads throughout the object..

  - For e.g. Egly et al., (1994) asked participants to keep their eyes on the +, then one end of the rectangle was briefly highlighted.

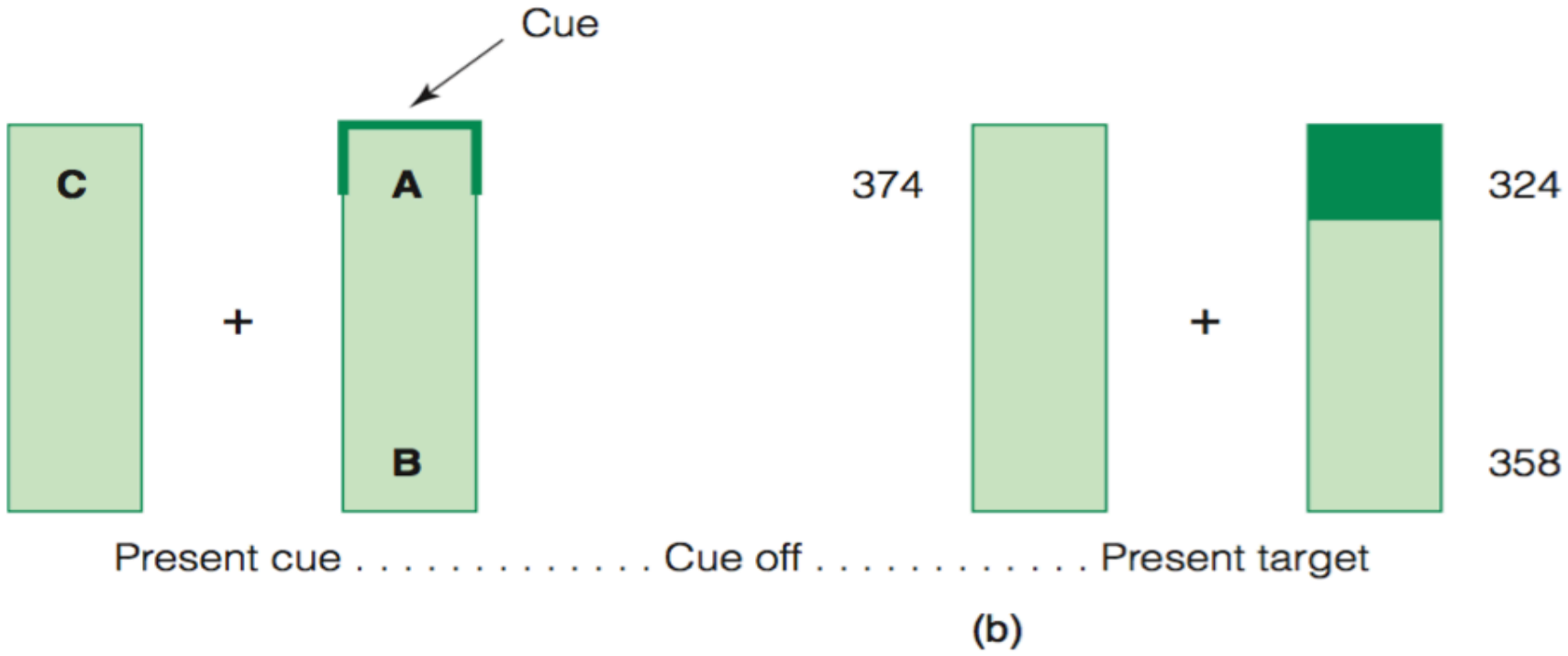
- This was the cue signal that indicated where a target, a dark square would appear.

- The participant's task was to press a button when the target appeared anywhere on the display.

- Reaction Times were fastest when the target appeared where the cue signal predicted it would appear.

- However, the most important finding is that participants responded faster when the target appeared within the same rectangular object location B than when it appeared at another location C. Note that B & C are same distance from A.

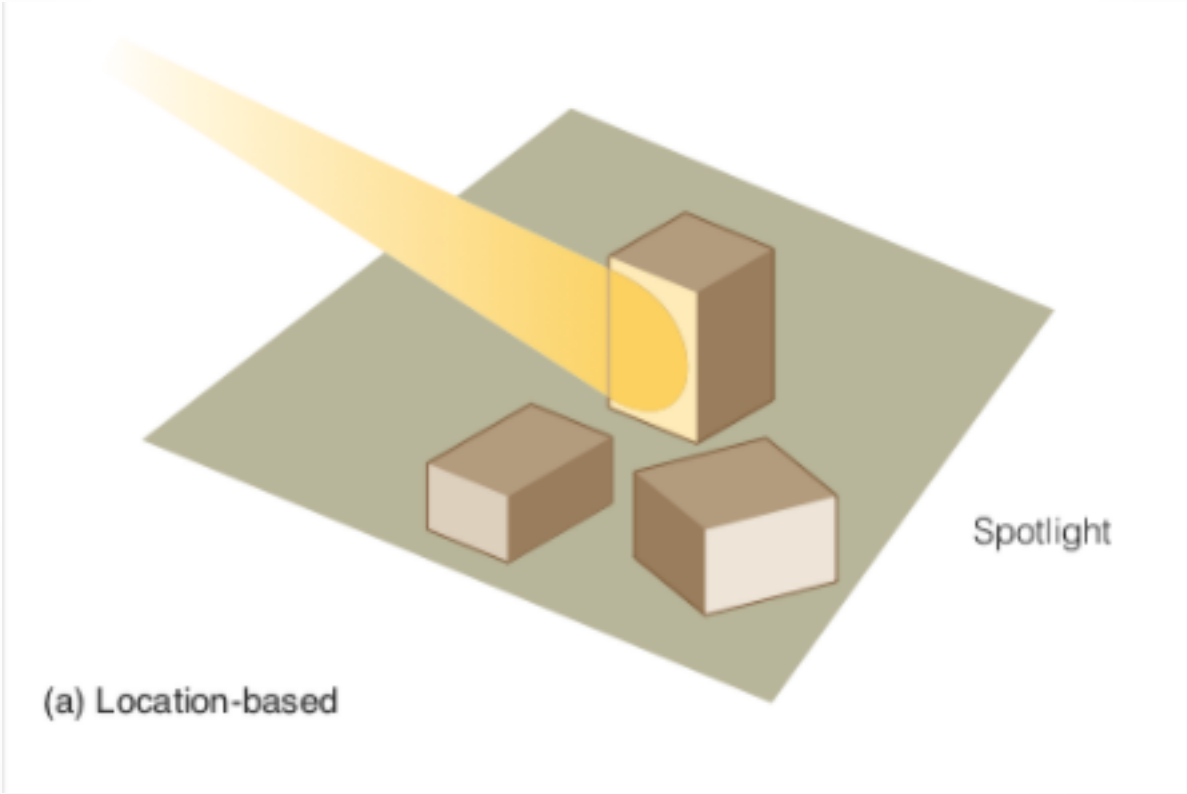
- Apparently, the enhancing effect of attention had spread within the rectangle, so even though the cue was at A, some enhancement occurred at B as well, this is the **same object advantage.**



● **FIGURE 4.29** Stimuli for Egly et al.'s (1994) object-based attention experiment. (a) The cue signal, darkened lines, appears at the top or bottom of one of the rectangles to indicate where the target will probably appear. The letters were not present in the display viewed by participants. (b) The target, a darkened square, appears at one end of one of the rectangles. Numbers indicate how long it took, in milliseconds, to respond to targets presented at positions A, B, and C when the cue had appeared at position A.

Image: E. B. Goldstein, *Cognitive Psychology_ Connecting Mind, Research and Everyday Experience.* Wadsworth Publishing. 3rd Ed. Fig. 4.17., (p. 103)

Location and Object Based Attention



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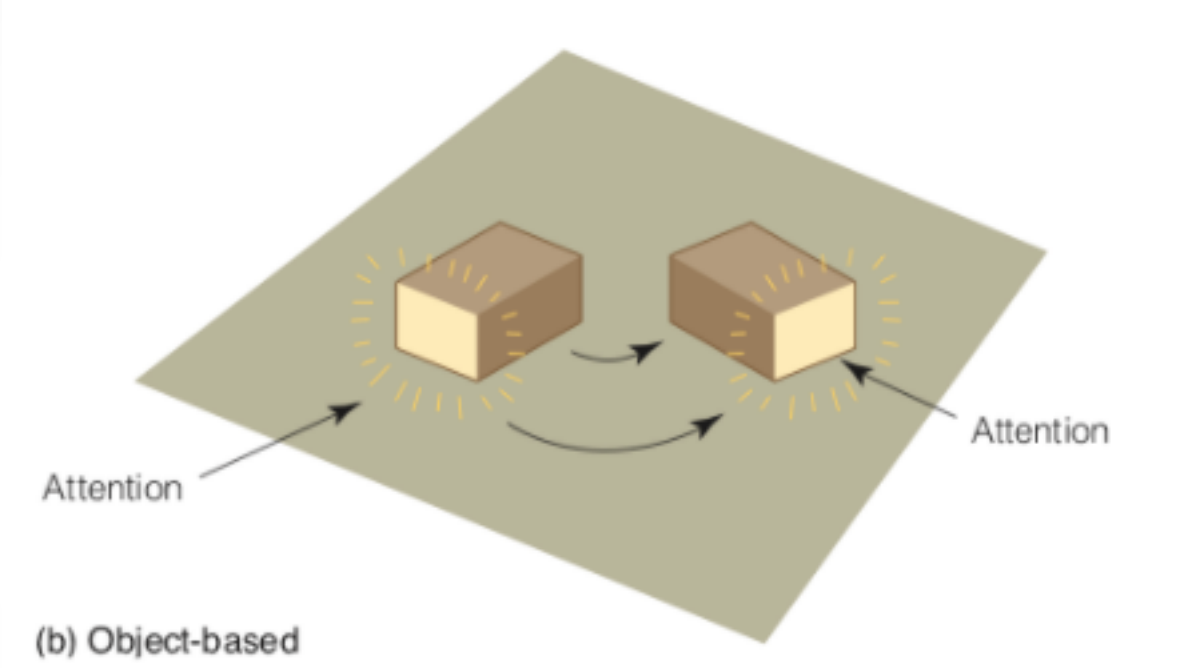

Image: E. B. Goldstein, *Cognitive Psychology_ Connecting Mind, Research and Everyday Experience.* Wadsworth Publishing. 3rd Ed. Fig. 4.17., (p. 103)

To Sum Up

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- E.B. Goldstein (2010). Cognitive Psychology Connecting Mind, Research and Everyday Experience. *Wadsworth Publishing. 3rd Ed.*